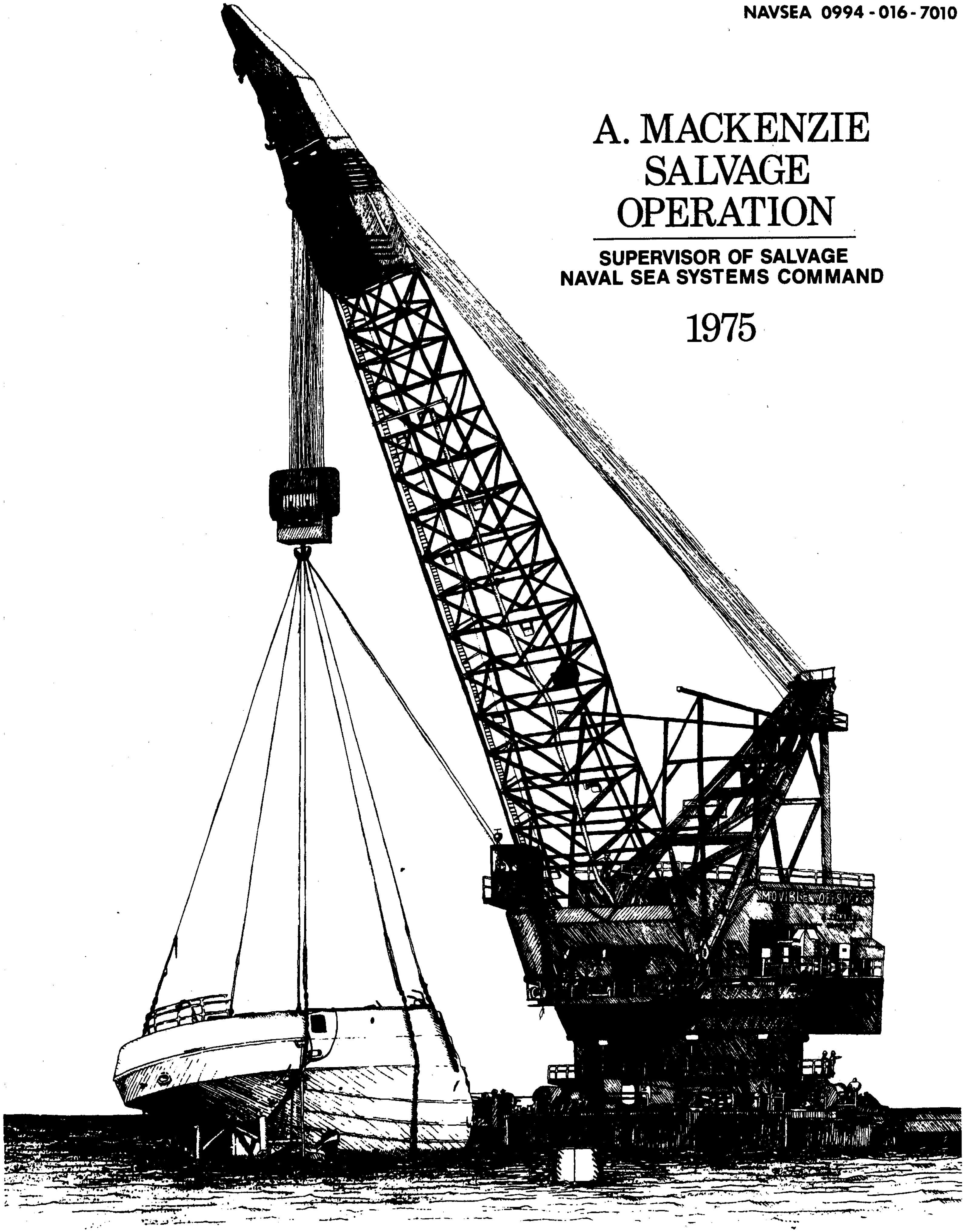
NAVSEA 0994-016-7010

A. MACKENZIE SALVAGE OPERATION

SUPERVISOR OF SALVAGE
NAVAL SEA SYSTEMS COMMAND

1975



DEPARTMENT OF THE NAVY

SUPERVISOR OF SALVAGE

NAVAL SEA SYSTEMS COMMAND
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FOREWORD

On 24 April 1974, the Hopper Dredge A. MACKENZIE was involved in a three ship collision while dredging in the Galveston Inner Bar Channel. Shortly thereafter, the stricken dredge sank in a position which restricted passage through the waterway.

A prompt survey was initiated to determine the most economical and feasible way to remove the sunken vessel and to restore navigation in the channel.

The subsequent salvage operation, using a "cut-in-place and lift" technique, is documented in the following chapters. Of interest and possible use to salvors challenged by future harbor clearance operations are the solutions found to initial difficulties encountered with the use of explosives as a cutting technique and rigging up to the 500 ton capacity of the lift crane. Of particular interest to U. S. Navy salvors is the delegation of authority within the several governmental and private organizations employed on the salvage project which provided leadership for each component and defined responsibility to an overall command.

In tribute to detailed and careful planning, work was completed ahead of schedule and under-budget with safety precautions meticulously observed and the environmental balance protected and maintained.

J. Huntly Boyd, Jr.
Captain, U.S. Navy
Supervisor of Salvage

27 January 1975

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A. MACKENZIE SALVAGE OPERATION

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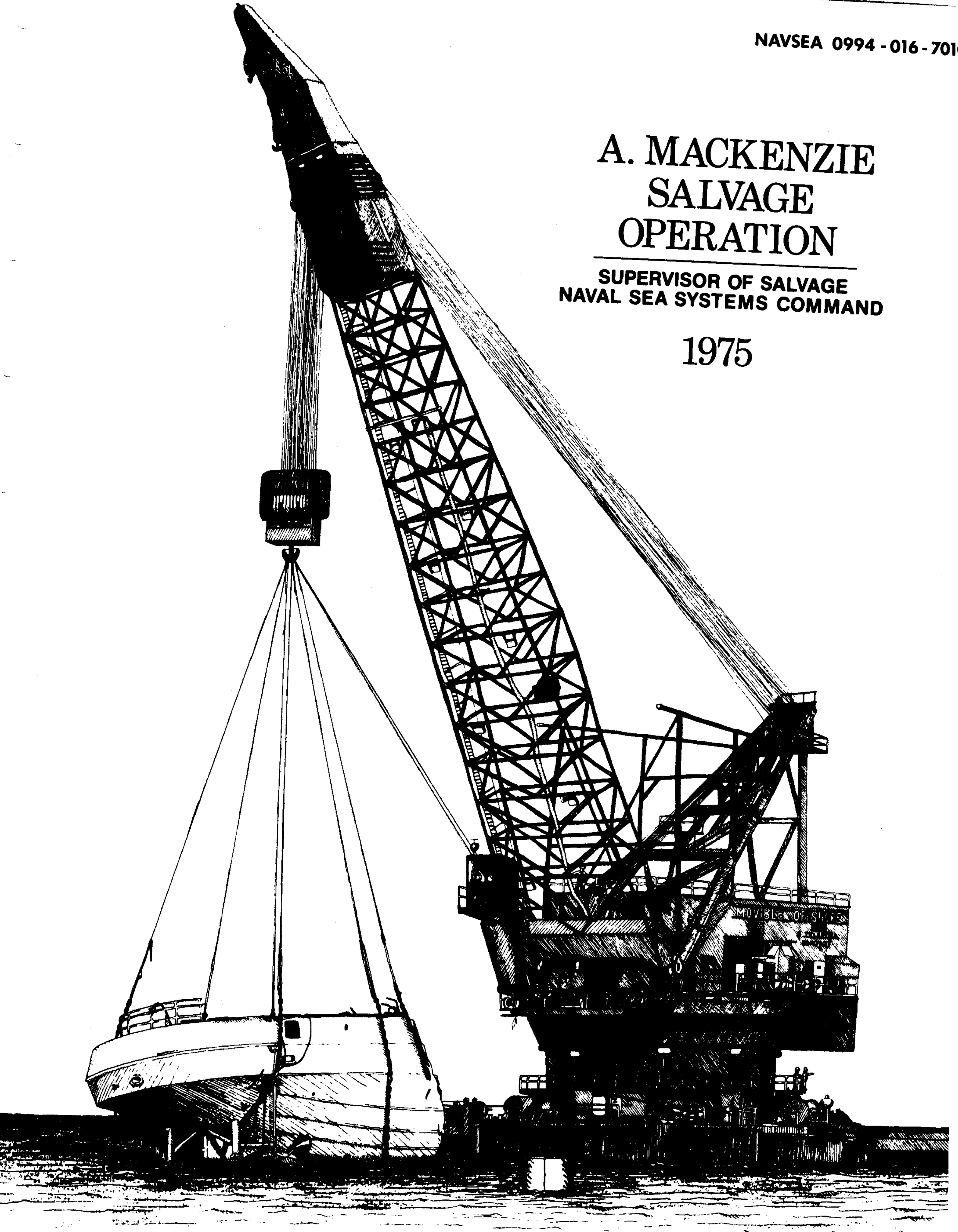

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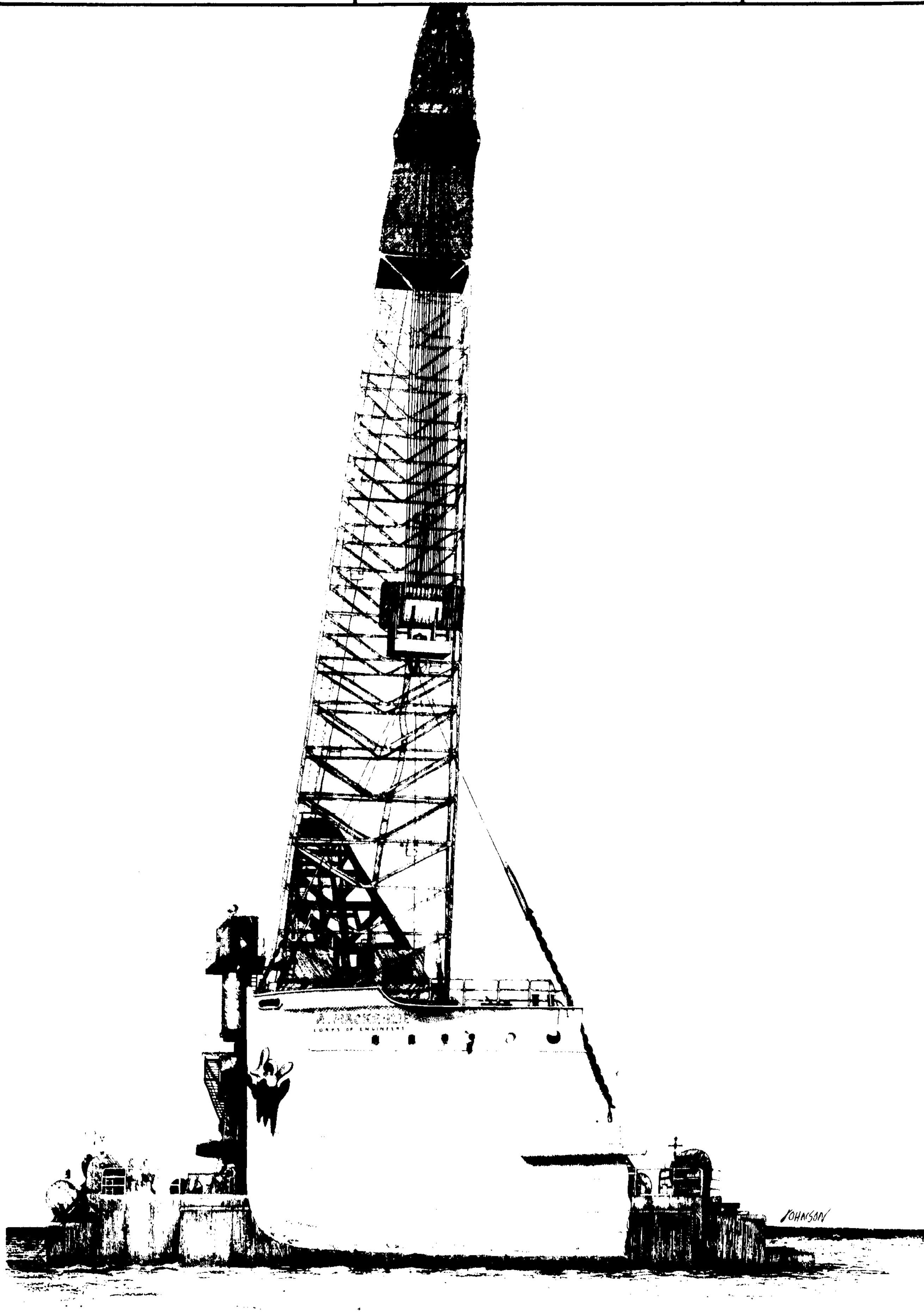
DREDGE " A. MACKENZIE " SALVAGE OPERATIONS


JOHNSON

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List of Drawings and Photographs

SECTION I. NARRATIVE OF OPERATIONS

1. Narrative of Operations

1.1 Introduction

On 24 April 1974, the Hopper Dredge A. MACKENZIE was involved in a collision while dredging in the Galveston Inner Bar Channel. Progressive flooding caused the ship to sink in the channel partially blocking the waterway.

The great importance of the channel prompted an immediate survey, and shortly thereafter, a task force was organized to remove the MACKENZIE. The ship was removed by a cut and lift method of harbor clearance and complete waterway access was reestablished to the Galveston Channel.

Throughout the following documentation of the salvage project, specific reference is made to the Appendix Section. Original surveys, calculations, projections and analyses are included to allow the reader to follow the daily work assignments and developing expertise as problems were met and solved.

1.1.1 Task

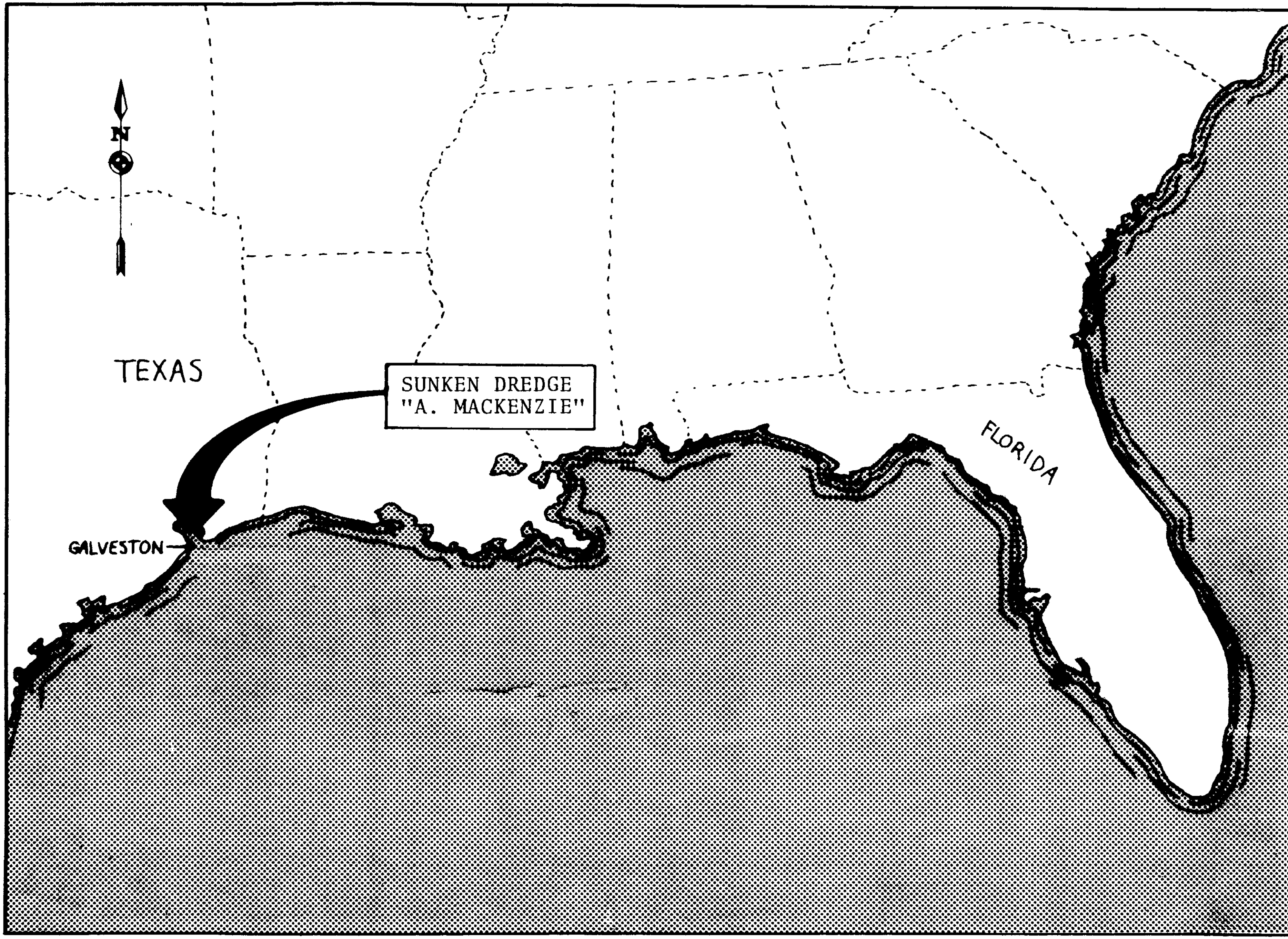
The U.S. Navy Supervisor of Salvage was tasked through the U.S. Army Corps of Engineers with the clearance of the wreck of the Hopper Dredge A. MACKENZIE from the Galveston Inner Bar Channel. This report traces the operational, technical and logistical efforts on this salvage job as a combined Army, Navy and private contractor venture. The report has been prepared in three major sections, each of which treats the overall job from its special aspect. The report has been written from a "lessons learned" and "how to" standpoint; it is hoped that it will serve as a reference for inland waterway clearance work.

The report of the U.S. Army Engineer District, Galveston " After - Action Report on Salvage of Hopper Dredge A. MACKENZIE, 24 April - 16 September, 1974 " has been used extensively and directly quoted from in the preparation of the first and third sections of this report. Other primary source information has come from the daily situation summaries prepared by the Salvage Master, the memoranda and calculations of the Project Engineer and the shooting log of the Explosives Technician.

1.1.2 Ship's History

The Hopper Dredge A. MACKENZIE was constructed for the Corps of Engineers by Sun Shipbuilding and Dry Dock Co., of Chester, Pennsylvania, in 1924. She was named for Maj. Gen. Alexander Mackenzie, a former Chief of Engineers. In 1939-40, the MACKENZIE was converted from a center-drag type to a side-drag type and the hopper capacity was increased from 1400 to 1656 cubic yards, largely by elimination of the single center-suction.

During World War II, the MACKENZIE was pressed into service in the South Pacific. She was fired on for the first time on 1 November 1943 while working off Funafuti, Saipan. On 8 October 1945, a typhoon with 147 mile-per-hour winds crippled the dredge. While anchored in Buckner Bay riding out the storm, a drifting vessel severed one of her anchor chains and the second gave way. The dredge was blown onto a sunken crane and beached with a side stove in and the forward engine room flooded.



A. MACKENZIE SALVOPS

CASUALTY SITE CHART

Figure Number 3

Patches were applied and she was returned under tow to San Francisco on 8 January 1946. A complete overhaul and modernization put the MACKENZIE in first-class shape in 1949.

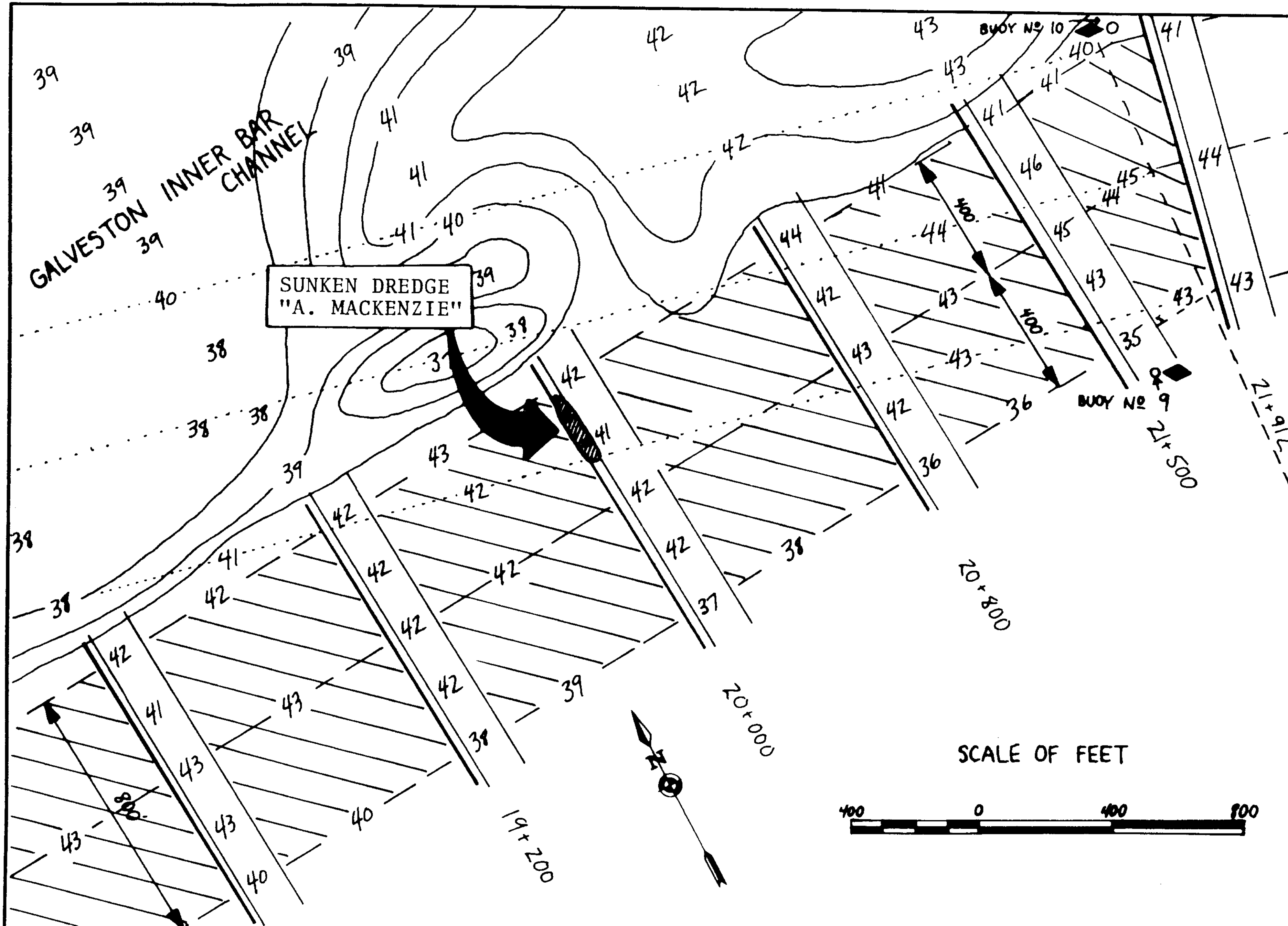
After spending two years on the Pacific Coast of the United States, the MACKENZIE was scheduled to be scrapped on the East Coast when she was temporarily detoured to Galveston in 1957 to perform emergency dredging. Shortly after her arrival in Galveston District, twin rudders were installed and the dredge operated within Galveston District since that time. On 6 March 1974, ceremonies were held marking 50 years of service. During that 50 years, it is estimated the MACKENZIE dredged 290 million cubic yards of material.

1.2 Casualty Circumstances

At about 1335 on 24 April 1974, while dredging near the centerline of the Galveston Inner Bar Channel, the MACKENZIE was hit on the starboard side of the after engine room by the Norwegian Tanker BOW ELM, owned by Rederiet Odfjell, Bergen, Norway. The BOW ELM had collided with the IDA GREEN, a research vessel owned by the University of Texas, immediately prior to colliding with the MACKENZIE. The IDA GREEN was under operation by Freeport Operators, Inc. of Freeport, Texas. Apparently the BOW ELM, in an attempt to avoid collision with the IDA GREEN, veered into the A. MACKENZIE which sank within 15 to 20 minutes after the collision.

The primary concern following the collision was for the forty-two men on board the dredge at the time of collision. The crew was taken aboard the M/V IDA GREEN and returned to the Corps of Engineers hopper dredge dock at Fort Point Boatyard. No loss of life occurred.

Immediately after the collision, the channel was closed to all traffic until the exact location of the sunken dredge, in relation to the navigation channel, could be determined. On 25 April 1974, a meeting was held with the representatives of the Corps of Engineers, U.S. Coast Guard, Galveston Pilots Association, Houston Pilots Association, and the Director of the Port of Galveston.



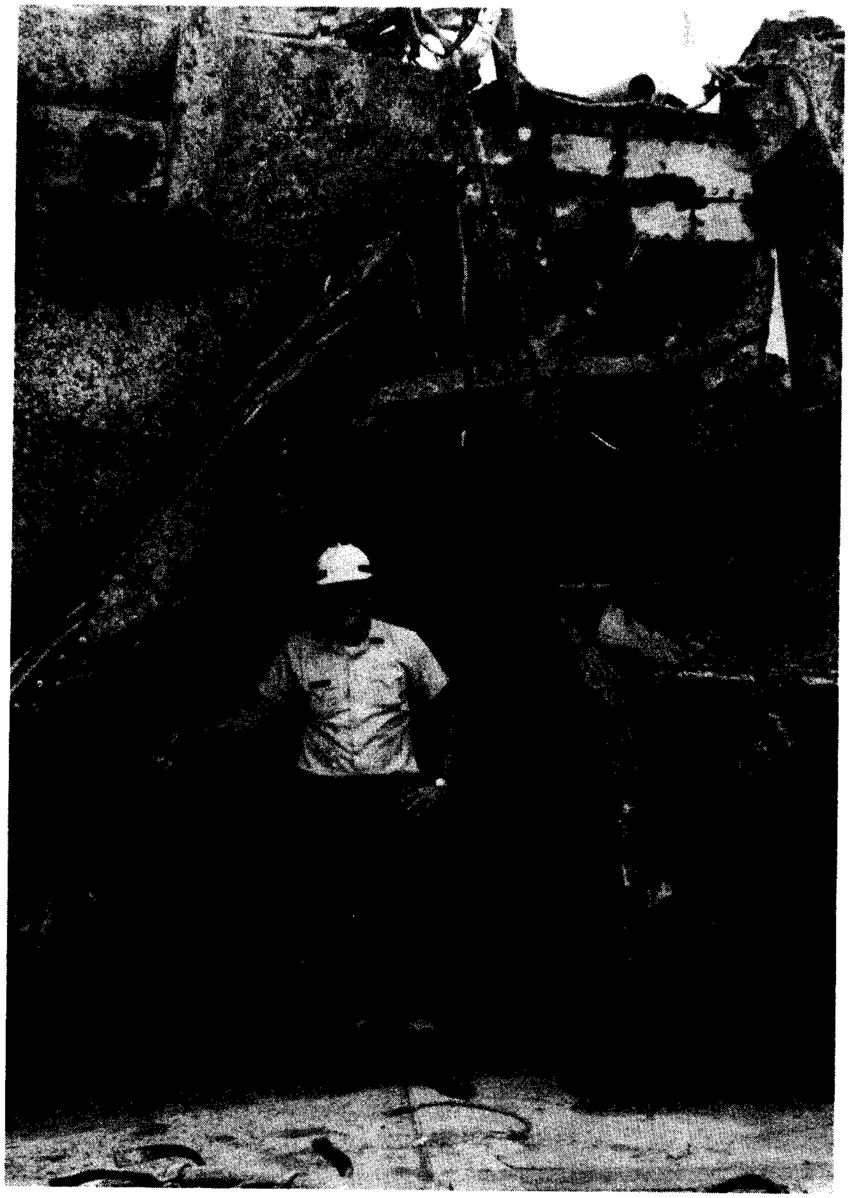
A. MACKENZIE SALVOPS

LOCATION IN CHANNEL

Figure Number 4

Page 6

Figure Number 5



VIEW OF COLLISION DAMAGE ON STARBOARD SIDE

THE BOW OF BOW ELM PENETRATED THE SIDE SHELL AT AN ANGLE OF INCIDENCE OF APPROXIMATELY 67°.

THIS PHOTOGRAPH WAS TAKEN SUBSEQUENT TO LIFTING THE DAMAGED SECTION FROM THE CHANNEL AND LOADING IT ON BOARD THE SCRAP REMOVAL BARGE.

1.2.1 Relief Actions

In order to provide temporary relief, it was agreed to establish a bypass channel through the anchorage area north of the entrance channel in the vicinity of the A. MACKENZIE. It would be marked with buoys by the Coast Guard at the bow and stern of the dredge, about 600 feet north of the bow of the dredge and at the north edge of the entrance channel about halfway between the dredge and Buoy 12.

No anchoring of vessels would be allowed between Buoys 7A and 12. Traffic would be restricted to one way only on a 24 hour basis between Buoys 7A and 12.

Vessels of up to 39 feet draft would be allowed to go outbound past the dredge in the south half of the channel only during daylight hours. Subsequently, this restriction was amended to allow vessels up to 39 feet to go both ways past the wreck during daylight hours with four hours notice to the Coast Guard.

Meetings continued to be held with representatives of the Corps of Engineers, U.S. Coast Guard, Galveston Pilots Association, Houston Pilots Association and Port Directors on a weekly basis through May 1974. During the remainder of the job, meetings were held with the same groups at critical times. These meetings were held to apprise the various interests as to progress, special problems and upcoming operations. Without the full cooperation of each of the individual organizations, another major collision could have resulted. In addition to the meetings, at times of operational change, Notices to Navigation Interests were issued.

1.3 Ship's Characteristics

1.3.1 Physical

A. MACKENZIE was built in 1924 and was one of the Corps of Engineers' oldest hopper dredges. She was of riveted construction with hoppers amidships; main propulsion aft and main pump machinery forward. She was twin screw and twin rudder, with two main diesels aft; two forward. With the pilot house forward, she had a wooden deck fore and aft.

Principal dimensions were as follows:

LOA	268' 5"
LBF	254' 0"
Beam-molded	46' 0"
-maximum (dragarms)	58' 0" approx.
Depth:	
Main deck	22' 6"
Boat deck	30' approx.
Draft-maximum (5672 displ.)	
Forward	20' 6"
Aft	22' 0"
Displacement:	
Light	3076 T
Service	3434 T
Hopper Capacity	1656 cubic yards
	2500 Tons Sand

1.3.2 Structural

The ship was essentially a single bottom steel vessel, transversely framed and of all riveted construction except in the hopper section areas. The thickest portions of the bottom shell were 25 lb. mild steel plate. The hopper areas had been extensively reworked in 1949 to eliminate the centerline drag and modernize to a port and starboard twin drag arrangement. During this interval, the pump rooms and machinery spaces had been modernized with the installation of all diesel electric equipment in lieu of the original steam plant. The new gain in machinery space was accompanied by the addition of working flats in both machinery spaces that were not in the original hull plans. One of these extended the first platform into the machinery spaces aft and the other provided a wiring flat for controlling the electrical plat in the pump room forward.

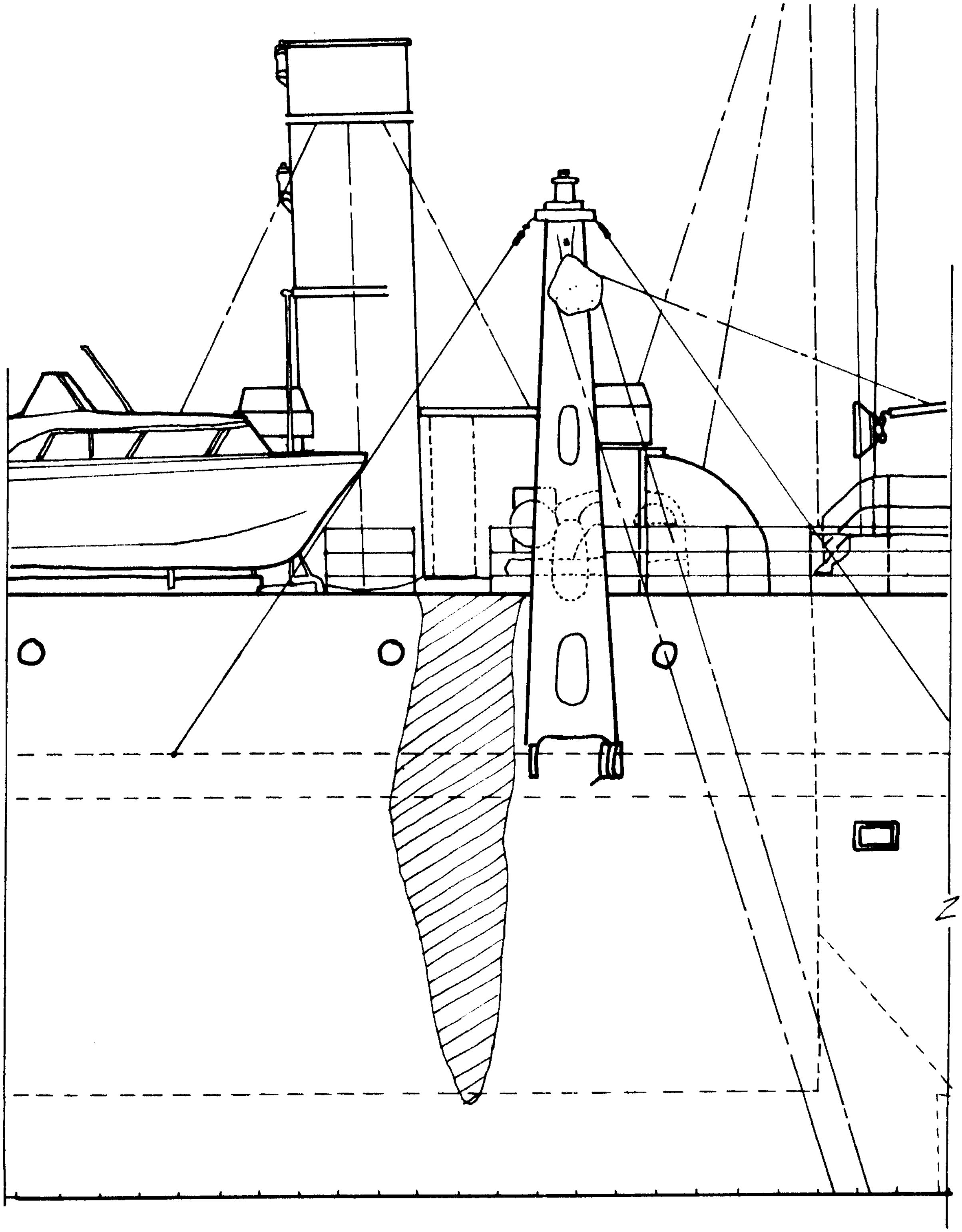
1.3.3 Mechanical

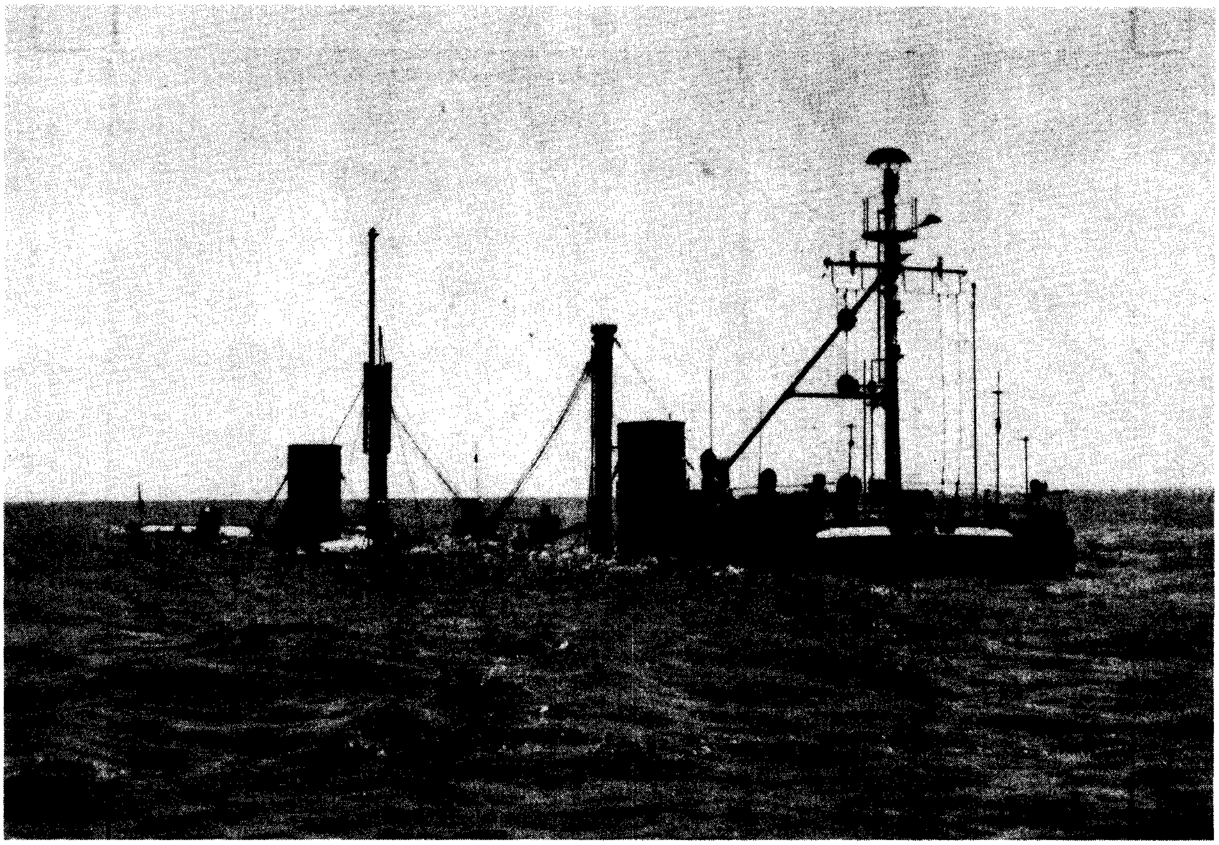
The hopper spaces were placed midway between two machinery spaces. The forward machinery space contained two main diesel generator units powering the main pump motor. The main portion of the fixed ballast was under the

A. MACKENZIE SALVOPS

STARBOARD SIDE COLLISION DAMAGE

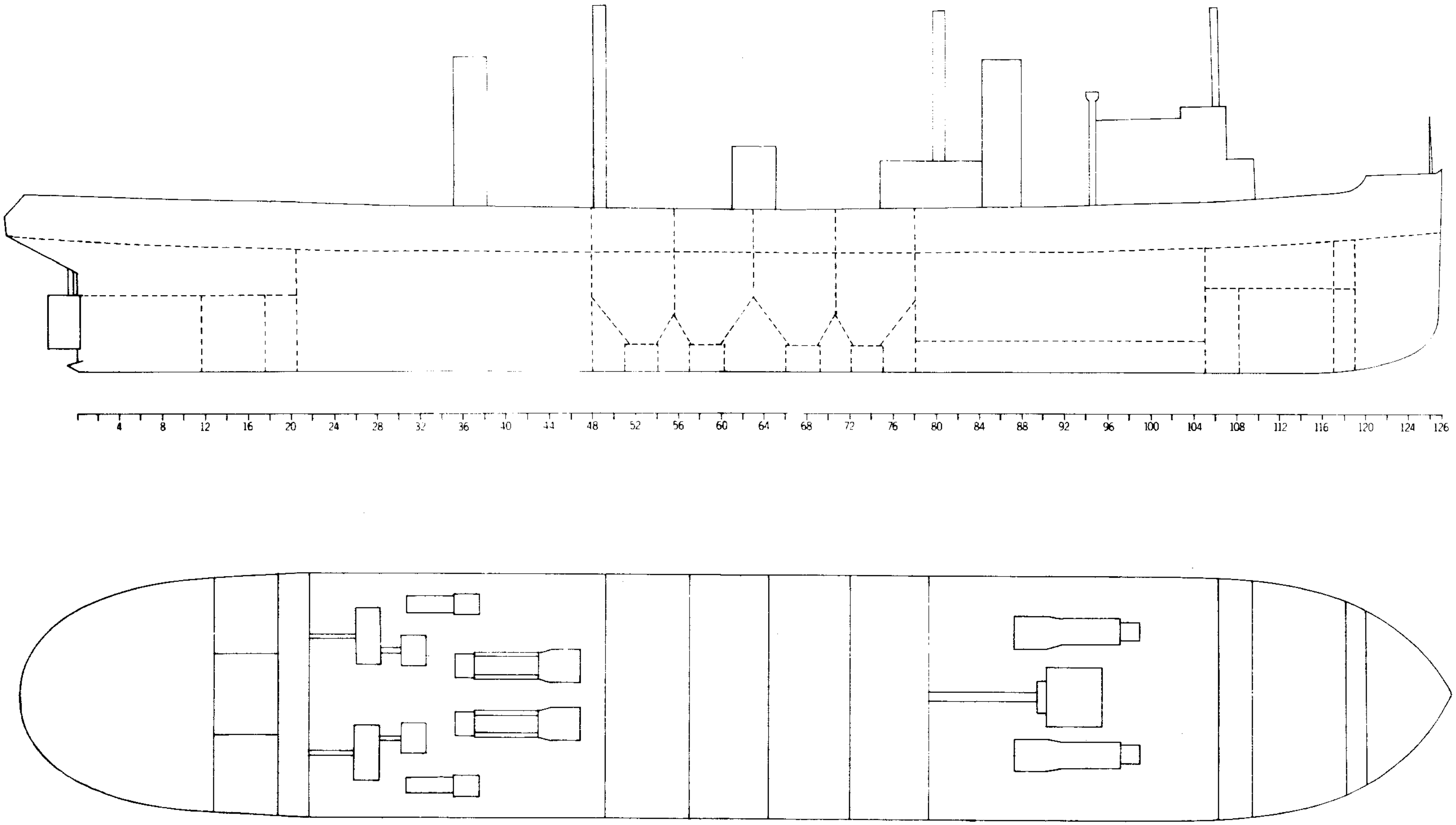
Figure Number 6





APPEARANCE OF THE WRECK OFF THE STARBOARD BOW FROM NE TO SW ON 25 APRIL 1974

MACKENZIE WAS STRUCK ON THE STARBOARD SIDE JUST AFT OF THE NO. 2 STACK AT ABOUT 1335, ON 24 APRIL 1974 BY THE NORWEGIAN TANKER BOW ELM. SHE SLOWLY TURNED TO A NORTHERLY HEADING AND SANK 20 MINUTES LATER, ACROSS THE GALVESTON CHANNEL, BLOCKING THE NORTHERN 300 FT. OF AN 800 FT. WIDE CHANNEL AND BECOMING AN IMMEDIATE HAZARD TO NAVIGATION.



Hopper Dredge A. MACKENZIE General Arrangement

A. MACKENZIE SALVOPS

Figure Number 8

machinery units in the bilges of this space.

The after machinery space also contained two main diesel generator units powering the motors for a twin shaft drive.

It is interesting to note that the diesel engines for this vessel were obtained as U.S. Navy surplus at the end of World War II, and were initially earmarked for the Destroyer Escort construction program.

1.3.4 Arrangements

The boat deck was a continuous wood deck of 4x6 fir planks over steel beams. The deck was faired to steel gunnel plates that formed the upper flange sections of the sheer strakes. The main deck was the only steel deck that had continuity over the length of the vessel. The only major structure above the weather deck was the house supporting the navigation bridge forward.

The weather deck areas in way of the hoppers were devoted to the functional requirements of handling the dredge spoils. The drag tenders' shacks for adjusting the drag heads and trunks, the davits and fittings to rig the drags, the sluice boxes to handle the spoils, were all located midship between the stacks.

There were essentially five major transverse functional arrangement boundaries on the vessel. These were the stern section aft of the machinery spaces, the after machinery space, the hopper area, the forward pump room and the bow section. The crew living spaces were essentially on the main deck in the after quarters and the officers' accommodations near the navigational spaces. The forward peak areas were essentially bosn and drag line logistic support storerooms. The after areas in the stern were similarly machinery and commissary support areas.

1.4 Casualty Survey and Preliminary Salvage Planning

On 25 April 1974, J and J Marine Diving Corporation of Pasadena, Texas, was hired to make an inspection and to survey damage to the sunken dredge. It was found that the MACKENZIE sank in a nearly upright position almost perpendicular to the channel, with her bow against the north side of the channel. Divers reported a large, jagged hole in the starboard side of the after engine room extending from the boat deck down to about two feet above the bilge keel at about Frame 40. The wooden boat deck was badly splintered and the main deck jagged and pierced inward about 5 or 6 feet. Inspection around the rest of the ship revealed no other damage.

Soundings of the dredge hoppers indicated that they contained about 550 cubic yards (nearly 700 tons) of material. The top of the pilot house was above water indicating about 10 feet of water over the boat deck or 18 - 20 feet over the main deck. No significant settling was noted during these investigations. With the MACKENZIE lying athwart the channel, she was broadside to the current which at times was known to exceed 5 knots. This gave cause for considerable concern since scouring could have caused the dredge to roll over or break in two.

It was estimated that, at the time of sinking, the MACKENZIE had about 28,000 gallons of diesel fuel on board. A strong odor of diesel fuel downwind of the dredge indicated leakage; a small oil slick indicated minor seepage of lube oil. A lightweight floating oil containment boom was rigged around the MACKENZIE on 25 April 1974 by Corps of Engineers personnel. Divers secured seals over the vents on 27 April 1974.

On 25 April 1974, Mr. William Murden of Office Chief of Engineers, Mr. George Johnson of Phildelphia District, Captain W.F. Searle and Mr. R.K. Thurman of Searle Consultants, Alexandria Virginia, inspected the MACKENZIE prior to making recommendations for salvage. On 27 April 1974, Mr. Fred Smith presented information on the Detroit District's experience with removal of the wreck SIDNEY E. SMITH from the St. Clair River. Searle Consultants' findings indicated that there were three management options open for salving the dredge; namely: (1) use of in-house personnel and resources, (2) a turn-key contract, and (3) U.S. Navy Supervisor of Salvage capability. Under each of the management options there were six technical alternatives:

- Cut and wreck-in-place
- Raise with deck-edge cofferdam
- Raise by external lift
- Raise by internal buoyancy
- Sheet-pile cofferdam
- Burial-in-place

In the opinion of Searle Consultants, the cost/value differences between any of the options would not be significant when compared to the overall cost of the salvage operation.

After due consideration of the management options, the Galveston District Engineer, by teletype dated 30 April 1974, recommended to the Southwestern Division Engineer that the dredge A. MACKENZIE be considered a total loss, that disposal be made as expeditiously as possible and that all expenditures in connection with the disposal of the dredge be charged to a separate account.

Since the dredge posed a serious threat to navigation and the Galveston District lacked the technical expertise associated with salvage work, the option to make use of the Navy Supervisor of Salvage seemed the most positive and expeditious method of removal of the dredge from the channel. On 2 May 1974, the District Engineer acquired approval from the Chief of Engineers for the Galveston District to request Supervisor of Salvage, U.S. Navy, to provide consultant services and act as prime contractor for selected salvage operations.

On 4 May 1974, the Chief of Engineers granted authority to the Galveston District to:

1. Remove the MACKENZIE from the Plant Account and to proceed with the removal of the dredge from the Inner Bar Channel on the basis that it was not feasible to raise the vessel for the purpose of refurbishing for further use.

2. Charge all expenses incurred in connection with the disposal of the dredge to a separate account of the Revolving Fund.

3. Utilize the Supervisor of Salvage, U.S. Navy, to provide consultant services and act as prime contractor for selected salvage operations.

1.5 Organization of the Salvage Force

Upon notification that the salvage would be performed by the Supervisor of Salvage, U.S. Navy, several actions took place almost simultaneously. An agreement between the District Engineer and the Supervisor of Salvage was reached regarding the operation to be performed.

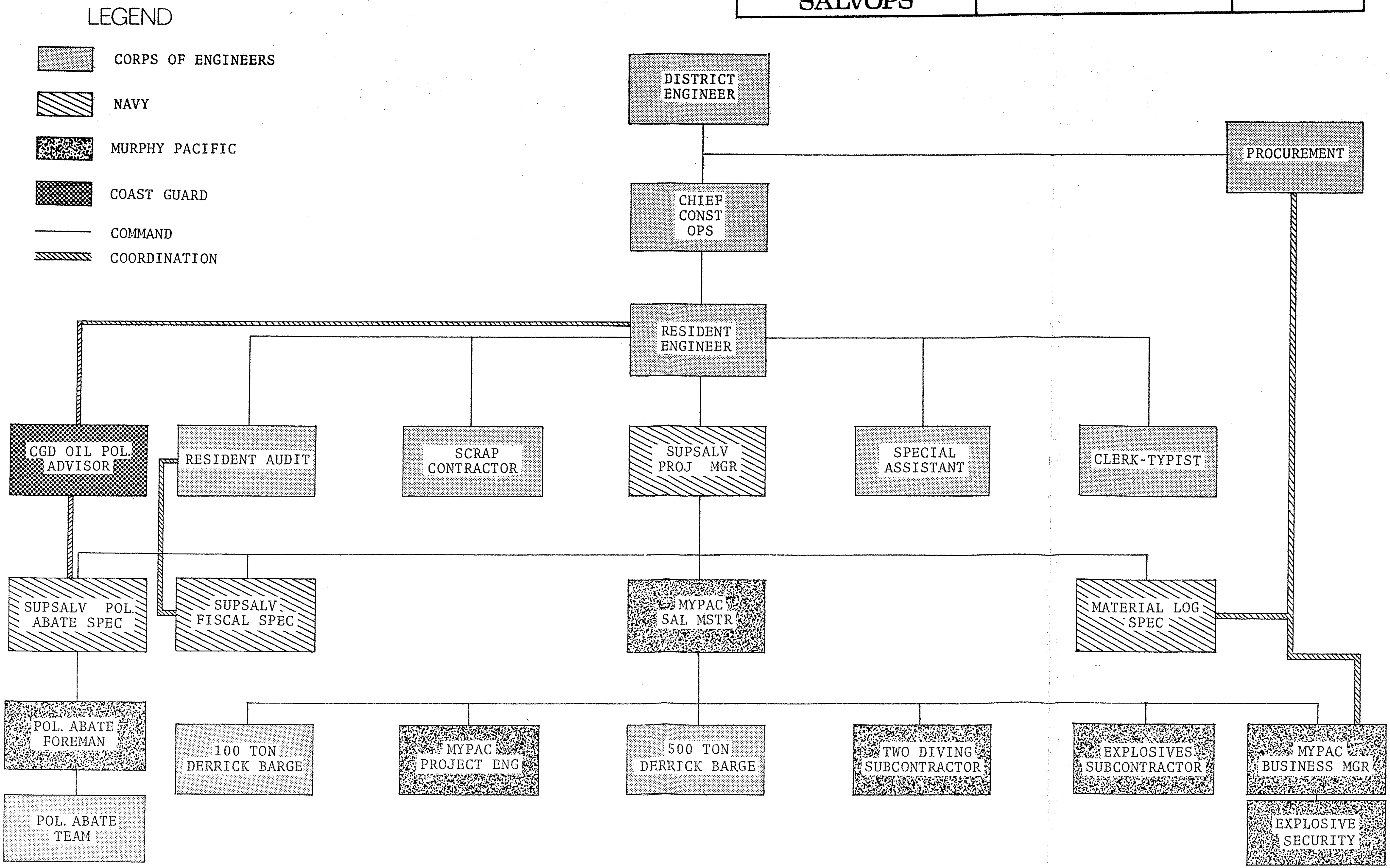
The District Engineer contracted for a derrick barge to be used as a diving platform with the capability of making the light lifts as the divers removed the equipment and structures above the boat deck. Because of the urgency of the operation, the initial derrick barge was obtained by telephone bid. The bids received were then analyzed as to size of barge, crane capacity, and time required to mobilize. Hunter Flores, Inc., Freeport, Texas, was selected. With a 110 ton crane mounted on a 197' x 45' x 12' barge, this bid met the requirements of the job. Later, a contract was formally advertised and bids solicited as time permitted. Three 10' x 50' mobile office trailers were obtained on a rental basis and set up at Fort Point Boatyard as the project office. One of these trailers was released as the job progressed.

The Supervisor of Salvage obtained the services of Murphy Pacific Marine Salvage Company under existing salvage contracts. Under Contract N00024-71-C-0234, Task No. 74-10, the contractor was directed to assist the Supervisor of Salvage in the salvage/removal of the A. MACKENZIE. Under Contract N00024-73-C-0273, Task No. 74-12, the contractor was directed to furnish labor, services and materials to support the pollution abatement phase of the salvage operation.

Jacksonville District loaned the Hopper Dredge GERIG to Galveston District on 4 May 1974 to deepen the bypass channel north of the MACKENZIE. The GERIG

Mackenzie Salvops Organizational Chart

A. MACKENZIE SALVOPS	ORGANIZATIONAL CHART Figure Number 9	Page 17



worked on the bypass until 19 May when it became apparent that it would be impractical to continue efforts to deepen the bypass to a 40-foot depth. A hard clay strata was encountered at about elevation minus 38 feet mean low tide which slowed dredge production to the point where it was impractical to continue with the hopper dredge.

On 2 May 1974, Captain R.T. Belcher, Salvage Master, arrived with Mr. Alex Rynecki, Ship Salvage Engineer, in Galveston and reported to Mr. J. Walker, representative for the Supervisor of Salvage, U.S. Navy.

1.5.1 Organization of a Task Force

The District Engineer established a separate task force under the Chief, Construction-Operations Division. Mr. J.D. Bissell, Resident Engineer, was assigned to coordinate the various components of the salvage effort. Mr. Bissell's staff would have direct access to each Division, Branch and Section of the District Office without going through normal channels in order that paperwork could be held to an absolute minimum. Full support of each Section was assured. Priority rating within the District was given to all activities relating to the salvage operations.

The resulting task force drew personnel from the Corps of Engineers, U.S. Navy, Murphy Pacific Marine Salvage Company and various subcontractors. LCDR C.A. Bartholomew, USN, was assigned the responsibility of Salvage Officer, representing the Supervisor of Salvage, U.S. Navy. The Murphy Pacific Marine Salvage team was under the direction of Captain C.E. Alleman, Salvage Master.

1.6 Analysis of the Survey Data and Delineation of Salvage Operations

During the period 25 April through 20 May 1974, various methods of salvage were investigated in detail. Philadelphia District furnished estimated weights for the entire vessel along with weights of the major machinery. They also furnished design calculations for a patch in case it was decided to raise the MACKENZIE.

Of the six technical options available, two were immediately eliminated; namely, burial-in-place and sheet-pile cofferdam. Burial-in-place was unacceptable since there was a strong possibility that the channel would eventually be deepened and the removal would only be postponed by exercising this option. A sheet-pile cofferdam was unacceptable because of the depth of water and exposure to the open sea. In addition, with the shortage of steel, the procurement of sheet piling could not be assured. Raising by external lift was ruled out due to the unavailability of lift equipment and the high risk factor. The success or failure of a deck edge cofferdam would have depended largely upon the MACKENZIE staying in an upright stable condition. With the ship broadside to the current, this condition could not be assured; therefore, this option was also unacceptable.

On 21 May 1974, after extensive engineering analysis, two plans were presented to the District Engineer as workable salvage plans. One plan entailed cutting the vessel at Frames 48 and 78, removing the hoppers, introducing internal buoyancy into the remaining bow and stern sections, towing the two sections to sea and sinking them. With the hoppers open on top and the boat deck constructed of wood, internal buoyancy systems could not lift the entire ship. Although several methods of internal buoyancy were explored, the best method was determined to be the introduction of foam. Provided a good quality foam could be obtained, the two sections would float with the boat deck awash. The 100 fathom curve is about 100 miles off the Coast of Galveston; therefore, it was questionable if the two sections could be towed that far with only the boat deck awash.

On 21 May 1974, the District Engineer approved the plan to cut and wreck-in-place and dispose of the scrap. Even though it was estimated that this plan would take about 30 days longer than the internal buoyancy method, the risks of failure were reduced. The plan proposed removal of all materials and structures above the boat deck and making transverse cuts at Frames 20, 32, 48, 62, 78, 92 and 104. A large floating crane would be used to lift the sections. After the first lift sequence, the section weights would be reviewed and, if necessary, horizontal cuts would be made about the 12-foot draft line.

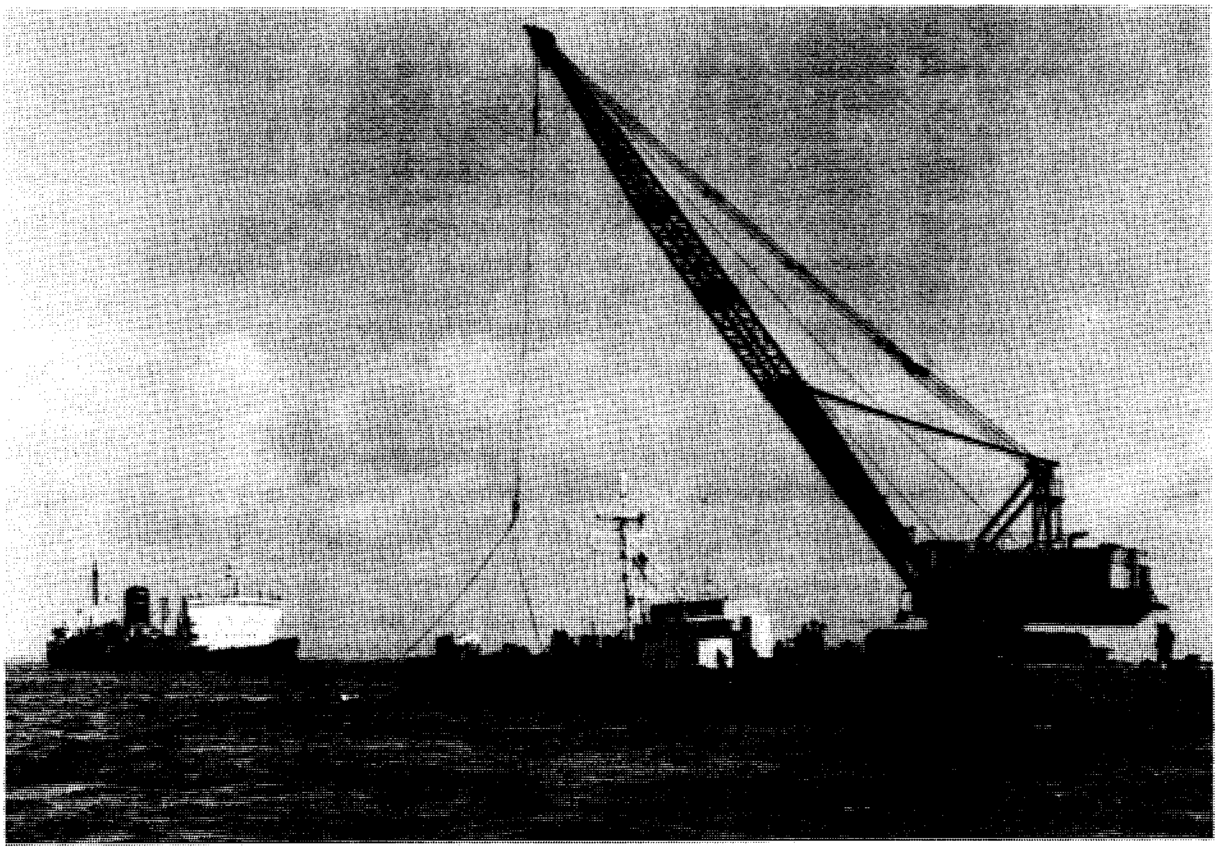
1.7 Initial Operations

Upon arrival of the Salvage Master on 6 May 1974, Murphy Pacific awarded a subcontract to Ocean Systems,Inc., of Morgan City, Louisiana, to furnish a diving crew to perform the initial salvage investigations, and to start removing material and structures above the boat deck. Under any of the salvage plans, removal of this material would be required. During this phase of the work, Alex Rynecki, the contractor's Project Engineer, continued making calculations and finalizing the salvage plan.

On 22 May 1974, following the approval of the wreck-in-place salvage plan, divers started the transverse cut at Frame 104. Murphy Pacific awarded a diving subcontract to Buck Steber Inc., of Belle Chasse, Louisiana, for another diving crew. A subcontract was awarded to Technical Explosives, Inc., of Harvey, Louisiana , to furnish technicians and explosives to assist in the cutting operations. The two engine room stacks were partially cut away and platforms installed for diver access into the interior of the vessel. The remaining portion of the stacks served to protect the divers from wave action and currents while entering the wreck. Being able to gain entrance through the stacks saved considerable time and expense by eliminating the necessity for fabricating an entrance cofferdam. On 10 June 1974, operations began on a 24 hour basis.

1.7.1 Communications

Upon arrival of the office trailers, procedures were started to obtain telephones. After considerable delay by the local telephone company, four temporary commercial lines were installed and an extension was installed from the existing phone at the hopper dredge dock. A radio network was established using portable sets obtained from Fort Point Boatyard. All radios were battery operated and were on the Corps of Engineers assigned frequency of 163.4125 Mhz. Four small handi-talkie sets were assigned to key personnel in order to maintain communications with the salvage operation at all times.



U.S. ARMY CORPS OF ENGINEERS HOPPER DREDGE GERIG WORKING ON THE BYPASS NORTHWEST OF THE HUNTER FLORES BARGE LIMA 400 ON 9 MAY 1974

WORK IS IN PROGRESS FROM THE HUNTER FLORES WORK BARGE LIMA 400. THE TRIPOD MAST OFF MACKENZIE HAS BEEN TEMPORARILY PLACED ON DECK, AND THE CRANE IS TAKING A LIFT ON AN ELEMENT OF ONE OF THE AFTER MOORING LEGS ON THE BARGE.

EMERGENCY ACTION WAS TAKEN TO WIDEN THE CHANNEL NORTH OF THE WRECK AND THE GERIG (SHOWN DREDGING IN THE BACKGROUND) WORKED ON THIS ASSIGNMENT FROM 4 MAY THROUGH 19 MAY 1974. ALTHOUGH THIS REDUCED THE HAZARD TO NAVIGATION, IT CAUSED DIFFICULTIES FOR THE SALVORS BECAUSE OF THE INCREASED DEPOSITS OF SILT IN THE WRECK AND THE REDUCTION OF VISIBILITY IN THE WATER FOR DIVING OPERATIONS.

1.7.2 Fuel Removal

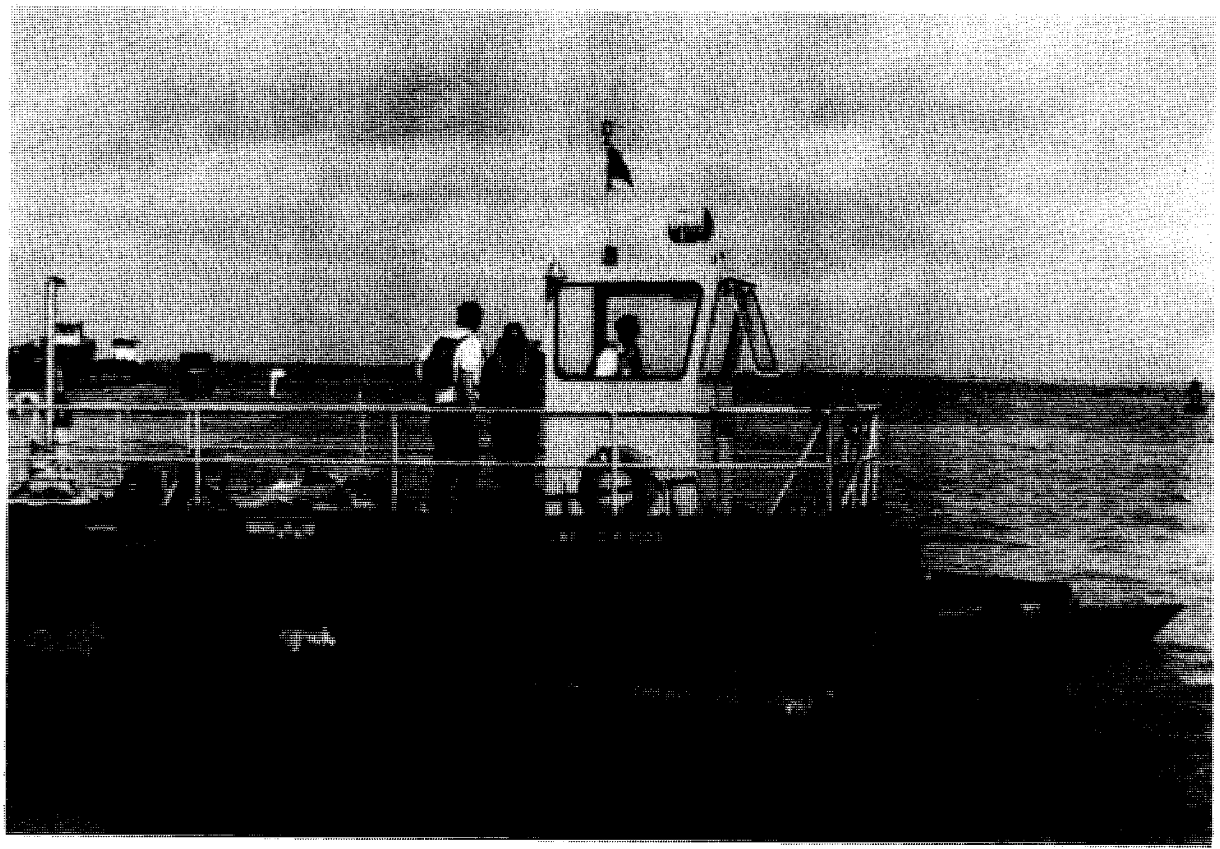
With the arrival of the oil containment boom on 7 May 1974, the pollution abatement phase went into full operation.

The oil boom was provided by the U.S. Navy through contracts with the Murphy Pacific Marine Salvage Company. The boom was deployed from a warehouse in Jacksonville, Florida by truck and set up and inflated in sections at Fort Point. The Coast Guard layed the termination buoys and ground legs of the boom array.

The boom was assembled by a work force from the crew of the MACKENZIE under supervision of Murphy Pacific. It was towed to the site in sections by Corps of Engineers tugs and connected to mooring buoys. Two days were required to connect the whole boom array.

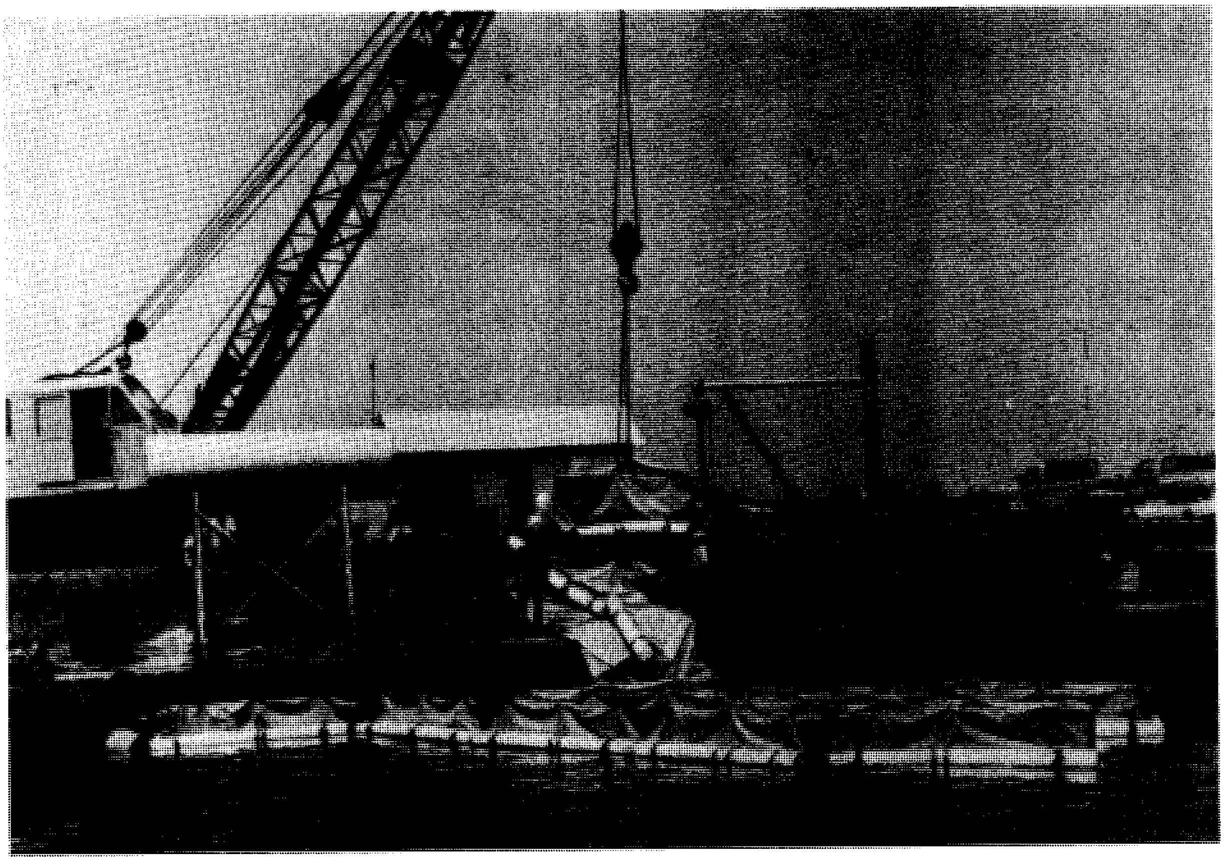
Meanwhile a fuel barge from Fort Point made up to the LIMA 400 work barge. A pump was placed aboard the work barge with the discharge line connected to the oil tank fill pipe on the sunken dredge. Another line, a 4 inch plastic Gem-line hose rigged as an air lift, was connected to one of the oil tank vents, with the free end brought up on the deck of Corps of Engineers Fuel Barge "C", which had been positioned alongside the work barge. At about 1715 on 17 May, the removal process was tested. Water was pumped into the oil tank while simultaneously operating the air lift to take suction on the oil tank vent, bringing the fuel to the surface. With favorable results on the test, operations were secured for the night.

Operations resumed at about 0740 on 18 May and before noon about 9000 gallons of diesel fuel had been removed from the MACKENZIE and placed aboard the fuel barge. The rest of the day was spent checking the remainder of the tanks. At 1640 it was agreed that all fuel had been transferred to the fuel barge. The operation had taken place with no spills.



SKIMMER WORK DURING DEFUELING OPERATIONS
18 MAY 1974

THE U.S. NAVY PROVIDED A SPECIAL SKIMMER CRAFT THAT HAD AN INTERNAL ENDLESS BELT ROLLER WITH A SQUEEGEE TO STRIP OFF THE OIL INTO A CENTER-LINE WELL TANK. THE FORWARD FLOATS CANTED TO MAKE AN ENTRANCE FUNNEL FOR HANDLING THE OIL.



MAKING UP THE NEW SECTION OF THE OIL POLLUTION BOOM FOR PHASE II ON 25 JUNE 1974

THIS BOOM DEPENDED ON POLYETHELENE FLOATS AND IMPREGNATED FABRIC TO TRAP THE OIL. IT WAS USED IN THE NORTHWEST QUADRANT OF THE ARRAY FROM ABOUT 28 JUNE TO 8 JULY. DURING THE FIRST WEEK IN JULY, IT SUFFERED EXTENSIVE DAMAGE IN HEAVY SQUALLS ASSOCIATED WITH VERY HEAVY EBB CURRENTS ESTIMATED AT GREATER THAN 5.0 FT./SEC.

1.8 Cutting and Lifting Operations Plans

It was initially decided after refinement of the base line weight data provided by the Philadelphia Division to cut the ship into eight major transverse sections. The schematic drawing shown is an artist's concept of the hulk after the preliminary efforts of removing the top hamper.

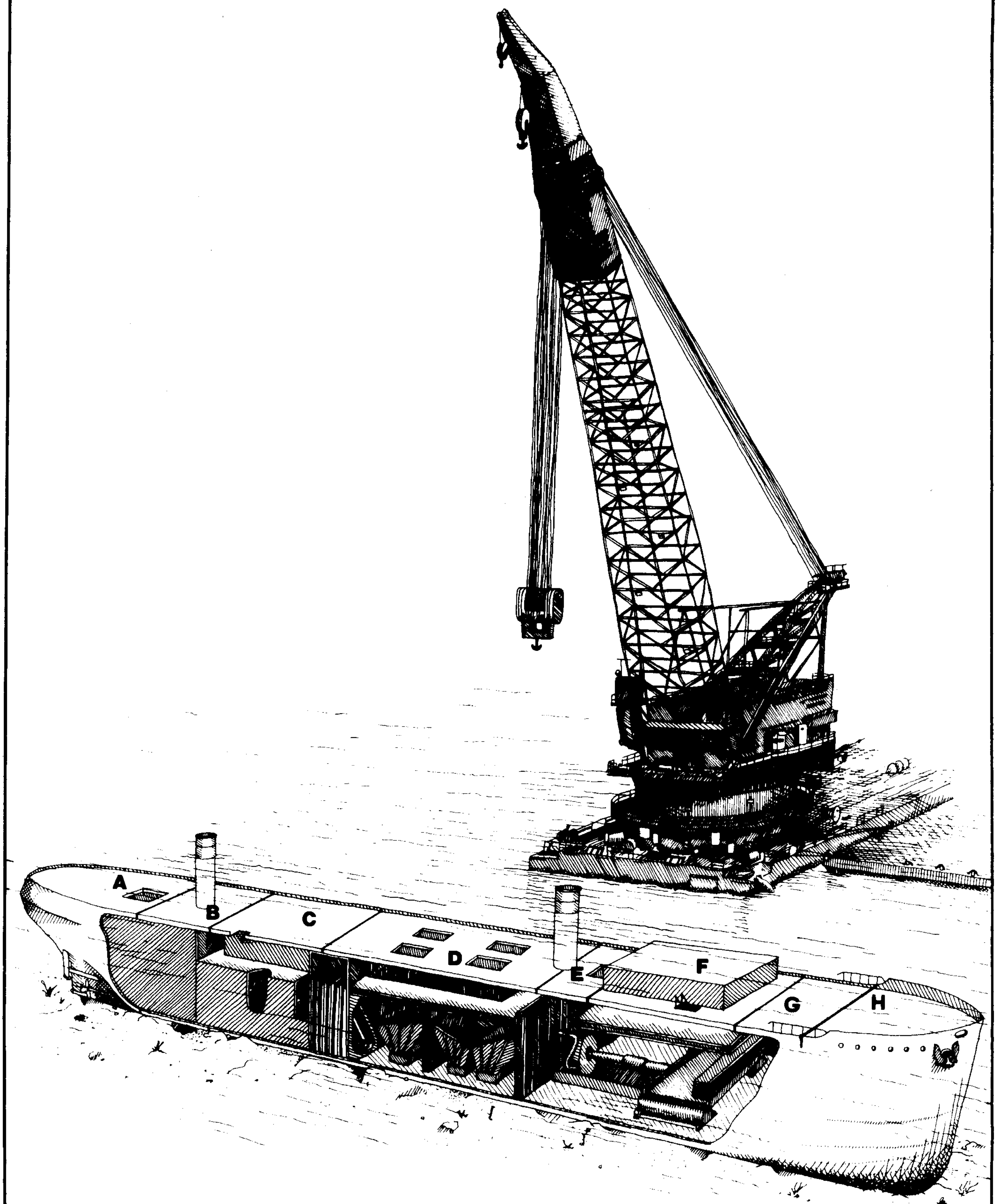
Considerable topside gear had to be removed in order to lighten the wreck and also to provide access. It was initially intended to cut off these items by oxy-arc burning and hoist them out with the 100 ton crane on the Hunter Flores Barge LIMA 400. Once this had been accomplished then "A" section (the stern section up to Bhd 20) and "H" section (the bow section from Bhd 104 to the stem) would be removed with a 500 ton derrick barge crane in Heavy Lift Phase I.

As several barge contractors were believed to be available in the Gulf area, the first heavy lift period was scheduled for the last week in June. A second lift period was tentatively set for the third week in July and a final lift period was scheduled for the third week in August. Contingencies of 14 days were provided in the plans for bad weather. Heavy lift intervals were initially estimated at 7 days on site with 2 days travel each way (4 days + 7 = 11 days per lift interval).

The PERT Analysis showed the following milestone event schedules on his critical path as of 1 June.

Event	Schedule Time (days after sinking)	Actual Completion Time
Finalize Salvage Plan	+37	+28
Lift Sections A & H	+61 to +71	+66
Lift Sections B,C,G	+88 to +102	+86
Lift Sections D,E,F	+119 to +132	+119
Complete & Demobilize All Contractors	+142	+133

Two major methods of cutting were used; oxy-arc burning and explosives.


A
B
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D
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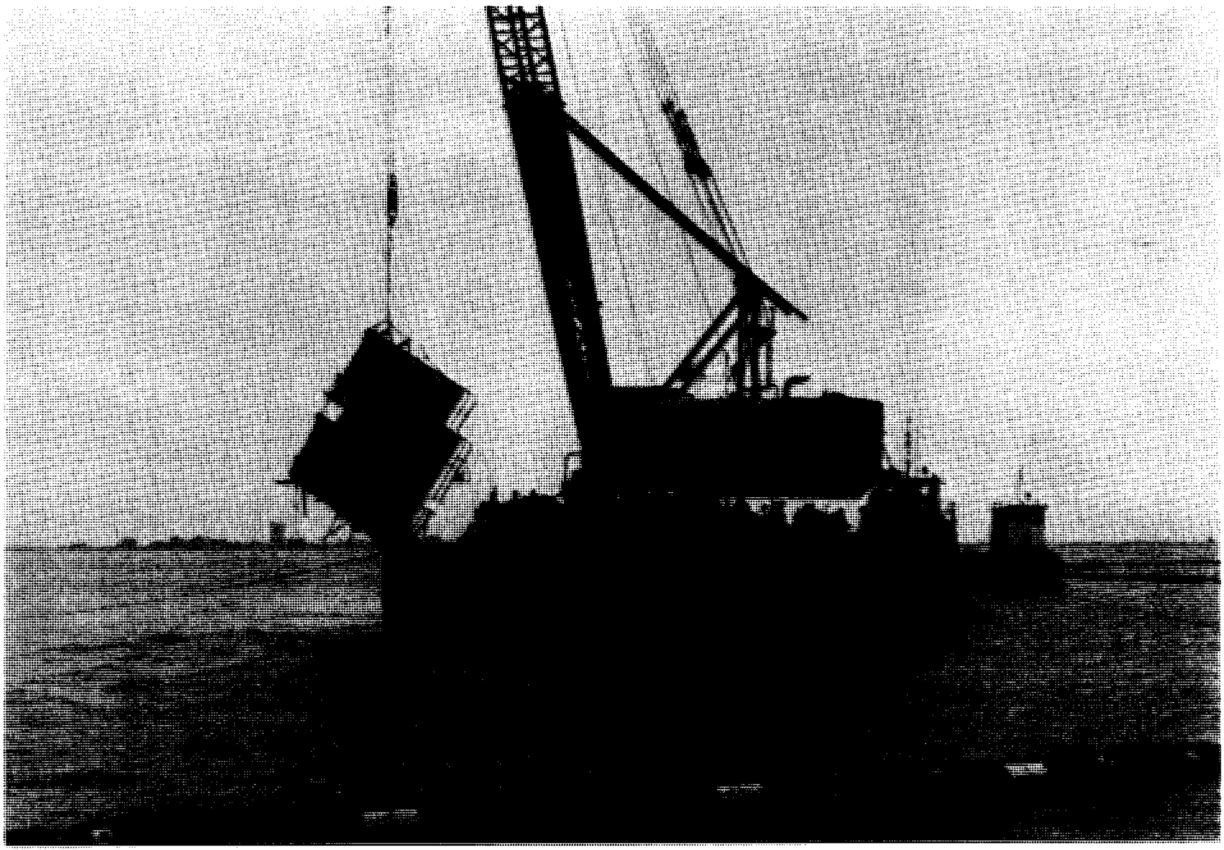
F
G
H

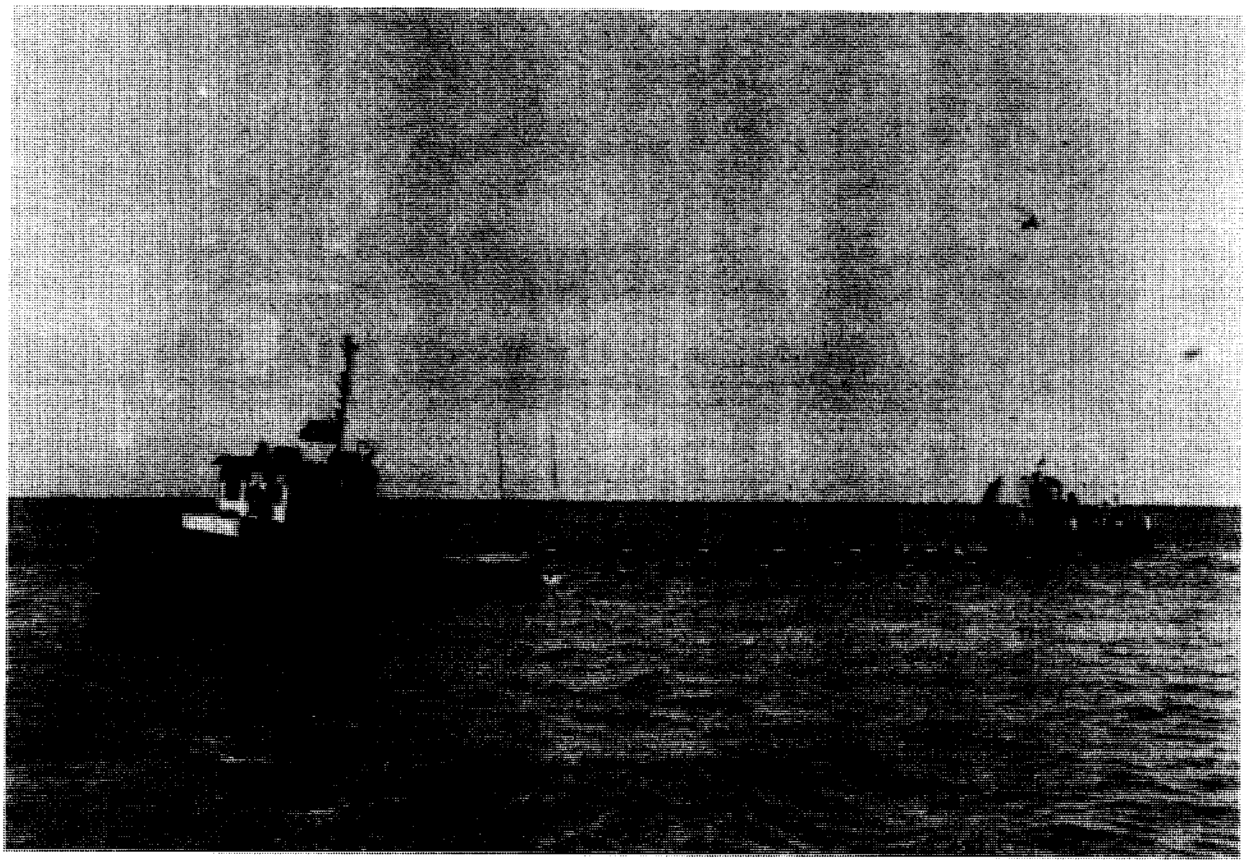


TOP HAMPER COMING OFF ON 23 MAY 1974

SALVAGE OPERATIONS COMMENCED WITH THE ARRIVAL OF OCEAN SYSTEMS INC. DIVERS ON 9 MAY. DIVING WORK STARTED ON A 24 HOUR BASIS ON 10 JUNE WITH OCEAN SYSTEMS INC. WORKING THE 1200 TO 2400 SHIFT AND BUCK STEBERS INC. ON THE 2400 TO 1200 TURN.

FROM 25 APRIL TO 20 MAY VARIOUS PLANS WERE STUDIED. ON 21 MAY THE DECISION WAS MADE TO CUT AND WRECK IN PLACE AND DISPOSE OF THE WRECK AS SCRAP. THE PLAN CALLED FOR THE REMOVAL OF ALL STRUCTURES ABOVE THE BOAT DECK AND MAKING MAJOR TRANSVERSE CUTS AT FRAMES 20, 32, 48, 62, 78, 92 AND 104.

THE 45' X 197' LIMA 400 DECK SPACE WAS USED ABOUT 25% OF THE TIME AS A SPOTTING AREA FOR WRECKAGE. PERIODICALLY THE 250 TON "AIR FORCE BARGE" LIGHTER WOULD BE BROUGHT ALONGSIDE FOR TRANSFER OF A LOAD OF SCRAP.



SKIMMER READY WITH EXTENDED BOOM FOR CATCHING SPILLS AND DEBRIS FOR THE FIRST SHOT ON 1 JUNE 1974

THE SIDE WALLS OF THE COLLECTING FUNNEL ON THE SKIMMER HAVE BEEN EXTENDED BY USING BOTH THE YTL'S TO "OPEN THE MOUTH." IN SUCH USE THE FLOATS FORWARD ARE RIGGED UP AND SPECIAL YOKE FITTINGS ARE FASTENED TO THE BOW OF THE SKIMMER.

Removal of the top hamper started on 9 May 1974 and cutting efforts on the bow and stern sections were started on a round-the-clock basis on 10 June after the arrival of the Buck Steber, Inc. divers.

The Salvage Master decided that best productive efforts could be achieved by having Ocean Systems Inc. divers continue the cut at Frame 104 on the Noon to Midnight shift and Buck Steber Inc. divers begin the cut at Frame 20 on the Midnight to Noon shift.

1.9 Cutting and Lifting Phase I

1.9.1 Environmental Coordination

On 17 May 1974, a meeting was held with representatives of the U.S. Environmental Protection Agency, U.S. National Marine Fisheries Service, Texas Parks and Wildlife, to discuss the effects of the salvage operations on the environment. The overall operation was discussed and the representatives were advised that explosives probably would be used to perform some of the cutting. All questions were answered to the satisfaction of the agencies. The representatives were given a tour of the wreck site and invited to visit the salvage operation at any time.

1.9.2 Explosive Cutting Efforts

The project engineer and the explosives technicians designed two shaped charge configurations for use on cutting the half-inch thick shell plate on the wreck. One was a 2.2 lb./ft. line charge using Comp C-4 and the other was a 0.8 lb./ft. C-4 charge. The first shot with a 48" length of the heavier configuration was fired on 1 June 1974 to study hull plate cutting effects and local fish kill. The shot demonstrated that the plate could be cut with the 2.2 lb./ft. charge and revealed some negative, although acceptable, effect on marine life.

Marine biologists from the Texas Parks and Wildlife Department observed the shot with representatives of the Coast Guard and the District Engineers. There were no large fish kills; although a few dozen small catfish

MARINE BIOLOGISTS CHECKING THE FISH KILLED AFTER THE FIRST SHOT, JUNE 1974

FIELD AUTOPSY INSPECTIONS WERE MADE BY THE STATE AND FEDERAL FISH AND GAME OBSERVERS ON FISH GATHERED AFTER THE FIRST EXPLOSIVE CUTTING TESTS ON THE WRECK. THEIR FINDINGS CONFIRMED PREVIOUS STUDIES MADE BY THE NAVAL ORDNANCE LABORATORY AND THE ATLANTIC DIVISION OF THE NAVAL FACILITIES ENGINEERING COMMAND ON ENVIRONMENTAL IMPACT EFFECTS ON MARINE LIFE BY UNDERWATER EXPLOSIONS. FOR CHARGES LESS THAN 100 LBS., FISH KILL EFFECTS WERE NOT NOTED BEYOND 150 FT. FROM THE CHARGE.

were recovered along with the debris. This demonstration satisfied the local authorities that explosives in the amounts to be used were no great threat to the local marine ecology; permission to proceed with explosive cutting operations was granted accordingly.

About 2000 lbs. of composition C-4 were stored by the explosives contractor TECNICAL EXPLOSIVES, INC. in temporary sandbag magazine barricades at Fort Point. Permission was granted to move explosives on the launch CM Woods in 50 lb. batches from the magazine to the test site. Permission was granted by the District Engineer to keep 150 lbs. in a ready-service locker aboard the work barge LIMA 400 at the job site.

1.9.3 Oxy-Arc Cutting

The early cutting efforts on the job were with the oxy-arc apparatus. A 300 amp machine experienced some difficulty with the initial batches of ARCO arc-aire blue coated electrode. This improved with the provision of 400 amp machines and by covering the electrodes with masking tape and varnish. When pink coated Craftsweld electrode became available, they were wrapped with a single cover of 3M electrical tape. No further problems were encountered.

All of the top hamper impeding the first heavy lift areas had been cleared by 5 June 1974 and Ocean Systems Inc. divers started the transverse cuts at Frame 104. By 10 June both the Ocean Systems Inc. and Buck Steber Inc. diving teams were at full strength and cutting operations were scheduled around the clock.
The ship's stacks were opened to allow divers access into the ship's structure during high current periods of diving.

1.9.4 Heavy Lift Phase I

This phase of the operation commenced with the arrival on 24 June 1974 of MOVIBLE NO. II, Teledyne heavy lift craft with Captain Thomasee as Master. The Salvage Master and the Master of MOVIBLE II determined a mooring plan for the heavy rig, and attended a meeting with the Houston Pilots Association and the U.S. Coast Guard officials regarding ship channel restrictions. Consideration was given to closing the north channel entirely and possibly blocking the south channel at brief intervals.

The LIMA 400 barge was removed from the wreck site and the MOVIBLE NO. II was brought in to port from north-northeast, laying mooring anchors across the north channel enroute.

With the heavy lift rig riding to a five point moor alongside to port of the sunken A. MACKENZIE, the LIMA 400 barge was brought alongside MOVIBLE NO. II to the south.

The forward lift chains of the bow section were picked up with intent of using leverage to break the bow away from the main hull. First lift attempts were unsuccesful because of a 6 inch pipe which had been left uncut in the upper portion of the forward engine room. After this pipe was cut, the bow was brought to the surface and separation of that section from the main hull was ascertained.

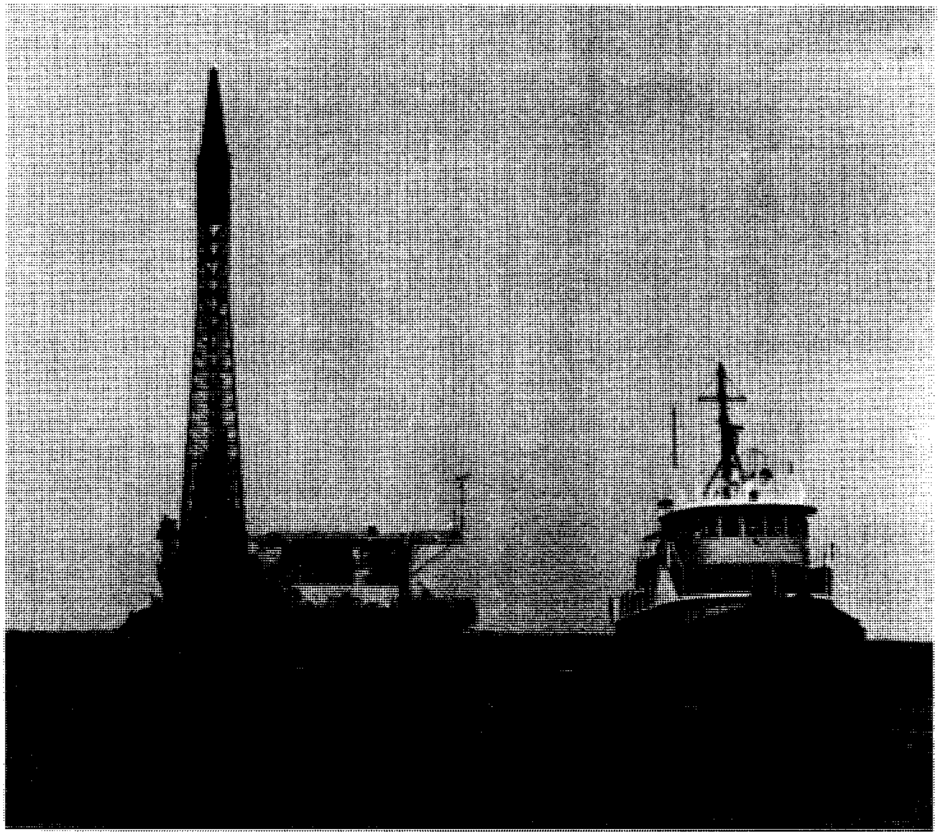
All four slings were then hooked up to the bow section and another attempt was made to lift the portion clear of the water. The bow proved to be much heavier than anticipated, exceeding 330 short tons at one point of the operation. As one 2½" sling was damaged early in the operation, the bow was lowered again for rerigging.

The damaged sling was replaced at periods of slack tide by divers who continued work operations throughout the night.

Just after first light, 25 June, the bow section was lifted clear of the water and allowed to drain until mid-morning. At 1017 the weight reading had dropped to 322 short tons and within the hour the bow section was landed on the cargo barge.

With slings clear of the bow, the heavy lift craft was moved aft along the wreck. The 2½" slings were replaced by 3" x 70' units. It was decided to bring the stern section straight up off the bottom, using all four slings. The lift attempt was made as planned but the starboard side plating became involved with the main hull structure and the stern section had to be lowered back to the bottom.

The operation continued throughout the night and at 0731, 26 June, a tug boat was employed to lever the starboard side clear of the main hull. Another lift was attempted but, when the main deck level came clear of the water, a partial failure of the die lock chain was observed in a link which bore full weight up and



GULF STORM WITH TELEDYNE MOVIBLE DBII IN TOW ON MORNING OF 24 JUNE 1974 COMMENCING THE MOORING OPERATION

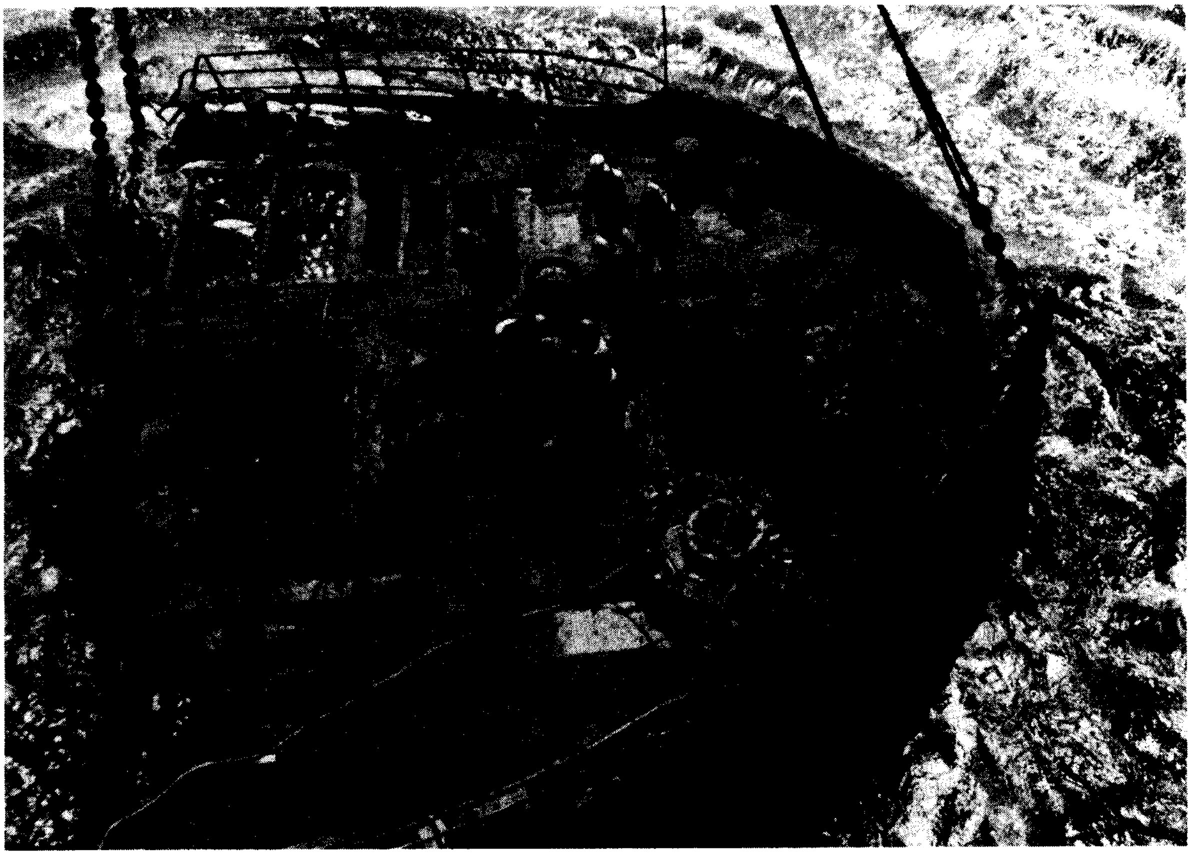
THE BIG BOOM ON THE MANITOWAC CRANE EXTENDED OVER 250 FT. ABOVE THE WATER. AT A 60° BOOM ANGLE, THE 62 TON JUMBO BLOCK WITH 20 PARTS OF 1 5/8 IN. WIRE, WAS 210 FT. OVER THE WATERLINE.

BY 1700, 24 JUNE 1974, THE DERRICK BARGE WAS IN ITS MOORS ALONGSIDE THE A. MACKENZIE AND DIVERS STARTED MAKING THE CONNECTIONS BETWEEN THE CRANE SLINGS AND THE LIFT CHAINS ON THE BOW SECTION. UPON COMPLETION OF THE CONNECTIONS, LIFTING COMMENCED.

CHECKING THE TELEDYNE 2½" SLINGS AND SHACKLES FOR THE FIRST HOOK UP IN PHASE I ON THE BOW
24 JUNE 1974

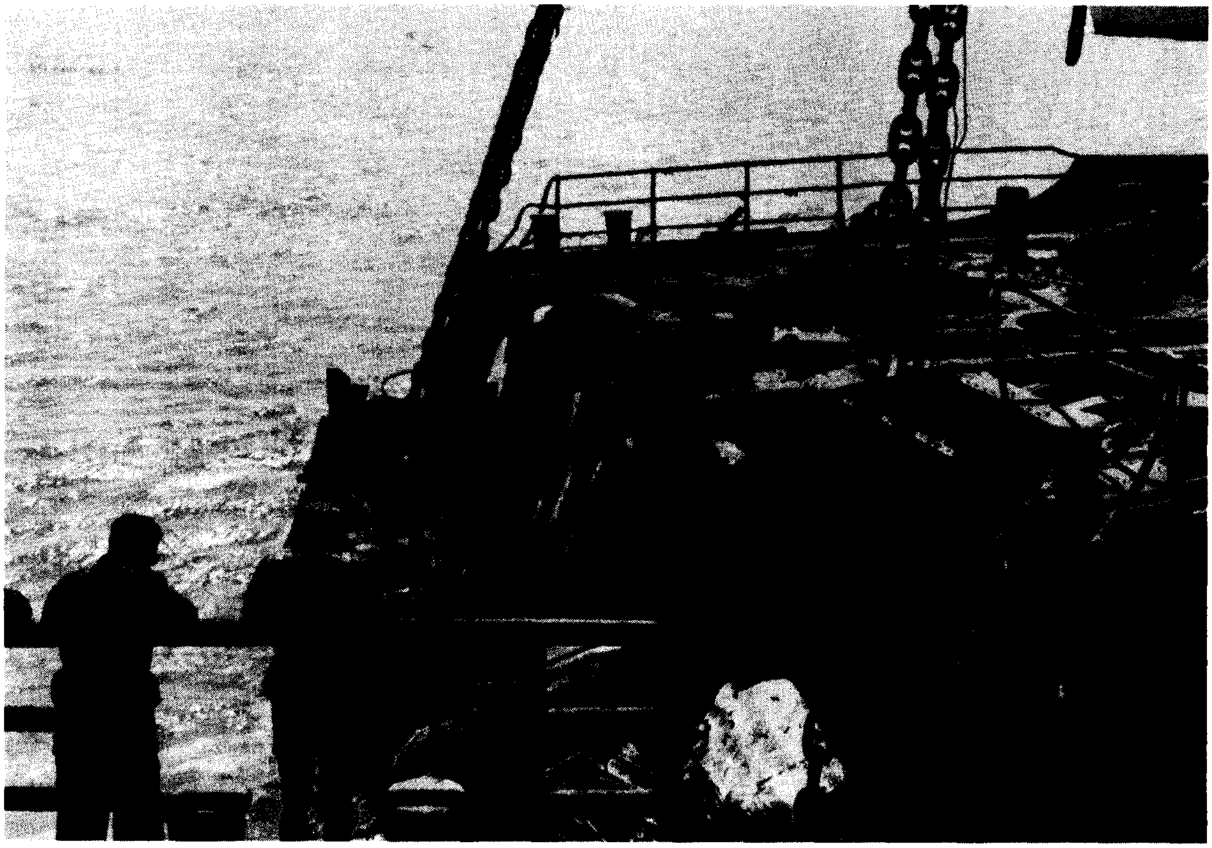
THE SALVAGE MASTER, CAPTAIN C.E. ALLEMAN, INSPECTS THE SHACKLES WITH THE LIFT MASTER, CAPTAIN THOMASEE OF TELEDYNE MOVIBLE DBII AS OCEAN SYSTEMS DIVERS LOOK THE RIG OVER.

THE INITIAL LIFT ESTIMATE OF 194 SHORT TONS WAS EXCEEDED ON ACTUAL HOOK WEIGHTS BY OVER 332 TONS ON INITIAL HOIST ATTEMPTS. AS A CONSEQUENCE, THE BOW SECTION WAS RERIGGED PRIOR TO FINAL LIFT ON 25 JUNE. THE FINAL WEIGHT LOADED ON THE SCRAP BARGE WAS 332 TONS AFTER AN ESTIMATED 60 TO 70 TONS OF MATERIAL AND SILT HAD BEEN TAKEN OFF THE WRECK.



REMOVING WEIGHT FROM THE BOW SECTION ON THE MORNING OF 25 JUNE 1974

THE BOW SECTION WAS HEAVIER THAN ESTIMATED, AND STEPS WERE TAKEN TO LIGHTEN THE LOAD BY REMOVING DECK MACHINERY, CHAIN, SODDEN DECK PLANKING AND MISCELLAENOUS MUCK AND DUNNAGE. TWO ADDITIONAL SLINGS WERE ADDED ON THE AFTER QUADRANTS TO LESSEN THE LOAD PER PENDANT BEFORE THE FINAL LIFT.



BOW SECTION COMING UP ON 25 JUNE 1974

THE EFFECTS OF THE BUBBLE OSCILLATION FROM LINE CHARGES OF 50 TO 80 LBS. ON THE HORIZONTAL CUT LINES ARE OBSERVED AS WELL AS THE JUMBLE OF THE INTERNAL SPACES.

across the knuckle of the port main deck structure. Therefore, the stern section was lowered back to the bottom and two additional lift chains were rigged across the forward corners under the main deck.

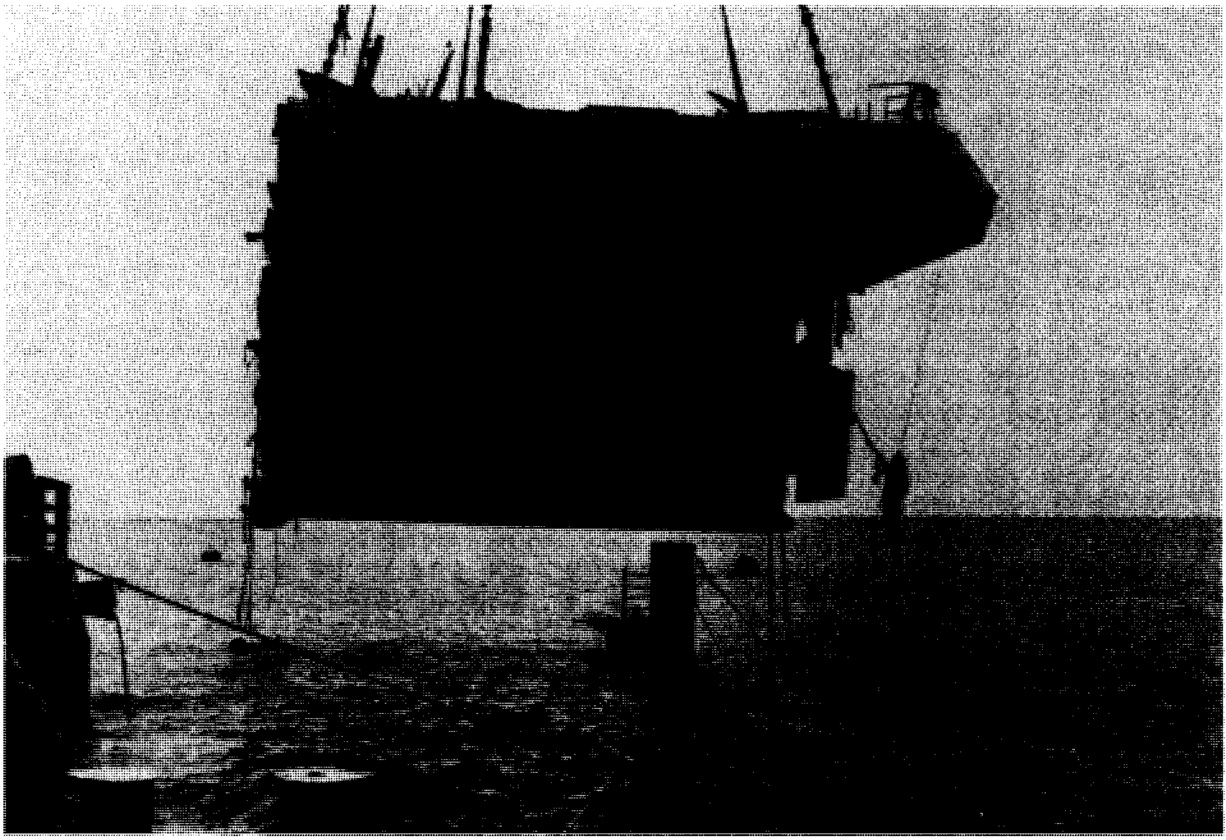
By 27 June, with rigging of the additional chains completed, another lift was attempted. As the machine shop platform came clear of the water, the recorded weight was 390 short tons. The Master of MOVIBLE NO. II deemed the piece too heavy to lift with the existing rig. All loose debris and wood deck planking was removed from the boat deck, but total weight of the section was still unacceptable to the lift master.

The Salvage Master, in company with Buck Steber, Inc. divers, boarded the section and found an average of one foot of mud throughout the main and second deck levels. Drainage holes were cut in the hull and the mud was washed out with 2½" fire hose. The lathe and other heavy machine shop equipment was also removed at this time.

By 1230, with an estimated 62 long tons of material removed, the stern section was picked free of the water weighing 362 short tons. By 1350 the stern section of A. MACKENZIE was loaded on the cargo barge. The LIMA 400 work barge was moved away to anchorage on the mud flats to the north while the heavy lift craft cleared her moorings from the wreck site.

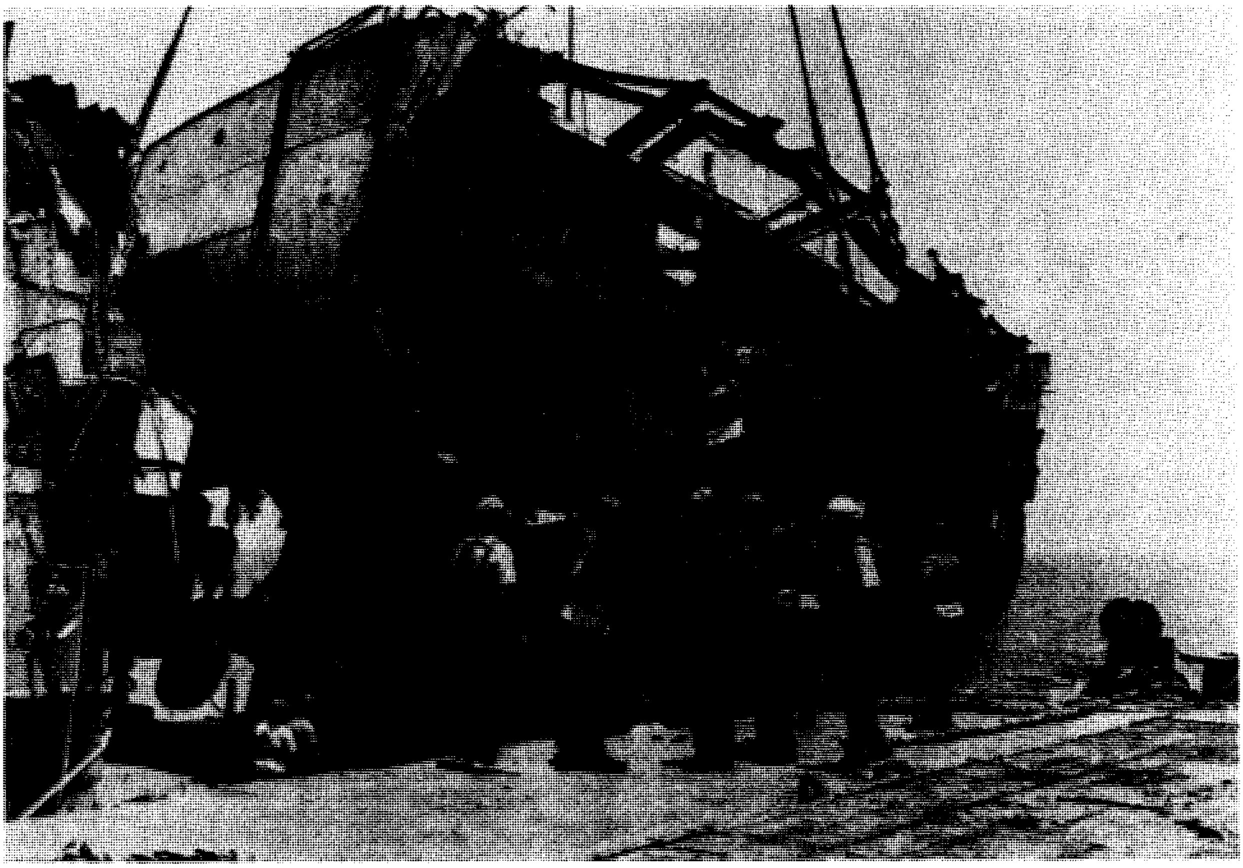
1.10 Cutting and Lifting Phase II

Refinement of the lift estimates followed the completion of the removal of the bow and stern sections. From this it was determined that "B" section, the after half of the engine room, could proceed in accordance with the original plan, but the remaining sections would have to be cut into their upper and lower components. Furthermore, it was decided that every lift would be rigged with 2¼" chain to permit 8 pick points on 3" wire pendants for the big crane. This decision was made on the basis of experience gained on the first lifts and with a view toward minimizing the standby time of the big crane for rigging preparations while onsite. By rigging each time for the full capacity of the big crane, and assuming that each piece would be under the 400 ton limit of 8X50 tons per sling, it was believed that hook up time



STERN SECTION SWINGING TOWARD THE TRANSPORT BARGE
27 JUNE 1974

NEW 2¼" CHAIN LEGS HAVE BEEN RIGGED THROUGH THE FORWARD QUARTER SECTIONS FOR THE SECOND LIFT ATTEMPT. THE CHAIN LEG DRAGGING FROM THE MIDDLE HOLE IS THE END THAT WAS USED IN THE FIRST ATTEMPT. A FAILED LINK WAS OBSERVED IN THIS UNIT AND THE LIFT ON THE FORWARD END WAS RE-RIGGED.



STERN SECTION ON THE SCRAP BARGE ON 27 JUNE 1974

THE MAJOR LESSON LEARNED ON PHASE I WAS TO RIG EACH PIECE TO THE CAPACITY OF THE 500 TON LIFT AVAILABLE DURING INITIAL PREPARATIONS. THE POTENTIAL TIME LOSS IN FAILING TO DO SO COST ABOUT $2,300/HR.

would be the only major factor in the lift operation. Subsequently, this proved to be correct.

LIMA 400 was back in moorings at midnight 28 June 1974 after a day's delay with adverse tide conditions. Full cutting operations were resumed 29 June on Frames 32, 47½ and 94. The Ocean Systems, Inc. divers were working in "G" section forward and had the main diesel and pump motor units to remove as well as the structural cutting. Explosive operations continued to strip the wooden deck off the upper portions. By the end of the first week of July over 70 tons of scrap had been taken off the wreck with most of it coming from the forward machinery room.

Work continued on the transverse cuts at Frames 32 and 94 to sever "B" and "G" sections. Meanwhile, on 4 July, inspection dives indicated mud build up in the bow section and an estimated 1.5 ft. of build up in the bilge areas in "G" section. Continued work at the 50 level required 50 foot decompression table observance accordingly. The wreck showed considerable scouring action under "B" section, but none at the bow.

Demudding operations with a small 3 inch jet line and air lift were attempted in the forward areas around the Frame 94 cut line in the bilge areas. Some silt was removed and the same technique was used with some success at Frames 32 and 47.

The Dredge MACFARLAND arrived in Galveston on 9 July and started working the north and south channels. This increased the rate of silt deposition in the wreck and resulted in zero visibility for diving operations.

Oxy-arc cutting at Frame 32 was completed on 11 July while the cut at Frame 94 was held up because of 100 lb. steel ballast bars across the cut line. The bars were tack welded in place and had to be burned free and removed from the bilge area one by one in order to clear the bottom plating. "B" section was completely severed from the wreck on 12 July by blasting the cut line with shaped charges of 2.2 lb./ft. Comp C-4. The average separation achieved at the cut line was about 10 inches all around the girth. The same day a complete separation of lower "G" section was achieved at Frame 94 using the same explosive technique.

Meanwhile, the Buck Steber Inc. divers started on "C" section and continued the transverse girthing cut at Frame 47. The Ocean Systems Inc. divers continued on upper "G" and started the longitudinal cuts to separate the upper and lower sections. Work had already started to rig up "B" section for lift, and for the next four days the divers continued on the longitudinal cuts on "G" and "C" sections. Each section was rigged with chains as the longitudinal cuts were completed.

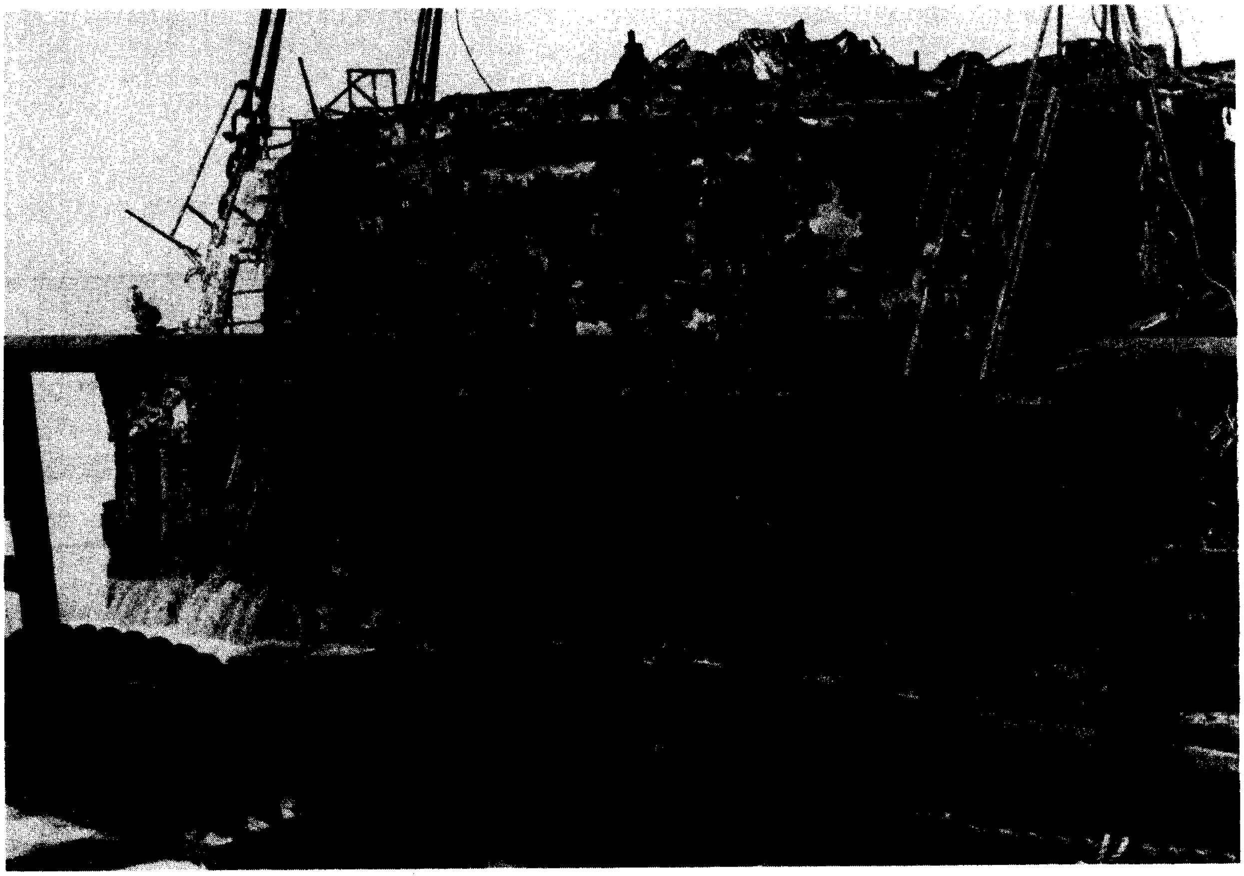
The Resident Engineer had been advised that Teledyne MOVIBLE NO.II and the same rigging crew would be available 20 July. Since the 500 ton derrick barge availability was so critical to the operation, it was decided to adhere to plans to have the derrick barge onsite on 24 July. The transverse cut on lower "C" was left for completion under Phase III.

Additional work involved in making the longitudinal cuts had used up the slack time gained during Phase I. On 22 July the derrick barge, MOVIBLE NO.II arrived at the wreck site and moored alongside the A. MACKENZIE as in Phase I. By Noon, divers commenced rigging the lift slings to the upper section between Frames 92 and 104. At about 1440, rigging was complete and upper "G" section was hoisted to the scrap barge without incident. Immediately, divers started rigging the lower section between Frames 92 and 104. At about 1830, lower "G" section was placed on the scrap barge. By 2350, upper "C" section between Frames 32 and 48 was also hoisted to the scrap barge.

It is worthy of note that this section was lifted from between two other sections. By the time this section was placed on the scrap barge, a strong ebb tide was running and continued to run for the remainder of the night. Nevertheless, divers entered the water and completed rigging "B" section between Frames 20 and 32 by about 0500. At about 0515 this section was placed on the scrap barge thereby completing this lift sequence. By 1100 on 23 July, MOVIBLE NO.II had departed the work site.

During this phase, the upper section of the after engine room damaged in the collision was lifted. On 26 July, marine surveyors for both the BOW ELM and the IDA GREEN inspected the damage while it was on view at Fort Point for the scrap dealers.

Figure Number 24



UPPER "G" COMING THROUGH THE INTERFACE
22 JULY 1974

UPPER "G" WEIGHED LIGHT AT 105 TONS. THE TOTAL TIME FROM DIVERS IN THE WATER UNTIL THE LIFT SLACKED ON THE FORWARD END OF THE SCRAP BARGE WAS 106 MINUTES.

LOWER "G" COMING UP ON 22 JULY 1974

WITH THE DIVERS HOOKING UP AT 1600, THE LOAD WAS DELIVERED AT 180 TONS TO THE SCRAP BARGE AT 1838. WORKING AT GREATER DEPTH WITH UNFAVORABLE CURRENTS, THE LIFT WAS MADE IN 158 MINUTES. CYCLE TIME ON PHASE II SHOWED A LEARNING CURVE IMPROVEMENT OVER PHASE I.

It is interesting to note that rigging preparations made for this lift reduced the onsite time interval of MOVIBLE NO.II from about 80 hours to 26 hours and doubled the number of lifts from two to four lifts. This improved the lift cycle from one lift every 40 hours to one every 6.5 hours. At a cost of approximately $2300/hr. for the use of the MOVIBLE NO.II time onsite costs for the first two lifts were $92,000 each. The cost of Phase II lifts was reduced to about $15,000 each. Since the cost of the contract salvage crew was approximately $5,000/day, one day's worth of rigging time in preparation for the big barge offset two hours of heavy lift delay. The lesson learned was "rig heavy and save money." The economy of the rigging plan was proved accordingly.

1.11 Cutting and Lifting Phase III

Cutting operations were again underway from LIMA 400 by 1400 on 24 July 1974. The after stack was repositioned over the hopper area in "D" section for access to the after cut lines at lower "C" and between "D" and "E".

Cutting in the hopper areas was complicated by several factors. First there was considerable thick bituminous covering of the hopper sides that made the striking of the oxy-arc impossible. Attempts were made to scale the cut lines with explosive primacord, but these proved to be ineffective. Pneumatic air hammers were rented, and the cut lines were scaled with chipping tools. Next there was the structural complexity of triple plate sections that resulted from the MACKENZIE's 1949 modernization and alteration program. The new welded hopper structure was laid over the old riveted structure, and in some areas there were 1½" of plate to sever. These regions occurred in the upper boundaries of the hopper wells and were difficult to cut through with oxy-arc techniques. Concurrently, the hoppers themselves were filled almost full in some sections with dredge spoils. This material had to be air lifted out before effective steps for cutting could be taken.

By 30 July the Salvage Master reported:

Frame 47 --- 95% cut thru lower bilge "C" to "D"

Frame 78 --- 65% cut " " " "E" to "F"

Frame 63 --- 05% cut " " " "D" to "E"

Work was proceeding topside on the cut at Frame 78 so that 78½ jogged to 77½ at the 15 ft. D.W.L. up to the boat deck. This put the forward bulkhead on "F" upper section and the after bulkhead on "E" lower. This bulkhead already required a transverse cut to separate "F" upper from "F" lower.

Explosive shaped charges using 2.2 lb./ft. C-4 were used to complete the severing of "C" section. As the work progressed, the cut line in the bilge at Frame 63 proved to be much less cluttered than those previously experienced in the forward machinery spaces. Rigging started on lower "C" section on 2 August and the hopper area bilge cut line at 78 was blasted with 2.2 lb./ft. C-4 shaped charges the same day. The transverse bulkhead at Frame 78 was cut the next day with 2.2 lb./ft. C-4 shaped charges.

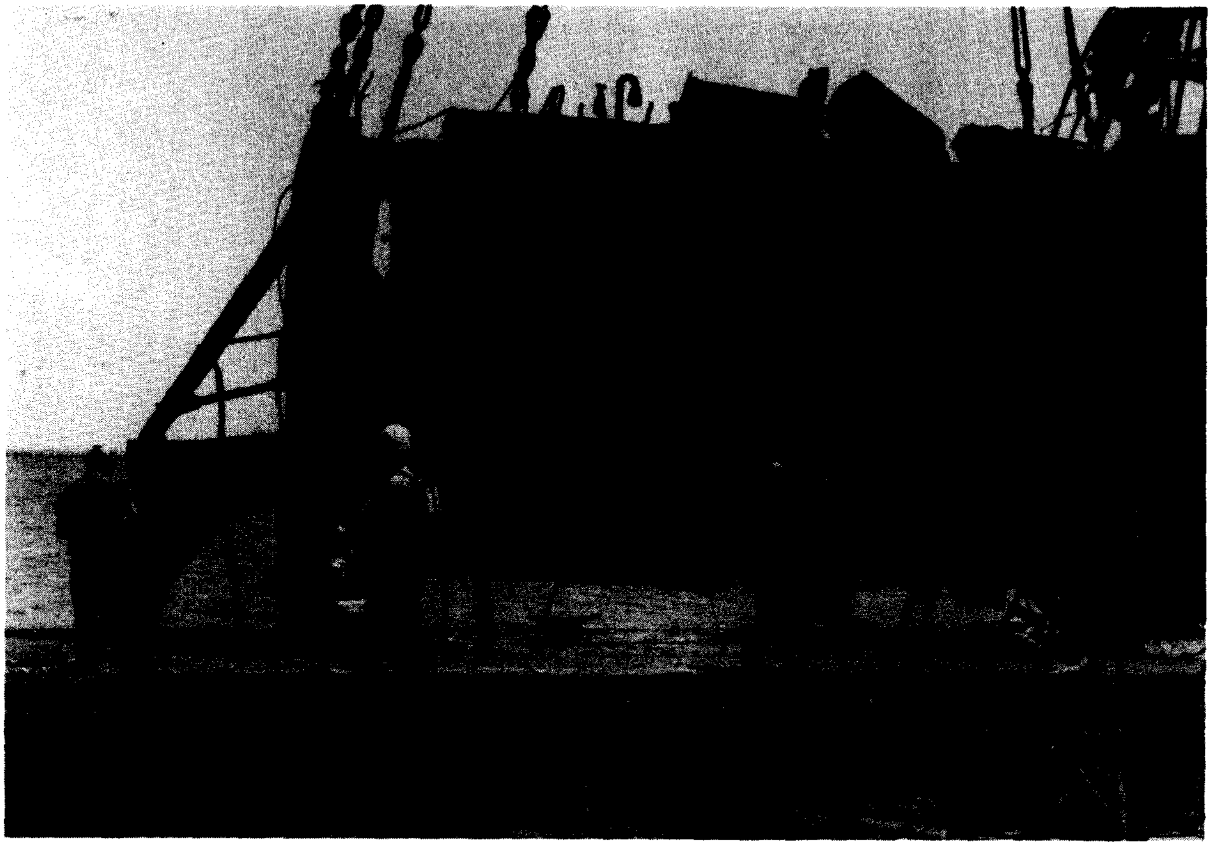
Air lift operations started in the hopper areas on 3 August and continued for three days while cutting operations in the Frame 63 area and lifting chains were rigged on upper and lower "F" section. By 8 August all the longitudinal cuts in both "D" and "E" sections were well underway. Air lift operations were continued on 10 and 11 August to remove dredge spoils from the starboard hoppers. On 12 August a 185 lb. shot of C-4 shaped charges was used to open the bilge cut at Frame 63, sever the transverse bulkhead 47 at the 17 foot DWL and blast drain holes in four cylindrical water tanks located inboard of the hopper sides.

On 14 August the longitudinal separations of upper and lower "E" section and upper and lower "F" section were assured by shooting 90 lbs. of C-4 shaped charges. Meanwhile, the lifting chains were rigged in "F", "D" and "E" sections, and all the chains were placed for Phase III lifts on 16 August. Divers inspected all the cut lines; dredge spoils were air lifted through 17 August. A final 25 lbs. of C-4 shaped charges were fired at apparent tight spots in Frame 63 on 17 August. LIMA 400 was moved out of the moor to await the arrival of Teledyne MOVIBLE NO.II on 19 August.

The Resident Engineer had again succeeded in securing the assignment of the Teledyne MOVIBLE NO.II with the same rigging crew for the Phase III heavy lifts. At first light on 19 August, MOVIBLE NO.II started up the ship channel toward the remains of A. MACKENZIE. By about 1000, mooring was complete and the divers commenced rigging the upper portion between Frames 62 and 78. At 1255 this section was placed on a scrap barge. The remaining six sections followed in rapid succession with the last section placed on the scrap barge at about 1315 on 20 August 1974. By 1700, the MOVIBLE NO.II had retrieved her anchors and cleared the wreck site thereby completing the removal of the main sections 13 days ahead of schedule. The last section lifted was the lower portion of the after engine room containing the remainder of the collision damage.

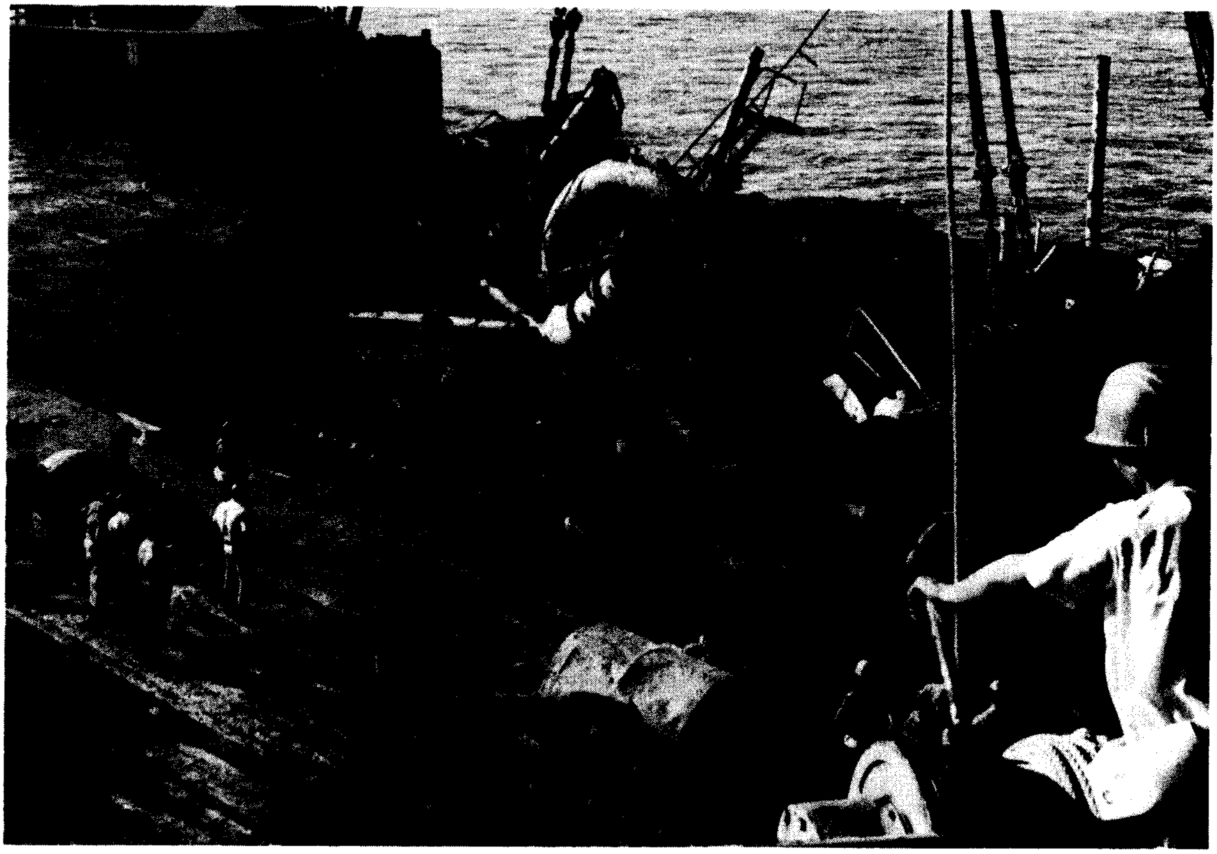
DOUBLE AND TRIPLE COURSES OF PLATING CUT BY OXY-ARC AND FINALLY SEPARATED BY EXPLOSIVE CHARGES IN AN UPPER HOPPER SECTION.

THE TRANSVERSE CUTS IN THE UPPER HOPPER AREAS WERE COMPLICATED BY THE FACT THAT OVER THE YEARS SLUICE CHANNEL AND UPPER HOPPER LINER PLATES HAD BEEN QUILTED OVER THE ORIGINAL PLATE AND GROUTED WITH FINE CEMENT TO COMBAT CORROSION. THIS PROVIDED A GOOD SOLUTION FOR MAINTAINING THE STRUCTURAL AREAS HANDLING DREDGE SPOILS, BUT MADE OXY-ARC BURNING THROUGH THESE LAMINATED STRUCTURES VERY DIFFICULT.



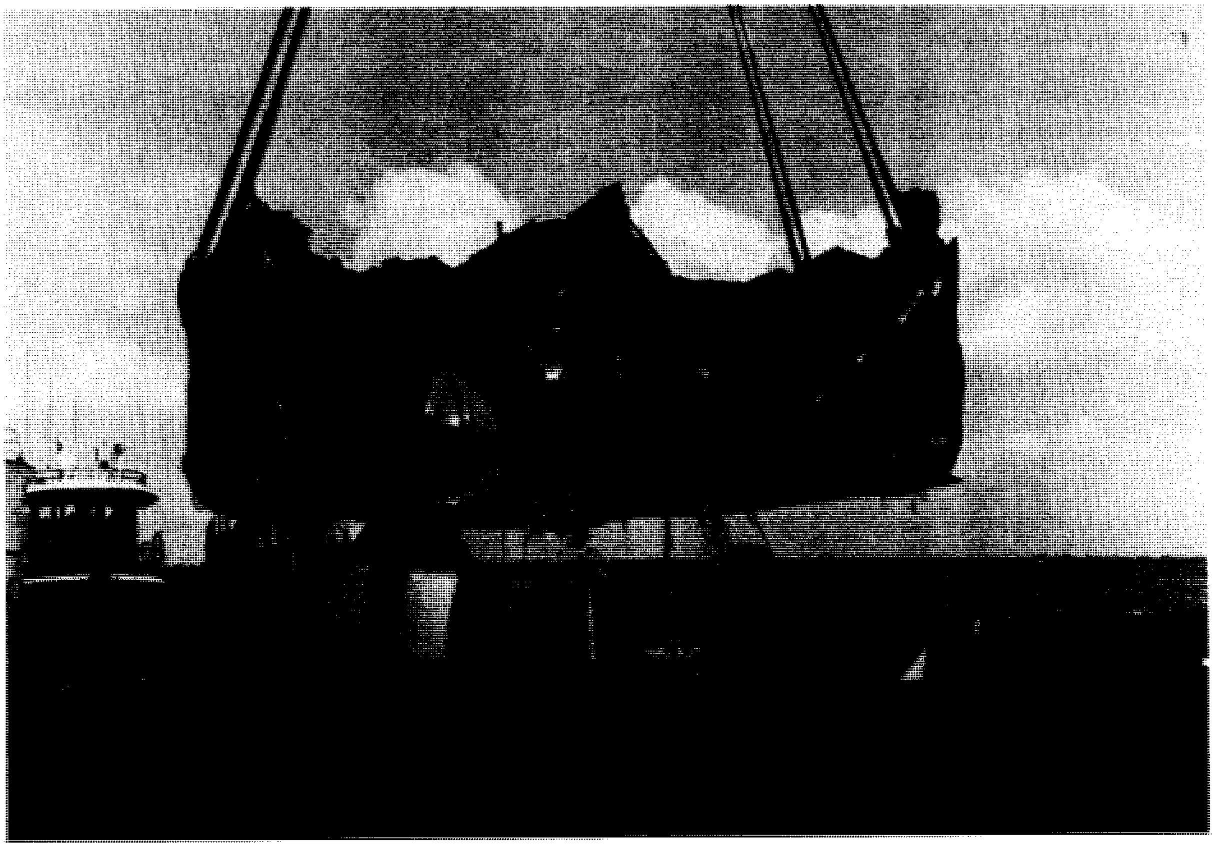
UPPER "F" SECTION BEING LOADED ON THE SCRAP BARGE AT 220 TONS HOOK WEIGHT 19 AUGUST 1974

THE PROCEDURE ADOPTED DURING PHASE II WAS ALSO USED IN PHASE III. THE FIRST LIFT ON PHASE III, STARTING WITH DIVERS IN THE WATER AT 1112, TERMINATED WITH THE LIFT LANDED AT 1245.



LOWER "F" SECTION BEING LANDED ON THE TRANSPORT BARGE AT 312 TONS HOOK WEIGHT ON 19 AUGUST 1974

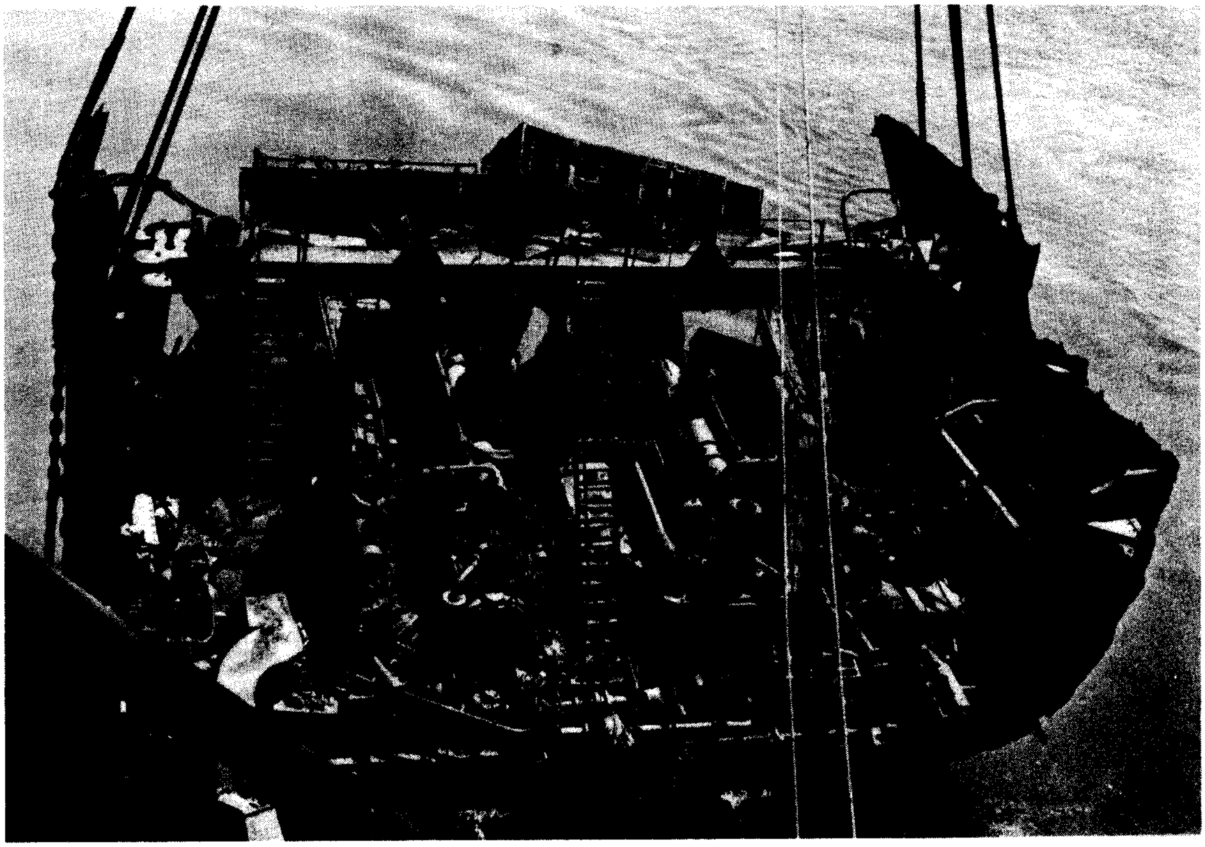
THIS CUT THROUGH THE BILGES WAS A DIFFICULT ASSIGNMENT. IN ORDER TO REACH THE BOTTOM SHELL CUT LINE, BALLAST PIGS AND SILT HAD TO BE REMOVED. THE SILT TRAPPED IN THE BOTTOM AREAS IS ABOUT 24" DEEP IN PLACES.



LOWER "D" HOPPER SECTION LIFTING THROUGH THE INTERFACE ON 20 AUGUST 1974

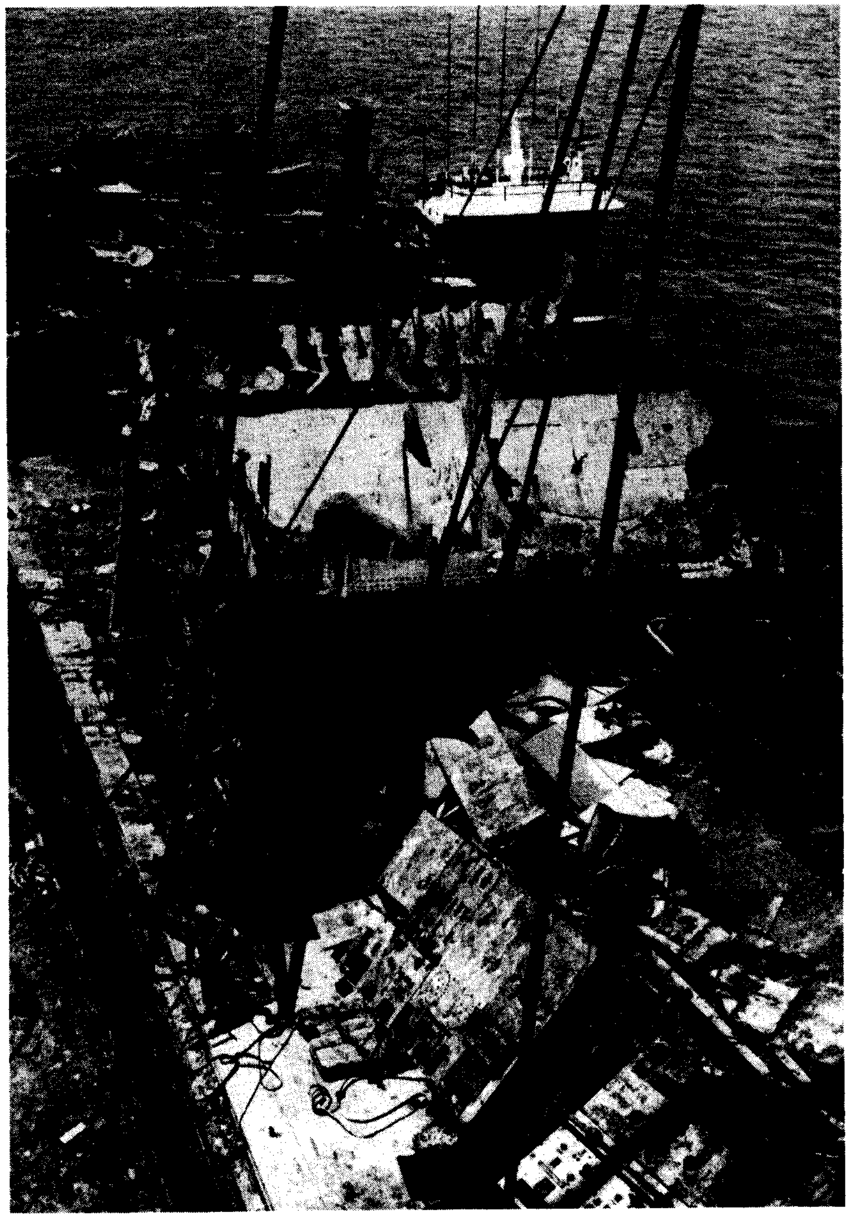
THIS WAS THE NEXT TO THE LAST SECTION TO BE REMOVED. DIVERS ENTERED THE WATER TO MAKE THE HOOK UP AT 0505; THE LIFT OF 370 TONS WAS LANDED ON THE SCRAP BARGE AT 0954.

THE TOTAL LIFT CYCLE OF 289 MINUTES FOR 370 TONS IN PHASE III MAKES A STRIKING COMPARISON WITH 2925 MINUTES ON THE 370 TON LIFT OF THE STERN SECTION IN PHASE I.



LOWER "C" COMING UP ON 20 AUGUST 1974

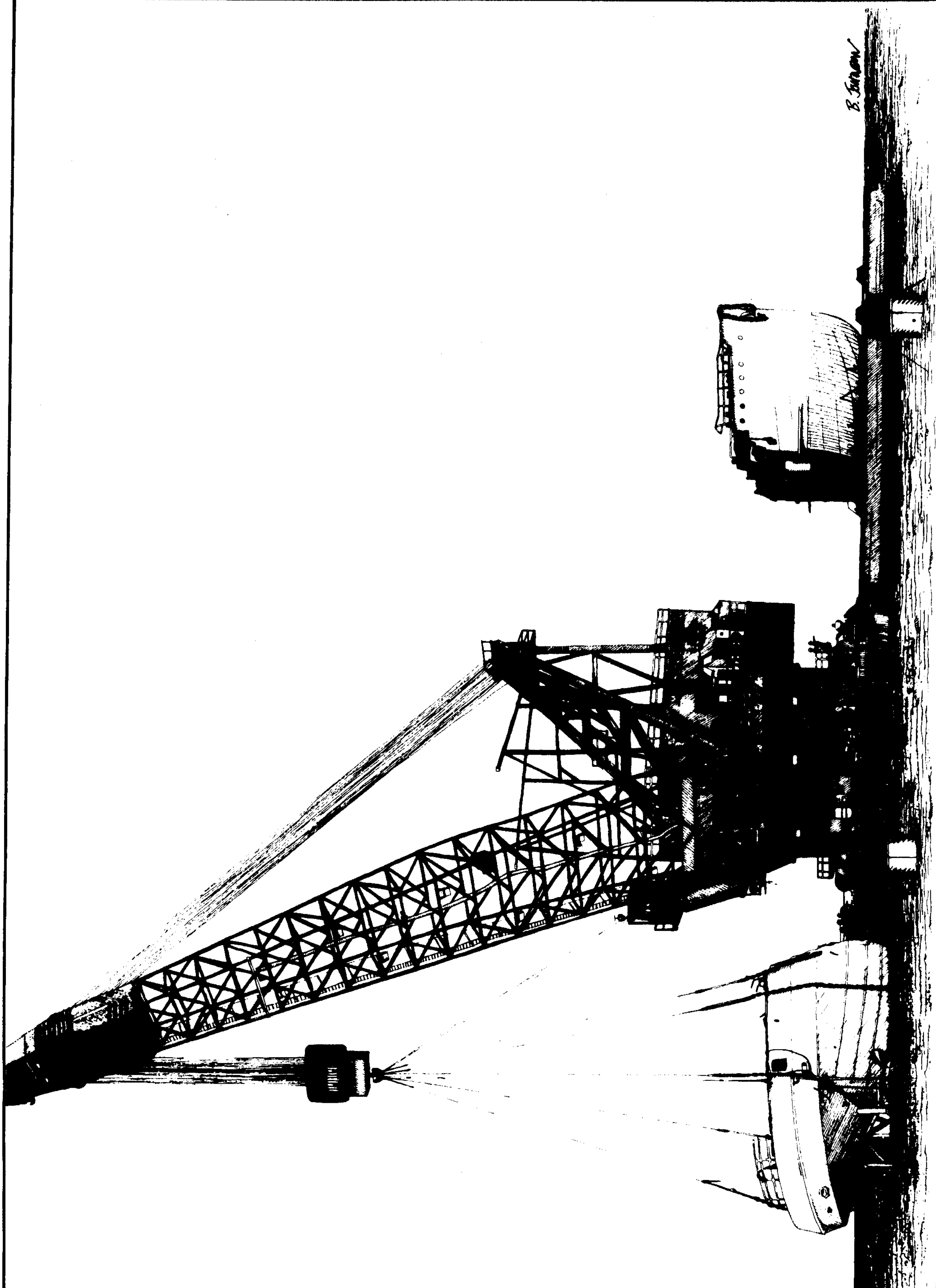
THE LAST SECTION CAME THROUGH THE INTERFACE AT 312 SHORT TONS AT 1311 ON 20 AUGUST 1974. THE TRANSVERSE CUT THROUGH THE BILGE AREAS (ON THE FAR SIDE OF THE PHOTO) BETWEEN THE MACHINERY SPACE AND HOPPER SPACE BULKHEAD WAS NOT COMPLETED IN TIME TO MAKE THE PHASE II SCHEDULE. THIS DID NOT AFFECT THE OVERALL LIFT SCHEDULE SINCE HOOK UP AND REMOVAL ON THE LAST LIFT WAS ACCOMPLISHED IN 170 MINUTES DURING AN EBB TIDE ESTIMATED OVER 3.0 FT./SEC.



LOWER "C", THE LAST LIFT, IS LANDED ON THE SCRAP BARGE ON 20 AUGUST 1974

SCRAP PRICES WERE RECEIVED ON THE PHASE III BID AT $61.66 PER TON FOR AN ESTIMATED 1760 TON LOT FOR SEVEN SECTIONS. THE TOTAL RETURNS FOR SCRAP, INCLUDING CONTAMINATED FUEL, WAS $207,161.95. THIS OFFSET THE TOTAL COST OF THE OPERATION BY TEN PERCENT.

SECTION II ENGINEERING SUMMARY



2.1 Introduction

The first section covered the historical development of the operation; no special attempt was made to deal with technical aspects. This section will address the questions of how technical decisions were made and what factors were taken into consideration for rationale of those decisions.

Probably the most important function of the engineer on such an operation is to make feasibility studies to evaluate alternative courses of action for decisions that involve allocation of men and material. Cost-benefit analyses take the form of estimating size, strength, results and time and safety factors. These engineering studies depend upon some technical data regarding detailed characteristics of the wreck, and the application of proven estimating procedures to the data in order to project an answer within a degree of certainty to the specific area of concern.

The engineer is faced with the historical revelation of his prediction capabilities by the passage of time in demonstrating the results, and in the case of ship salvage, the accuracy of engineering predictions is usually not long in being measured. In this case the engineering picture is presented as it actually developed in order to show the analytical techniques employed to solve the problems this job presented. Several usage factors were derived from MACKENZIE for under water cutting and heavy rigging. It is hoped that they will serve as examples in future needs.

2.2 Geography and Weather of the Site

The Galveston Channel at 29° 20' N and 94° 43' W forms an entry to the Gulf of Mexico from Texas and is a dredged channel maintained to a depth of 43 ft. mean low tide. It runs generally east and west through the corridor formed by the north and south jetty entrances to Bolivar Roads. The channel branches to the NW to the Bolivar Roads Channel, and then northward to serve Texas City and Houston. To the south past Fort Point, it leads to Galveston to serve the port of Galveston and to make up to the inland waterway to the south. There is a continuous flow of heavy traffic through the area, and the channel roughly approximates the natural drainage path of the southern Texas littoral to the north.

During the spring and summer seasons as the solar albedo reaches a maximum, the morning heating of the Gulf to vaporize water and the impingement of the humid marine atmosphere over the flat plains of the night-cooled land make for rain and squall conditions. Typical morning weather activity is the generation of heavy cumulus clouds over the Gulf after sunrise, and the movement of these over the coast from the Gulf. Thunder squalls occur before noon or early afternoon, with clearing in the evening. The cycle is repeated with more or less intensity the next day.

Added to this is the ever present danger of cyclonic or hurricane weather coming out of the Gulf. Galveston has a local history of disastrous storms of this nature; they can be expected anytime after late May through mid-October.

These two factors, the immediate problems generated by the local weather and the general threat of hurricanes, affected both the short run tactics of the local salvage effort and the strategy considerations of the actions taken.

The immediate effect of the weather was felt in the drainage of the area and the generation of ebb tides up to 5.0 ft./sec., and in one or two instances, even faster across the wreck site. The wind and chop also had negative effects in maintaining the mooring array at the site.

The long range effects of the weather were considered from the potential aspects of how a hurricane might disrupt the salvage operations. In this case about five to seven days of advance warning was expected by studying tropical storms in the Southern Gulf, and the "cut in place and remove" method chosen allowed for a 24 hour advance notice in order to clear the site. The work barge, oil boom and even the big lift barges would be slipped out of the moors and underway within four to six hours. Fortunately this decision did not have to be made, but concern for mobility was a part of the salvage plan. One tropical storm off the Yucatan Peninsula and two hurricanes along the Venezuela coast were plotted and observed during the operation.

2.3 Analysis of the Salvage Options

2.3.1 Rationale

The initial survey of the wreck and the recommendations for salvage action, corresponding to a command "Estimate of the Situation", are given in the Appendix. The rationale for the decision to "cut in place and remove" has been covered in Section 1; however the results of calculations which lead to this decision are presented here along with the summary data.

After analysis of the options enumerated in the early surveys there were essentially two that were pursued further in engineering feasibility studies. These were essentially alternatives:

- Foam Buoyancy/Cut in Place Combined
- Cut in Place

2.3.2 Alternative: Foam Buoyancy/Cut in Place Combined

From the standpoint of defining the magnitudes and uncertainties of the factors involved in comparing the two courses of action, primary reliance was placed on the weight summaries, strength calculations and design information provided by the Philadelphia District of the Corps of Engineers. An analysis was made of the longitudinal volumetric distribution of the hulk below the boat deck for foam insertions, and the results of the 10 May 1974 estimates are given below on the basis of the total hulk:

Space			Buoyancy	
Between Main and Boat Decks			1,600	L/T
Between Lower and Main Decks			2,900	L/T
Available Volume		Total	4,500	L/T
Required Weight Lift	about		2,600	L/T
Available Weight Lift	about		4,500	L/T
Contingency Percent	about		40	%

Taking the Philadelphia weight data, the total weight from the after perpendicular to Fr. 48, the break at the hopper spaces, was apportioned as follows:

Deck Machinery	8	L/T
Deck Wood & Outfit	73	
Steering Gear	12	
After Engine Room	485	
Main Hull Steel	417	
Total Dead Weight to Fr. 48	995	L/T
Feasible Weight Removals	197	
	828	L/T to lift clear
Estimated Weight in Water	720	L/T to lift to surface

Similarly over the Hopper Spores from Fr. 48 to Fr. 78

Main Hull Steel	300	L/T
Hopper Steel	330	
Wood and Outfit	75	
Total Dead Weight Frs. 48-78	705	L/T to lift clear

Again from Fr. 78 to the Bow (assuming some weight removals of top hamper, anchor windlass and Deck machinery)

	1,050	L/T to lift clear
Estimated Weight in Water	914	L/T to bring to surface

(This assumed no dredge spoils, silt or liquid weights as additional lift loads.)

These estimates were then refined from the buoyancy lift standpoint by applying permeability factors to the various spaces that were available to fill. Thus the density of the foam, water absorption and permeability were lumped into an assumption of 55 lbs.ft.^{3} foam lift available. Estimated space aft suitable to foam = 25,200 ft^3 Therefore Estimated Buoyant Force about = 618 L/T available versus 720 L/T weight in water to bring to surface.

This presented a problem, since there was not enough easily useable volume to foam and create the required buoyancy lift, even to the surface.

Once again the volume available was estimated for the forward spaces at 52,000 ft.^{3}, providing a buoyancy lift of 1276 L/T, or in this instance, a potential reserve buoyancy of 28%.

From this study, it was thought that by making special efforts to foam some of the more difficult spaces in the stern, thus requiring additional time and labor, plus the certainty of reserve buoyancy capacity of the bow, that the hulk could be sectioned into three parts and the forward and after ends floated out with foam in place techniques. However, the midship section containing the hopper areas would best be suited to cut in place and then use heavy lift removal techniques.

Time and cost estimates to support this effort were prepared accordingly and are given in the Appendix Section. Total time was estimated at 100 days to clear channel, and total cost at $3,136,627 for this method.

2.3.3 Alternative: Cut in Place

The major engineering problem was to carefully define the section weights within designated cut lines. Seven major transverse sections were chosen, and the weights were apportioned on the basis of the Philadelphia District data with adjustments for top hamper removals.

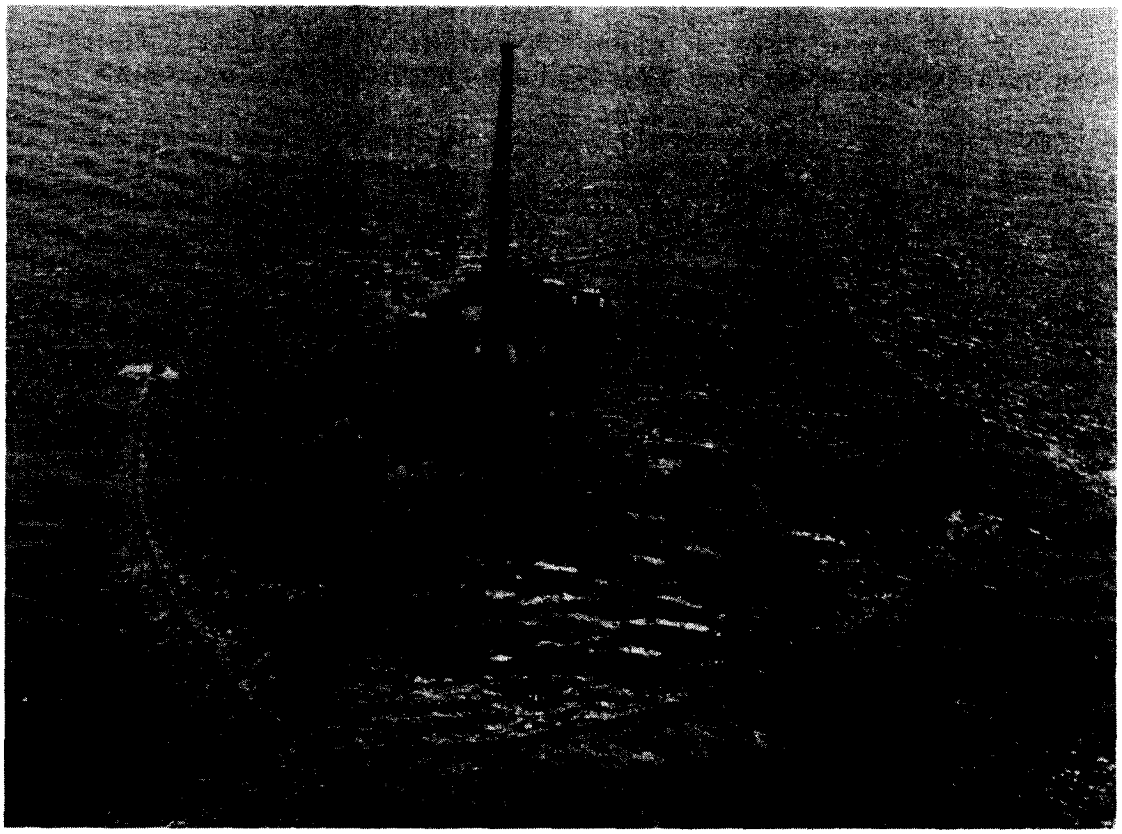
Time and cost estimates to undertake this method are also given in the Appendix Section. The total time was estimated at 130 days to clear channel and total cost at $2,536,139.

The decision was made by the District Engineers to take the somewhat slower but less operational risk and less cost option to "cut in place."

2.4 Oil Removal and Pollution Control Operations

The basic scheme to reduce pollution hazards was to set up a primary oil trap with a floating oil boom and skim off the contaminated surface with the new U.S. Navy oil skimmer craft. Small craft patrolled the area and recovered flotsam by boat haul.

Two classes of engineering problems were encountered in the oil pollution control operations. The first involved the maintenance features of the oil boom elements and their moors. Two varieties of lightweight boom designs were used on the project, and each had a unique set of problems. Maintenance and operation of



AERIAL VIEW OF THE ARRAY LOOKING WEST ON AN EBB TIDE ON 1 JUNE 1974

THE DEFINITE SURFACE WAVE PATTERN DOWNSTREAM INDICATES THE STRONG CURRENT ACTION THAT DELIVERED SILT INTO THE WRECK. IT ALSO ILLUSTRATES THE VARYING HYDRODYNAMIC DRAG LOADING OF THE OIL POLLUTION BOOM. CHAINS CONNECTING ELEMENTS IN THE BOOM ARRAY WERE STRETCHED AS MUCH AS 4% BY THIS TYPE OF LOAD.

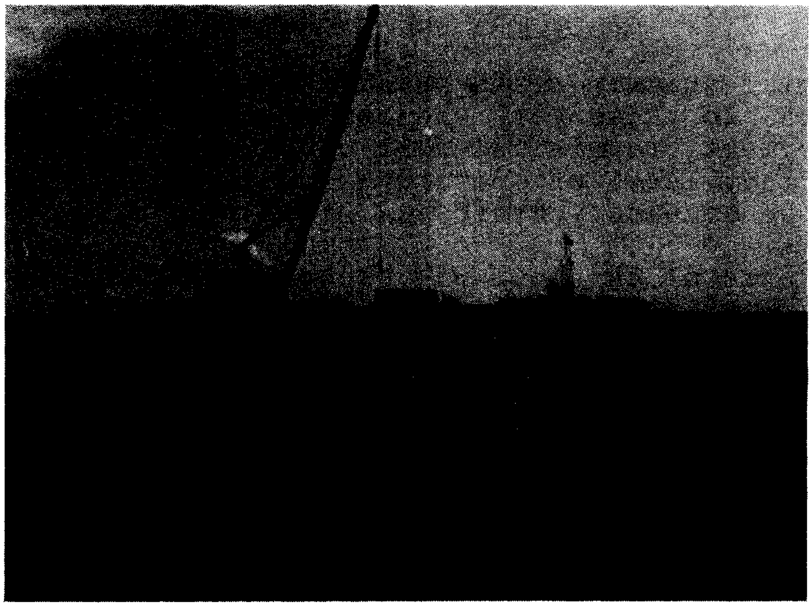
the special skimmer craft posed a second problem. Incidental to these were the logistic support problems of deployment, repair and roll up to maintain a satisfactory level of operational readiness for field use of the necessary craft and gear.

The presence of the boom was especially important during the preliminary work phases on the wreck prior to the start of cutting operations in preparation for Phase I. An aerial photo of the site shows the general nature of the deployed booms. Actually two "V" boom elements were moored separately; one to catch oil and debris on the ebb current and the other on the flood. These were layed out in the case of the ebb as a "V" element with the apex towards the east pointed downstream. The flood current boom had the apex positioned towards the west pointed upstream.

Entryways were provided on the north and south flanks of LIMA 400 as access routes to allow replenishment and offloading services to the LIMA 400 by attending craft.

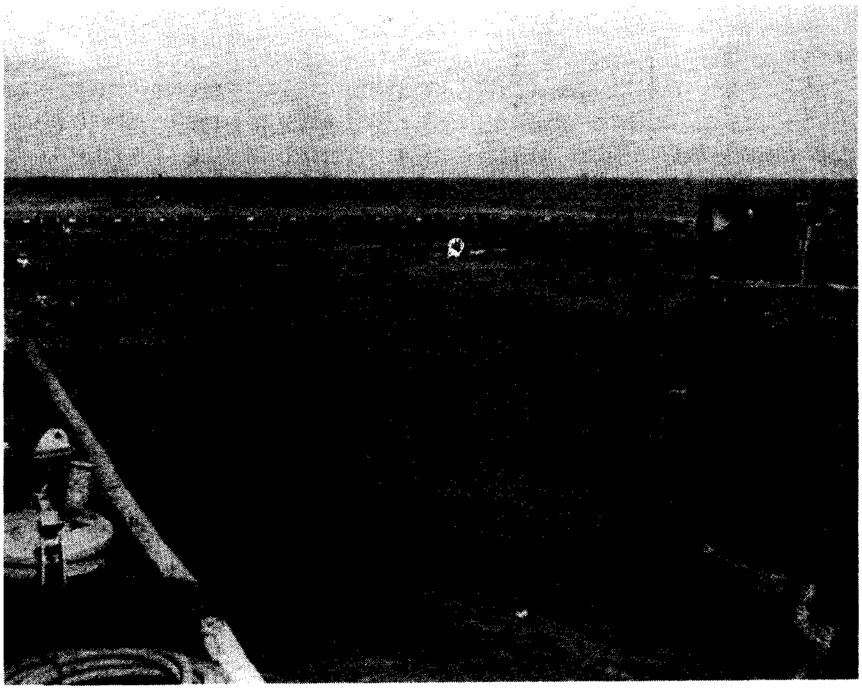
2.4.1 The Boom

The initial deployment of the boom started 14 May 1974 and was essentially unchanged, except for boom element replacements, until 24 June when the western section was moved for the entry of the heavy lift barge. This approximate 5 1/2 week interval placed about 800 continuous operating hours on certain elements of the gear, and several faults were revealed. The CLEAN WATER rubberized fabric inflatable sausages carried a 5/16 inch welded link longitudinal connector chain through a series of web tabs that in turn were vulcanized to the side walls of the sausages. During the long periods of mooring and consequent flow drag loading, the chains stretched, kinked and tore out many of the web connector tabs. By 20 June over 30 sausage units had been pulled and replaced with less than 500 operating hours. About 2/3 of the sausage elements were damaged to the extent of requiring extensive patching repairs. Estimates of chain stretch over this 500 hour interval were about 2 to 3% of original length; for each 50 ft. shot of chain there was a stretch of 12 to 18 inches.



VIEWING LIMA 400 WORK BARGE AND THE CLEAN WATER OIL BOOM LOOKING FROM NORTH TO SOUTH 20 JUNE 1974

HIGH PRESSURE WASHING THE CLEAN WATER OIL BOOM ON THE FORT POINT PIER ON 26 JULY 1974



EBB TIDE SHOWING HEAVY DOWNSTREAM EDDY EFFECT FROM WRECK ON BOOM

SKIMMER WORKING ON DOWNSTREAM SIDE OF EBB

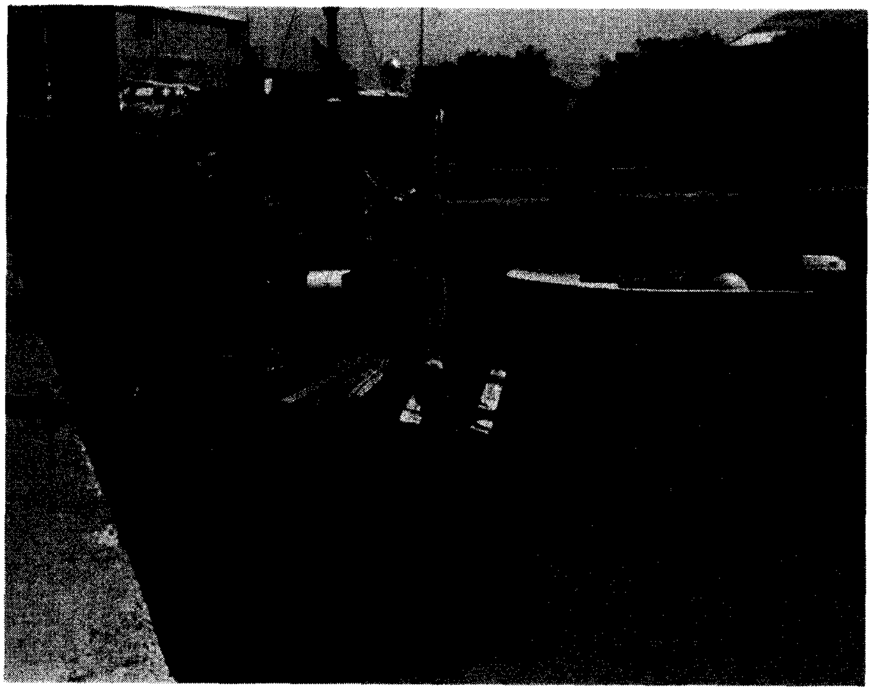
The mooring legs for the boom dragged at every anchor point. As the boom had to traverse varying currents up to a 5.0 ft./sec. peak, there was considerable unsteady current flow and consequent drag forces induced on the tensile elements of the boom array. These produced current drag forces in turn that generated continuous and varying tensile forces that stretched the longitudinal connecting chains supporting the inflatable sausage elements.

The boom was renewed with floats of lightweight plastic and plastic-impregnated fabric skirts in the "V" element on the western leg during Phase II cutting operations. The whole array was removed prior to Phase II lifts. Difficulty was encountered in untangling the new "V" element on the western side caused by a particularly heavy run out after heavy rains during mid-July. As a result, the entire pollution boom array was removed prior to Phase II lifts to affect repairs and was not redeployed for Phase III.

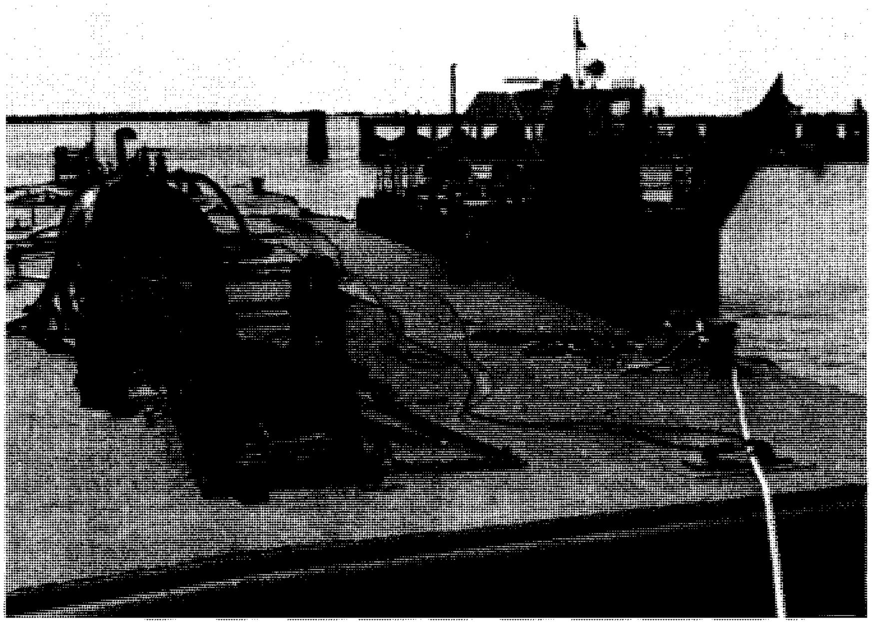
2.4.2 The Skimmer

The maneuverability and speed of the prototype skimmer was barely able to meet maximum local current demands, although the craft responded satisfactorily at lesser current intensities of below 2.5 ft./sec. surface. Offloading of fuel from the wreck over the initial preparation period was accomplished without major spill problems; since fairly light and volatile diesel oil was the major contaminant, no serious incident occurred. The skimmer belt and chain units performed well. Some difficulties with contaminated lube oil from a bearing failure were experienced with the Murry Tregatha drive unit in the later period of the Phase II portions of the operation.

Meanwhile, explosive cutting efforts continued to dislodge wooden decking and debris, which were picked up by small craft patrols after each shot. This phase of the pollution control effort was straightforward and successful.



NECHES II AND PUNT USED IN COLLECTION OF DEBRIS
AFTER SHOT DURING PHASE II PREPARATIONS



SKIMMER ALONGSIDE CORPS OF ENGINEERS FUEL BARGE
BERTHED AT FORT POINT DURING PHASE II
LIFT PREPARATIONS

2.5 Section Weight Strength and Drag Analyses

2.5.1 Base Line Data

The initial estimates of the section weights were provided by the Corps of Engineers, Philadelphia District. Several factors were recognized as uncertain; the extent to which silt trapped in the wreck would add to hook weight and the unknown cumulative weight of sodden dunnage and stores in the berthing and work areas. With all tanks drained through limber holes and all trapped liquids drained prior to lift, it was believed that these weights would be only small factors in the overall hook loads through the interface. Another factor carefully noted during the actual lift was the "break-out" hook weight in order to observe suction effects; they were not observed during any lifts on this operation.

Engineering recommendations on actual lift results have been included in the Appendix Section since they were directed primarily at an analysis of the rigging scheme.

WEIGHT ESTIMATES FOR
PHASE I LIFTS
20 JUNE 1974

Reference: Philadelphia District (Short Tons/Long Tons)

SECTION	FRAME	EST. WEIGHT	ACTUAL HOOK FINAL
A	0 - 20	227/203	319/285
B	20 - 32	272/243	320/286
C	32 - 48	478/427	415/371
D	48 - 62	358/320	485/433
E	62 - 78	371/331	495/442
F	78 - 92	543/485	500/446
G	92 - 104	456/407	385/343
H	104 - Bow	194/173	370/330
		2589 LT	2936 LT

2.5.2 Hook Weight Returns, Phase I

In general, the bow and stern sections were considerably heavier than had been anticipated to the extent that the initial rigging attempt was too light. A review of the lift operations and a survey of the recovered bow and stern sections revealed the following major points:

(1) Silting had been extensive in both sections with as much as 100 to 140 tons of silt trapped in each unit.

(2) Because water and fuel tanks had not been breached in every instance, hook weights on the bow section were extended about 70 tons for liquid weights.

(3) Silt weight was not apparent as immersed and break out weight; it loaded at the rate of about 90 lbs./ft.^{3}.

(4) Break-out weights and immersed weights indicated that suction effects were no problem.

(5) Immersed weights were in reasonable agreement with section weight estimates.

Based on Phase I experience, it was decided that all Phase II lifts would be rigged to 500 tons, the full capacity of the lift craft. In addition, the heavy sections were severed into upper and lower sections estimated to weigh less than 400 tons in order to provide reserve weight margins.

2.5.3 Hook Weight Returns, Phase II

Another estimate was made for the Phase II lifts that essentially adjusted the initial Philadelphia District weight analysis. The adjustments were in weight removals for machinery, fittings and weight additions for estimated silt deposits. Several observations of this phase were made:

- The initial section gross immersed weights were reasonably accurate in total for both B and G sections.

- The upper halves of G and C sections were lighter than the initial estimates; the lower half of G was heavier.

- A better lift prediction for Phase III could be made by analysis of previous lifts based on "upper and lower parent weight" experience to establish the silt weight effects with greater certainty.

WEIGHT ESTIMATES FOR
PHASE II LIFTS
30 JUNE 1974

(Short Ton/Long Ton)

SECTION	EST. WEIGHT	ACTUAL HOOK FINAL
B	249/223	320/286
Upper C	244/218	105/94
Lower C	213/190	310/277 (Phase III)
Upper G	169/151	105/94
Lower G	293/(including ballast)	180/161

2.5.4 Hook Weight Returns, Phase III

A "parent weight" analysis was made from previous lift results to better predict the silt weight effects. This method of analysis provided accurate estimates and demonstrated a learning curve in understanding the task.

WEIGHT SUMMARIES PHASE III
(Short Tons)

SECTION	ORIGINAL PHILADELPHIA DISTRICT ESTIMATES	CORRECTED ESTIMATES 7/25/74	BREAK OUT HOOK WT. 19/20 AUG	SUBMERGED HOOK WT. 19/20 AUG.	ACTUAL HOOK WT. LANDED ON BARGE 19/20 AUG.	SILT ESTIMATES
Upper F	277	115	208	160	188	28
Lower F	321	358	225	240	312	72
Upper E	336	176	90	100	120	20
Lower E	228	388	225	240	375	135
Upper D	274	164	70	80	110	30
Lower D	204	332	320	275	375	100
Lower C	238	258	190	190	310	120

2.5.5 Silt Effects

In this instance, although silt effects were troublesome from a deposition standpoint, bottom suction effects were minor. This may be explained from the observation that current conditions which allowed the deposition of silt were too swift to allow deposition of clay.

It is suspected that the flocculating clay particles that slime a stagnant bottom are scoured out by currents in excess of 1.0 ft./sec. This particular site was suited to the massive delivery of silt into the wreck. The conditions for trapping waterborne silt particles in the complex cellular tangle of dunnage and structure were ideal. Had there been no strong tidal effects to produce a fluid delivery mechanism, this weight source would probably have been lessened considerably.

Silt deposition rates of 1.0 in./week/ft.^{2} were observed on the overall plan form of the main decks and 3 in./week/ft.^{2} in machinery bilges. This led to weight accumulations of 60 to 240 lbs./ft.^{2} in lift dead load. Despite jet washing, silt accumulation on the Phase III sections was significant.

Effects of MACFARLAND's dredging operations during Phase II were noted with a marked increase of turbid water in the wreck area. There is no doubt that the silt deposition rate into the wreck was increased over this 14 day interval.

2.5.6 Current Intensities

Surveys of the current intensities were previously made by the Corps of Engineers in the channel at Buoy 9 at a site within 500 yards of the wreck. However, greater current ebbs were estimated at the surface during diving and lifting operations. The maximum intensity observed was in mid-August after heavy rainfall in the general area when the surface run out was estimated at 6.0 ft./sec.

PEAK VELOCITIES OFF BUOY 9
TAKEN BY THE CORPS OF ENGINEERS
WITHIN 500 YARDS OF THE WRECK

23 - 24 February 1961

DEPTH	FLOOD	EBB
1'	3.47 fps	4.74 fps
9'	4.04	3.94
19'	3.47	2.89
29'	2.78	2.03
35'	2.43	1.53

26 - 28 February 1964

1'	3.00	4.44
9'	2.87	4.35
20'	2.89	4.10
28'	2.77	3.95
37'	2.35	3.38

2 - 3 April 1963

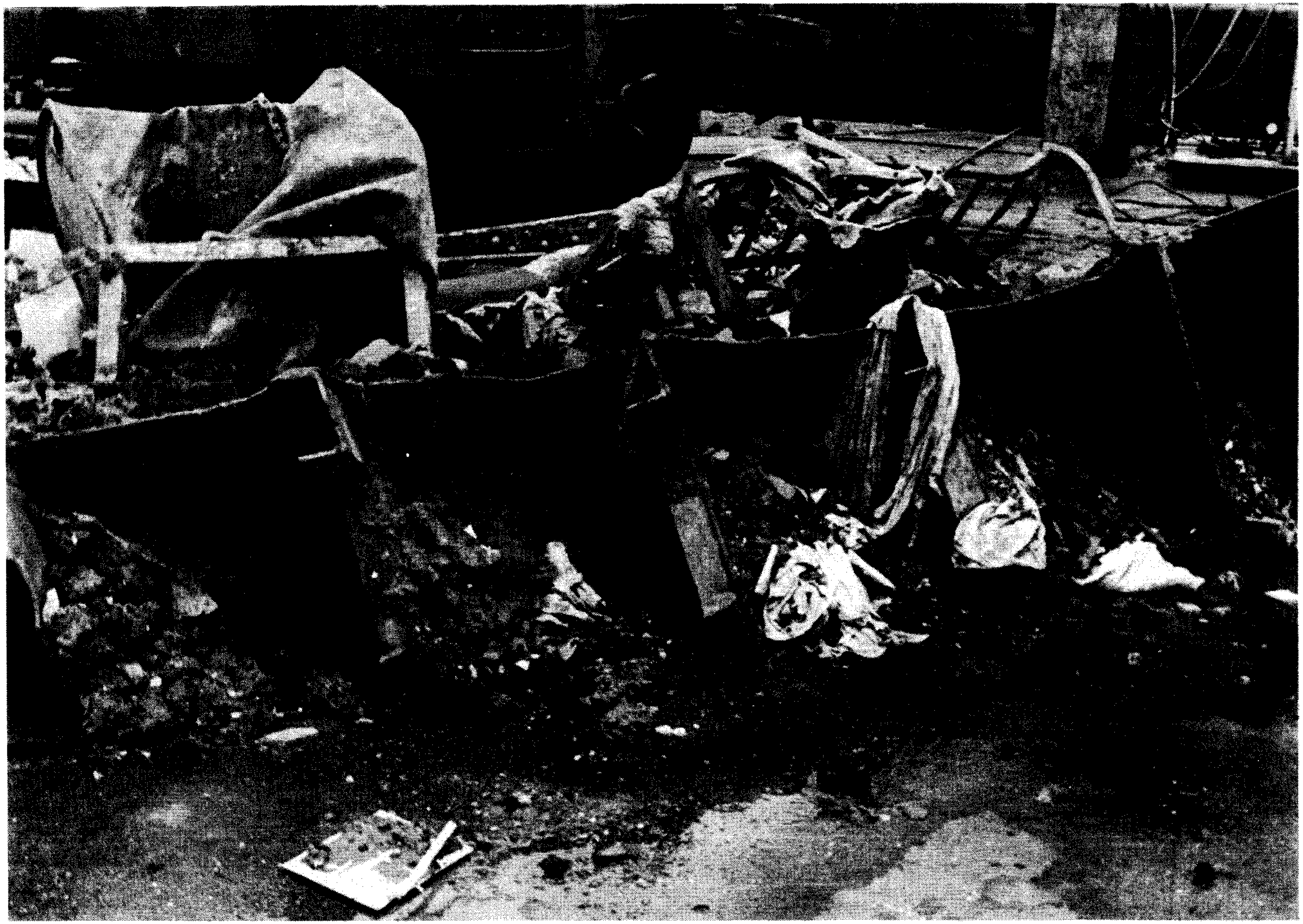
1'	2.24	2.35
10'	1.78	1.84
20'	1.67	1.60
30'	1.50	1.71
40'	1.33	1.78

12 - 13 December 1964

1'	3.04	3.55
16'	3.08	1.90
31'	2.77	2.11
46'	2.11	1.68

4 - 5 May 1965

1'	4.26	4.94
9'	3.95	4.71
15'	3.80	4.10
25'	3.41	3.71
35'	2.89	3.41



SILT TRAPPED IN BOW SECTION UNCOVERED DURING SCRAPPING OPERATIONS

A. MACKENZIE SALVOPS

SILT IN BOW

Figure Number 37

2.5.7 Current Effects

Minor weathervaning effects of the sections in the current during heavy lift operations were observed during lift operations; it was not a serious factor in the execution of the job. Data and sample calculations on this point are given in the Appendix Section.

2.5.8 Failure of Main Hull Girder

The possibility of inadvertent cracking of the main hull girder from scouring action was a concern, especially for the after engine room section. It was decided to wait to cut the main deck and longitudinal members that were above the inner bottom until the last severing operation on the section and to do this with the use of explosives. The supporting calculations for this decision are given in the Appendix Section.

2.5.9 Collision Effect on Hull Girder Strength

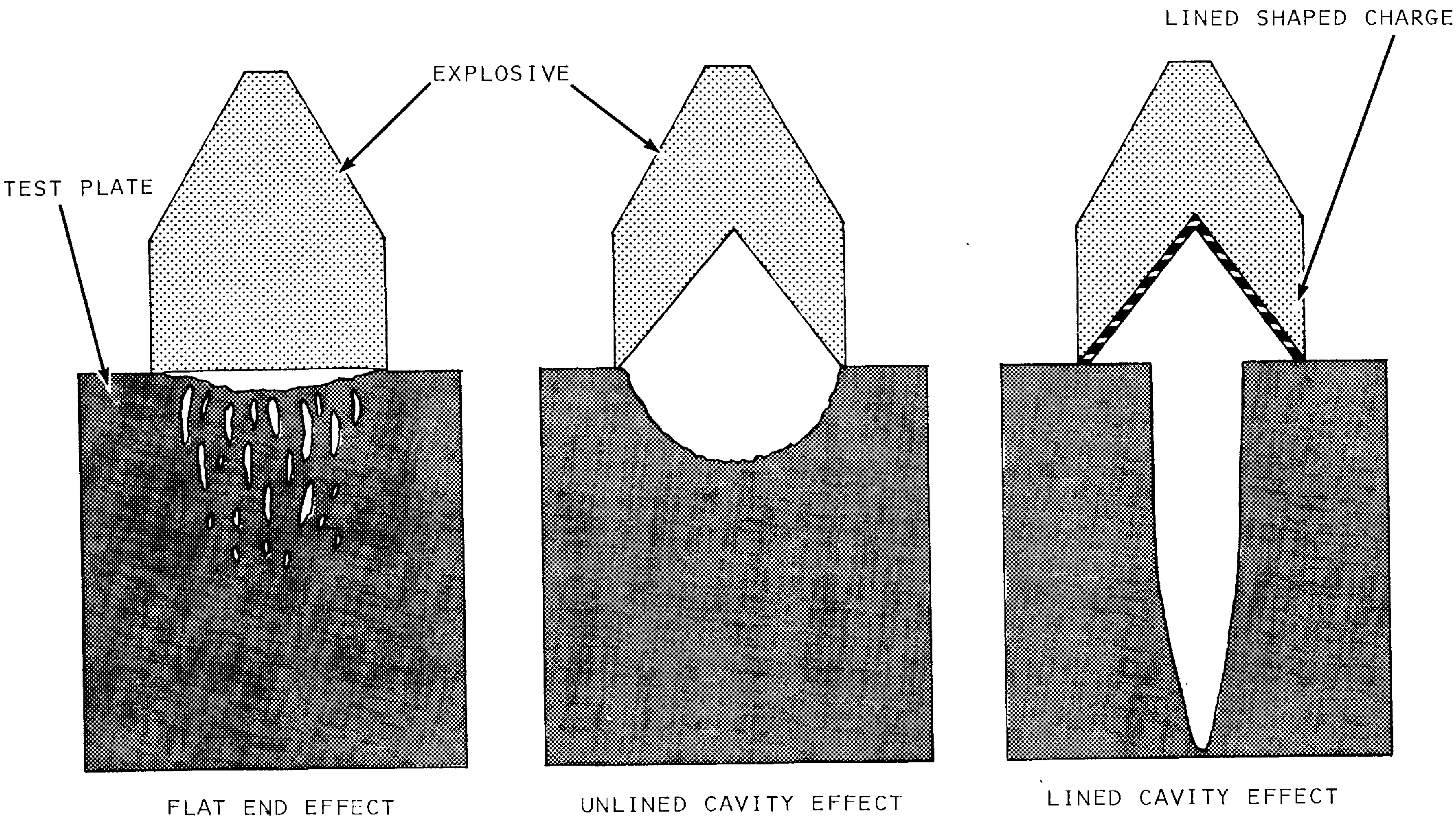
The calculations of the Philadelphia District are included in the Appendix Section to show damage repair required in order to make an overall lift of the wreck. Although this salvage option was not pursued, the results of these calculations had a bearing on the decision to"cut in place."

2.6 Use of Explosive Cutting Charges

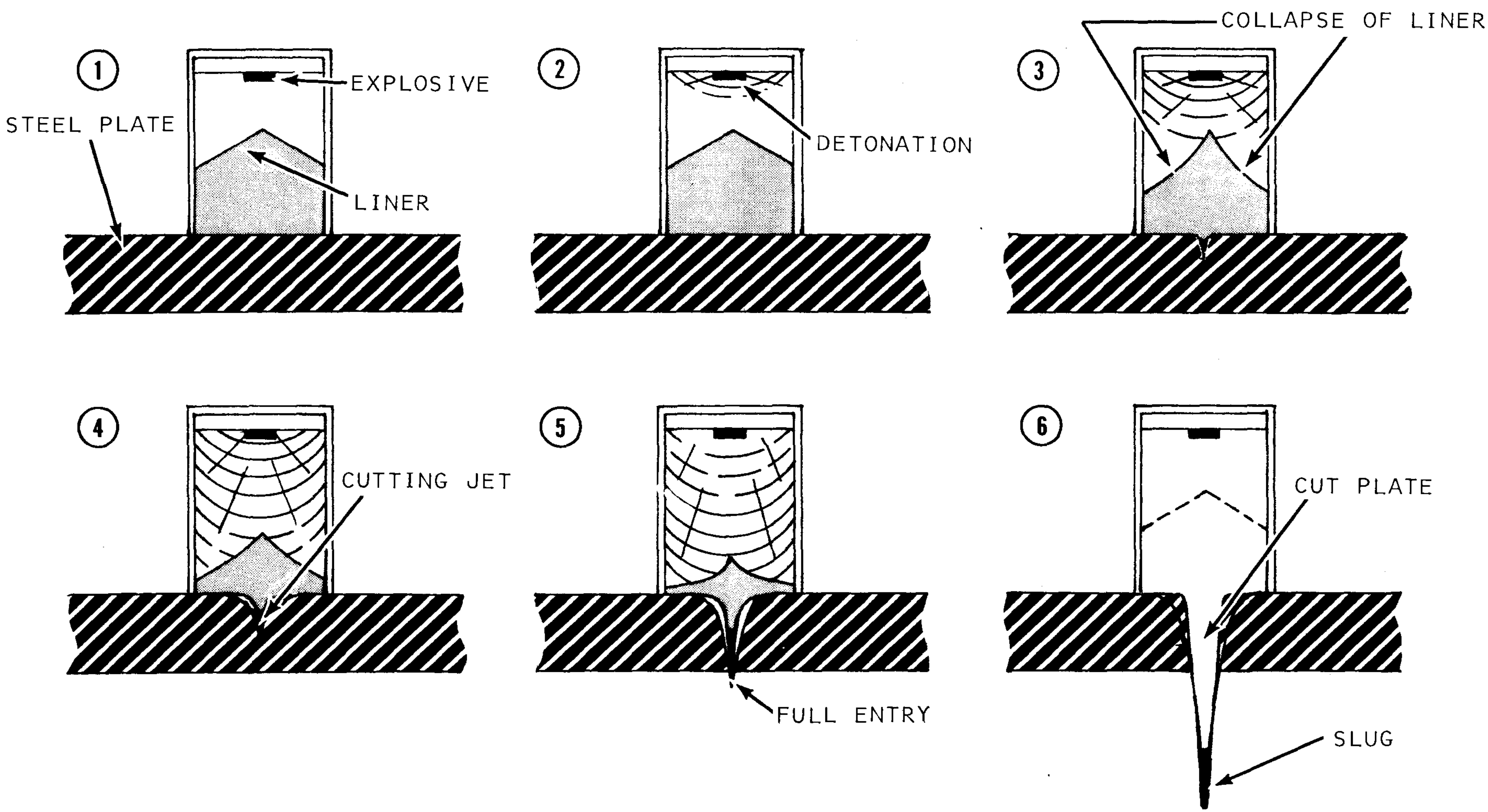
2.6.1 Cutting Plans

After preliminary salvage operations, it was firmly decided on 21 May 1974 to cut and wreck in place. Technical Explosives Inc. was contracted on 27 May to provide explosive services on the cutting operation.

The clearance plan was to cut the hull transversely at seven sections, Frames 20, 32, 48, 62, 78, 94 and 104. The primary cutting devices to be used were shaped charges made up of 26 gauge zinc coated shell steel



COMPARATIVE ANALYSIS OF EXPLOSIVE CUTTING OF STEEL PLATE



EXPLOSIVE SHAPED CHARGE CUTTING SEQUENCE

SHAPED CHARGES

Figure Number 39

containers packed with C-4. Storage of the C-4 involved establishing a magazine site in the Fort Point area, hiring guards to secure the area on a continuous basis, and establishing a local handling procedure in accordance with U.S. Army Corps of Engineers' safety regulations.

A space on the forward port quarter of the LIMA 400 work barge was established for the use of Technical Explosives Inc. Two insulated chests were provided for storage and transfer of explosive material.

The project engineer and explosive technician designed two configurations of shaped charge cross sections, one with 2.2 lbs. of C-4 per foot and the other with 0.8 lbs. per foot. Container lengths of 18" and 48" were fabricated for the cross sections. Use of these charges started on Phase I on 1 June 1974. The first shot employing 10 lbs. of C-4 in a 48" long shaped charge was used on the main deck to cut along a transverse line at Frame 104 1/2. It succeeded in cutting and ripping a hole about 18" wide and 6' long.

The Coast Guard was concerned regarding possible damage to marine life as a result of explosive cutting. Reports were collected for local officials; however, damage to marine life was minimal.

2.6.2 Shot Results

Work continued using the 2.2 lbs./ft. shaped charges; Tables I, II and III show the shot geometries employed and the approximate results.

TABLE I
SHOT GEOMETRIES PHASE I

SHOT DATE	WT AND POSITION	RESULTS
1 June 1974	Main Deck, transverse Fr 104 1/2 10 lbs @ 48" shaped C-4	Tear 18" x 6' Minimum fish kill
2 June	Boat deck fwd. 107 transverse 20 lbs @ 96" shaped C-4	Boat Deck Forward. Cleared away wood, tile & insulation out of blast area. Cut a hole generally 2ft. wide & 10 ft. long
2 June	Side shell fwd about Fr 20 vertical 10 lbs @ 48" shaped C-4	Tear 1' wide about 5.5' long
3 June	20 ft of 2" angle iron packed up with C-4 and 20 lbs @ 96" shaped C-4 on boat deck Fr 107	Deck plating & wood planking 95% removed but did not cut longl. frames. No damage to main hull girder at main deck
3 June	11 charges @ 10 lbs each @ 528 inches. C-4 shaped on boat deck Fr. 47	
5 June	11 charges @ 10 lbs each C-4 shaped on boat deck Fr. 20	Clearing away wood deck & asphalt overlay
5 June	One 3.5 lbs @ 48" C-4 shaped fwd machy space on shell	Cut achieved, 4" wide and 4" long
5 June	One 3.5 lb C-4 shaped and 8' length of 1 1/2" fire hose packed with C-4	Removed wood at boat deck Frame 107 center line
7 June	Two 3.5 lb @ 48" C-4 shaped fwd engine room skin	Cut about 4 ft.

TABLE I (cont'd)
SHOT GEOMETRIES PHASE I

SHOT DATE	WT AND POSITION	RESULTS
7	Two 3' x 3" Angle iron in Stem Section Bilge	Cut a lower longitudinal & blew a hole in bottom shell
8 June	One 4' x 3" Angle iron packed with C-4 One 2' x 3" Angle iron packed with C-4	Sever vertical flooring at Frame 20 1/2 after engine room
16 June	3 shaped C-4 @ 3.5 lbs & 48" each in Section H	Blasted drain holes P/S in fwd skin & thru engine room bkd.
17 June	5 ft 1 1/2"dia hose charge main deck fwd.	Access hole for bolster
18 June	Five C-4 shaped 3.5 lbs. each @ 48" Section A	Breached Stern Section fuel tanks, cut drain holes
19 June	Eleven C-4 shaped 3.5 lbs. each @ 48" continuous row across main deck Frame 104 1/2 @ 48" underneath the main deck	30% effective. The two heavier shaped charges @ 2.2 lbs./ft. were effective. The 0.8 lb/ft. small charges did not cut
20 June	Sixteen 10 lb. each @ 45" C-4 shaped on main deck aft at Frames 104-106 plus G & H strakes one 2ft. x 1 1/2 hose charge tract a longl.	Effective in separating the stern from the wreck
21 June	Four 3.5 lbs. @ 48" shaped charges tanks & holds fwd. Fr. 104 1/2	Blasted drain holes

TABLE I (cont'd)
SHOT GEOMETRIES PHASE I

SHOT DATE	WT AND POSITION	RESULTS
21 June	Four 10 lb. @ 48" shaped charges tanks & holds fwd. Fr. 104 1/2	Enlarged holes cut by the first set of shots
Recap		Shot 666 lbs. of explosives on Phase I

TABLE II
SHOT GEOMETRIES PHASE II

SHOT DATE	WT AND POSITION	RESULTS
11 July 1974	Four 10 lb. C-4 shaped @ 48" each. Main deck B section	Opened drain holes
12 July AM	Five 10 lb. C-4 shaped @ 48" each line B transverse	Achieved complete lower severing B
12 July AM	One hose charge 3 1/2' of 1 1/2" C-4	Opened drain hole
12 July AM	One ring charge 14" diameter	Opened drain hole
12 July PM	Twelve 10 lb. C-4 shaped 2 48" each line G transverse	Achieved complete lower severing G
13 July	Eight 10 lb. C-4 shaped @ 48" each on main deck at Fr. 94	Cut Main Deck
14 July AM	One 10 lb. C-4 shaped @ 48" Bottom of G section portside	Exterior to G bottom shell torn only a few inches wide & 4 ft. long
14 July AM	Four 10 lb. C-4 shaped @ 48" Horizontal C-1	Produced longl. cuts 1 ft. wide & 4 ft. long each
14 July PM	Four 10 lb. C-4 shaped @ 48" Horizontal G-1	Produced longl. cuts 1 ft. wide & 4 ft. long each
17 July	Five 10 lb. C-4 shaped @ 48" on Horizontal G-1 and Horizontal G-2	Completed longl. severing on G section

TABLE II (cont'd)
SHOT GEOMETRIES PHASE II

SHOT DATE	WT AND POSITION	RESULTS
20 July AM	Twelve 10 lb. C-4 shaped @ 48". Main deck & sides on C-1 section plus three 3 1/2 ft. x 1 1/2 inch hose charges to cut longl.	Completed severing section
20 July PM	Two 2 1/2 ft. x 2 1/2" hose charges stanchion in fwd G Section	Sheared stanchion
Recap		Shot 608 lbs. of C-4 explosives on Phase II

TABLE III
SHOT GEOMETRIES PHASE III

SHOT DATE	WT AND POSITION	RESULTS
27 July AM 1974	15 ft. of 400 grain prima cord. Upper Hopper Area D section	Moderately effective on scaling
29 July	20 ft. of 400 triple grain primacord. (Nylon web sleeve ceramic magnet grab) Upper Hopper E section	Charge would not stick on scale covered hopper sides
31 July PM	12 charges 10 lbs. each @ 48" C-4 shaped. 1 charge 3.3 lbs. @ 18" C-4 shaped. 6 3 1/2 ft. x 1 1/2" hose charges	(bad cap) Cut switch box flat and transverse cut through bilges between C & D sections
2 August PM	8 3 1/2 ft. x 1 1/2" hose charges. 1 charge 10 lbs. each @ 48" C-4 shaped. 22 3.3 lbs. @ 18" C-4 shaped	Completed transverse cut through bilge area between F section, pump room & E section Forward Hopper space
3 August PM	9 10 lb. each @ 48" C-4 shaped. 8 3.3 lbs. @ 18" C-4 shaped	Longitudinal cut on after Bhd of forward pump room between E & F sections
12 August (Total 185 lbs. in one shot)	11 10 lbs. @ 48" C-4 shaped. 1 3.3 lbs. @ 18" C-4 shaped	After engine room Bhd for transverse cut
	6 10 lbs. @ 48" C-4	Longitudinal cuts after Hopper section
	2 10 lbs. @ 45" C-4 shaped. 2 3 1/2 ft. 1 1/2" diameter hose charges	Transverse cut Bilge section after Hopper
Recap		Shot 610 lbs. of explosives on Phase III

TABLE IV
EXPLOSIVE CUTTING EFFORT & USAGE DATA

Total no. of shots on operation		37
Total no. of charges placed in wreck		244

1420 lbs.	No. of 10 lb. 48" C-4 shaped	142 =	568 lineal ft. effective
81 lbs.	No. of 3.5 lb. 48" C-4 shaped	23 =	92 lineal ft. (50% effective)
106 lbs.	No. of 3.3 lb. 18" C-4 shaped	32 =	48 lineal ft. effective
162 lbs.	No. of 3½ ft. 1½ in. C-4 hose charges	27 =	95 lineal ft. effective
115 lbs.	No. of C-4 packed & misc. shots	20 =	Drain holes, misc.

Total lineal feet cut = 803

	610 lbs. C-4 used on Phase III
	608 lbs. C-4 Phase II
	666 lbs. C-4 Phase I
Recap Total	1884 C-4 lbs. of high explosives used in all three phases

Although the summaries do not indicate difficulty in placing the explosives, this was a major concern to the Salvage Master in scheduling the cutting operations. Diving activities on the exterior shell of the wreck were continually hampered by strong tidal currents. The wreck interiors were complicated by a welter of debris; once shooting started, the effects of the oscillations of the explosion bubble on the interior was a further complication. This posed a fouling hazard for the divers' life support and cutting lines. Consensus of the divers was that the primary cutting technique should rely on oxy-arc in lieu of explosive cutting methods in order to assure schedules, increase local visability and reduce diving hazards inside the wreck.

Small ceramic magnets were used to support 100 grain/ft. and 400 grain/ft. primacord charges to clean off surface scale in the hopper areas in Phase III. These tentative attempts were not completely successful although the method has potential.

By far the best method of attaching the shaped charges was accomplished by oxy-arc burning small holes through the plate to be cut and using 1/2" Bongee rubber bands fastened off on hooks at each end. The hooks were made out of brazing rod and were poked through the holes to hold the shaped charges onto the plate. This method was developed in Phase III and greatly sped up the placement of the charge arrays.

2.6.3 Discussion of Results

- Cutting Operations

The 2.2 lb./ft. C-4 shaped charges were capable of cutting any of the plates encountered, provided they could be placed properly. The 48" charge lengths restricted the use of these units to cutting deck and shell elements. Prior to use of the Bongee cord lacing, the 48" long charges were almost impossible to rig vertically or externally. On Phases I and II, they were used primarily for main deck cutting and boat deck clearing operations where they could be placed horizontally over the deck to be cut.

The 2.2 lb./ft. C-4 units in the 18" lengths fit between frames and longitudinals and could be placed above the shell plates through the bilge area and along the longitudinals for horizontal cutting between upper and lower sections. These units were effective in the cluttered structural areas.

The 0.8 lb./ft. C-4 units were not successful in cutting the joggled seam and double plate areas of the general 1/2" thick steel courses attacked. Although these charges produced less bubble effects than the 2.2 lb./ft. charges, their use was abandoned because of their lesser assured cutting effect.

The long 2" angle iron charges initially used to make horizontal longitudinal cuts were almost impossible to set up close enough to the structure to cut effectively and were abandoned as a viable cutting method.

Hose charges of 1 1/2" and 2 1/2" fire hose packed with C-4 were successfully used to cut longitudinals, stanchions and pipes. The hose was wrapped around the object and the ends stretched and tied off with line so as to make up the hose tight to the target.

The 14" ring charges were successfully used in cutting out 1/2" thick deck plates. These were essentially 2.2 lb./ft. C-4 shaped charges formed in a doughnut shape.

- Blasting Operations

The 2.2 lb./ft. C-4 charges were successful in blasting off the wooden boat deck.

Single "Blue Boy" conical shaped charges were used to punch drain holes through the main deck, but the after flow effects associated with bubble oscillation tended to plug the holes with debris.

- Scaling Operations

A variety of low key attempts was made with several configurations of primacord and C-4 spherical charges to scale the plates in the hopper areas. In general, the results of these attempts were "too little" on the explosive side and "too late" to have any real effect. However, the use of nylon sleeving with magnetic holders may have potential merit.

2.6.4 Analysis of Explosive Cutting Phenomena

The physical mechanism of the cutting operation involves both the shock wave and bubble phenomena induced by the explosive used to make the cut. If we consider the degradation of the shock wave pressure front on the plate to be cut that is induced by even small amounts of increased standoff, an explanation of some of the results observed can be made.

The shock pressure front at the water/charge interface is approximately 10^5 atmospheres with the shock wave to water forming the step wave boundary. Using AEC data for TNT explosives, it is shown that the high pressures fall off quite rapidly as the shock wave passes into the water. Even at one tenth of a charge diameter away from the charge/water interface, the shock wave peak may have attenuated into the 10^4 atmospheres region. This is a non-linear behavior in the region of the charge while the shock wave is traveling faster than sound in water and persists past three charge diameters. The presence of a water-filled gap between the side wall of the charge and the material to be cut, therefore, produces a much less intense shock wave peak acting upon the plate.

This decidely reduces the high pressure stress/strain situation in the plate that induces cutting. Although ideal plate cutting can be achieved by rather low weight charge distributions per foot of material attacked, this is achieved only when the peak pressure off the charge/plate interface is not degraded by mechanical coupling impedences.

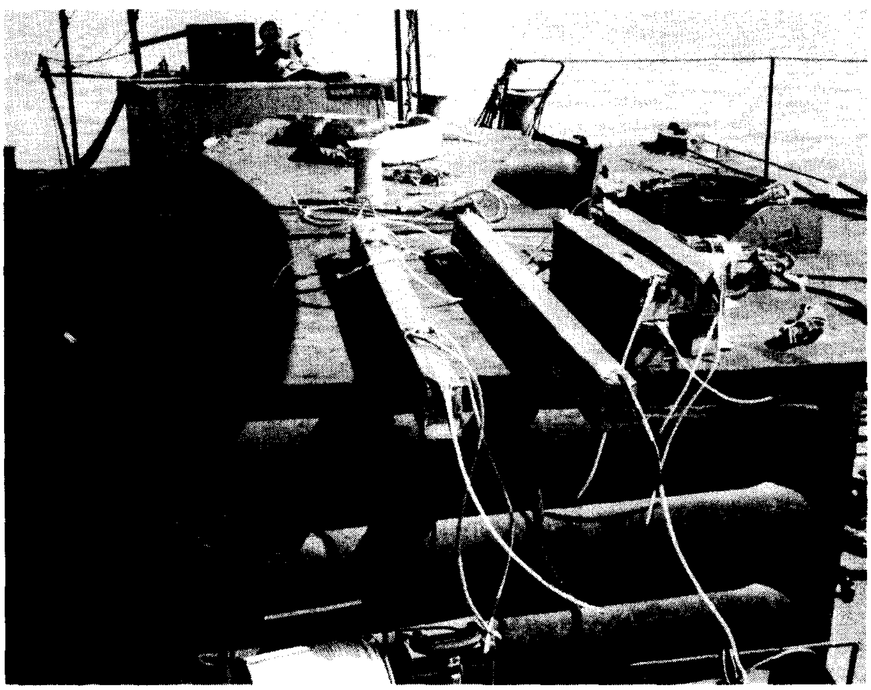
Detonation and peak pressure characteristics of a 20,000 ft./sec. explosive (TNT)

Charge Radii Interface	Peak Pressure Atm
1.02	13.6×10^5
	3.12×10^4
1.08	2.74×10^4
1.52	1.69×10^4
2.17	$.54 \times 10^4$
3.26	$.35 \times 10^4$
4.35	$.19 \times 10^4$
10.89	$.09 \times 10^4$

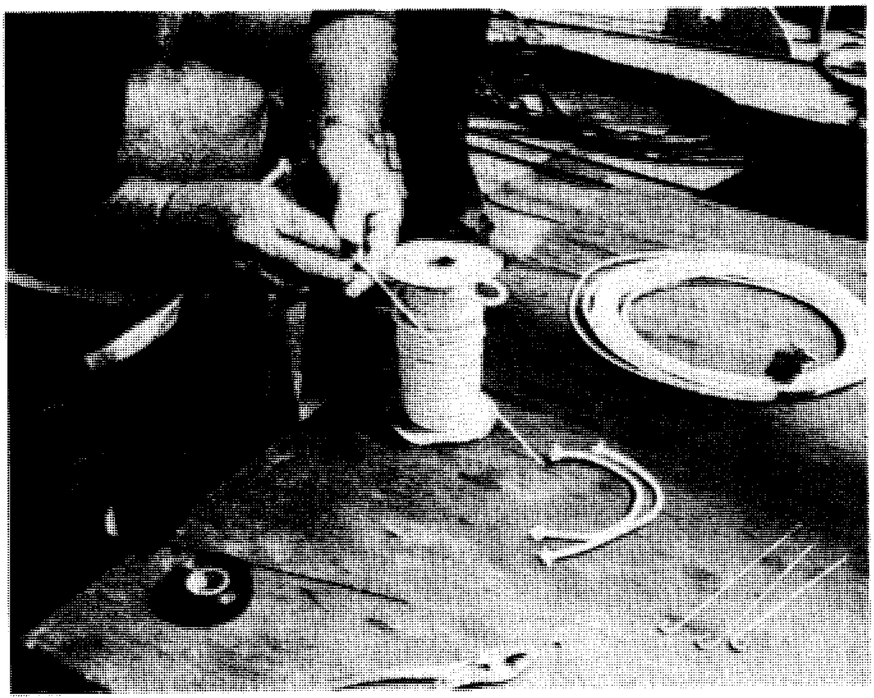
However, as the weight of charge is increased to overwhelm the coupling problem, there are some secondary side effects that occur well after shock wave phenomena have passed. About half the total energy in the explosion is retained in the gas globe after the shock wave passes off. This gas globe will expand and collapse to produce water hammer and overall structural loading effects which can be devastating to overall ship structure. This damage feature can produce unwanted results. In this instance, long lengths of 2.2 lb./ft. C-4 charges required about 100 lbs. of high explosive, and this was enough to cause rather large volumes of gas globe at depths of 30 or 40 feet. The irregular collapse of these sausage voids inside the confines of decks, bulkheads and miscellaneous geometrical fittings throughout the MACKENZIE interior produced large-scale disarray of interior joiner areas.

As a result of difficulties in placing shaped charges externally in strong currents, and the unpredictable effects of using strong, long length cutting charges inside, a compromise for explosive use was followed. Major reliance was placed on precision cutting by the use of oxy-arc equipment. However, final severance and assurance of positive separation was achieved by using linear arrays of 2.2 lb./ft. C-4 shaped charges in 18" and 48" configurations. Good results were achieved in assuring the complete separation of upper and lower sections in a longitudinal sense as well as separation from each other in the transverse planes.

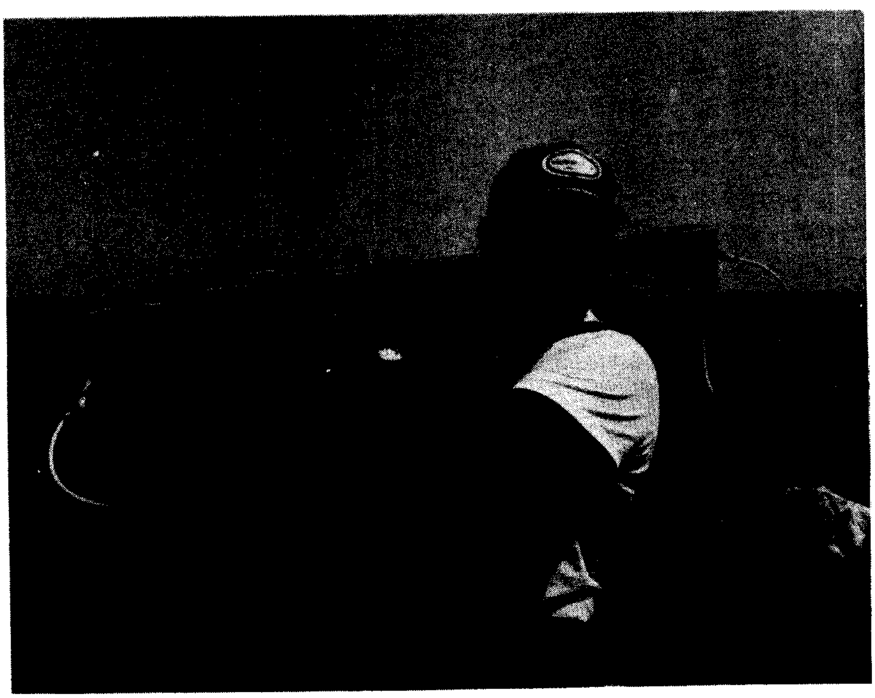
SHOCK WAVE PLUME - 155 LBS. OF C-4 IN DISTRIBUTED CHARGES ON 31 JULY 1974



10 LB. 48" LONG AND 3.3 LB. 18" LONG SHAPED CHARGES PRIOR TO PLACEMENT IN D SECTION 31 JULY 1974



PREPARING BONGEE LACINGS FOR HOLDING SHAPED CHARGES
12 AUGUST 1974



10 LB. 48" LONG C-4 SHAPED CHARGES BEING TAKEN TO
THE FORWARD STACK ON 12 AUGUST 1974

2.7 Use of Oxy-Arc Cutting Procedures

2.7.1 Description of Task

The scope of the lineal cutting task was estimated in the following categories to about an 85% certainty:

Category 1. Major Transverse and Longitudinal Cuts Through Decks and Shell
Estimated @ 1980 ft.

Category 2. Cuts Through Stiffeners, Girders, Floors, Bulkheads, Frames and Foundations in Way of Major Transverse and Longitudinal Cuts
Estimated @ 1340 ft.

Category 3. Removal of Top Hamper, Gear, Rigging and Secondary Structure in Order to Reduce Weight and Improve Local Access
Estimated @ 540 ft.

Total 3860 ft. min.
4439 ft. max.

Assume a 4150 lineal foot severing requirement.

Typical work estimating sheets were prepared for the Salvage Master's review of Phase II of the operations. These sheets were gross estimates of overall work as well as the cutting efforts required for each major lift. A copy of the work sheets for a typical unit, B section, appear in the Appendix Section to illustrate the estimating rationale used. These estimates, a first analysis, were inaccurate as to diver performance predictions. Actually, the divers proved much more proficient in accomplishing the general tasks listed. The method attempted to analyze the following work package:

- Clearance of Top Hamper
- Removal of Interferences in Way of Cut Lines
- Transverse Cuts by Oxy-Arc
- Transverse Cuts by Explosives
- Removal of Machinery Weights
- Drainage & Limber Holes
- Air Lift & Jet Wash
- Rigging for Lifting
- Last Check of Cut Lines
- Diving During the Lift Operations

Based on similar estimates, the decision was made to cut the remaining transverse sections into upper and lower portions. This exploited the heavy lift craft capacity to the full 500 tons on any lift without further rigging preparations other than to shackle on.

2.7.2 Oxy-Arc Techniques

Two 400 amp welding generators were provided, one for each diving team. The Ocean Systems Inc. team, assigned to the forward end of the wreck used the Lincoln generator, obtained on lease. The Buck Steber Inc. team, assigned to the after end of the wreck used the Libby generator provided by the U.S. Navy from Emergency Ship Salvage Pool stocks. Each diving team provided its own heavy DC current knife switches and cable along with the divers' life support umbilicals.

As the Galveston Channel had a high silt content, the divers' work was accomplished in almost zero visibility. The Channel was subjected to ebb currents of 5 ft./sec. maximum. In addition, most of the work was accomplished from inside the wreck where the cutting was done from the inside out. Since knowledge of his work space was acquired by touch, each diver was assigned specific location tasks by his supervisor. Exploratory and observation dives were made by the diver supervisors and the Salvage Master to assure that cuts were being made along the proper lines.

Almost 80% of all the cutting was accomplished by oxy-arc. It is estimated that 7000 lbs. of rod were consumed on the job, with about 6500 lbs. manufactured by Craftsweld Equipment Corporation. The rest came from other manufacturing sources. Usage data would indicate that a general cutting rate of about.53 ft./lb. of rod was accomplished. Allowing 3060 diver shift hours on oxy-arc cutting operations, a cutting rate of about 1.36 feet/dive hour available was achieved on a 12 hour dive shift. On cutting operations, eight divers cut about 131 feet per day of Category 1, 2 and 3 wreckage and used about 257 lbs. of rod. This is approximately correct if a check is made against the daily situation summaries of the Salvage Master on work progress.

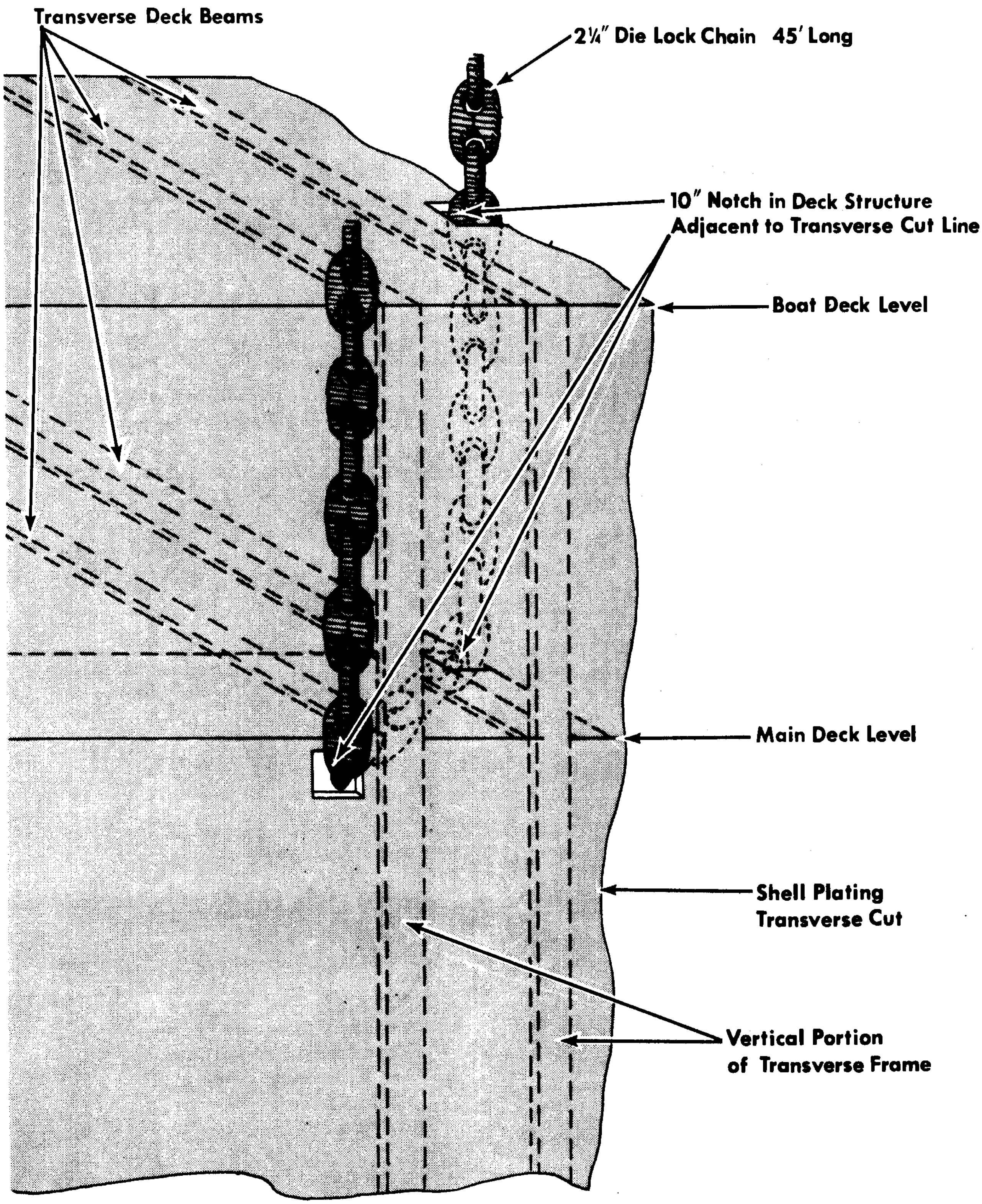
However, oxy-arc cutting, as a primary method for achieving severance of the sections, was not completely satisfactory by itself to do the whole job. The use of explosive cutting for the final separation of the sections proved to be a positive and useful technique to assure complete severance of the sections and rapid removal during the lift operation.

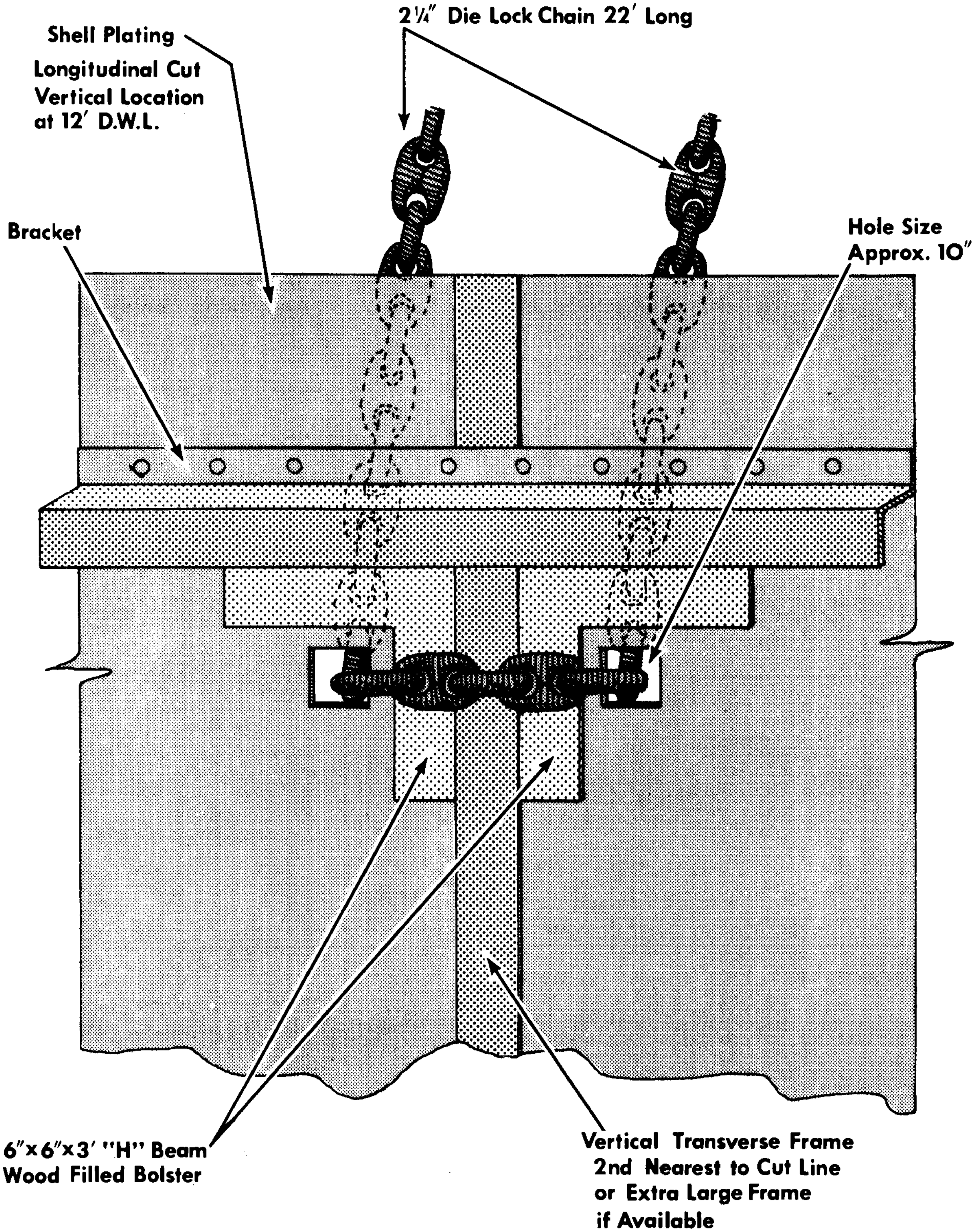
Providing a steady supply of satisfactory cutting electrode proved to be a problem. Murphy Pacific made arrangements with Manpower, Inc. of Galveston to provide a labor crew to wrap both the ARCO arc-aire blue rod and the Craftsweld pink electrode. During the course of the operation about 2000 lbs. of blue rod were coated with three wraps of 3M masking tape and dipped-dried twice in epoxy varnish. Less than 300 lbs. of this rod was actually used. Over 6500 lbs. of Craftsweld pink was single coated with one wrap of 3M electrical tape.

2.8 Rigging and Lifting

2.8.1 Rigging Material

The U.S. Navy Supervisor of Salvage provided the major portion of the rigging material through Emergency Ship Salvage Material Stores. This consisted of 2¼" Die Lock Chain, for the most part with back up shots of 2¼" stud link chain. A useable chain inventory check on 2 July 1974 indicated fifteen full shots were available for lift assignment. A purchase was made from Balt Chain, Chester, Pennsylvania, of sixteen 2¼" pear end links to make up to the lift barge 3" shackles. More of these end links would have been used, but the latter purchase exhausted the available U.S. inventory.


Transverse Deck Beams
2¼″ Die Lock Chain 45′ Long
10″ Notch in Deck Structure Adjacent to Transverse Cut Line
Boat Deck Level
Main Deck Level
Shell Plating Transverse Cut
Vertical Portion of Transverse Frame


2¼″ Die Lock Chain 22′ Long
Shell Plating
Longitudinal Cut
Vertical Location
at 12′ D.W.L.
Bracket
Hole Size
Approx. 10″
6″×6″×3′ "H" Beam
Wood Filled Bolster
Vertical Transverse Frame
2nd Nearest to Cut Line
or Extra Large Frame
if Available

2.8.2 Basic Rigging Scheme

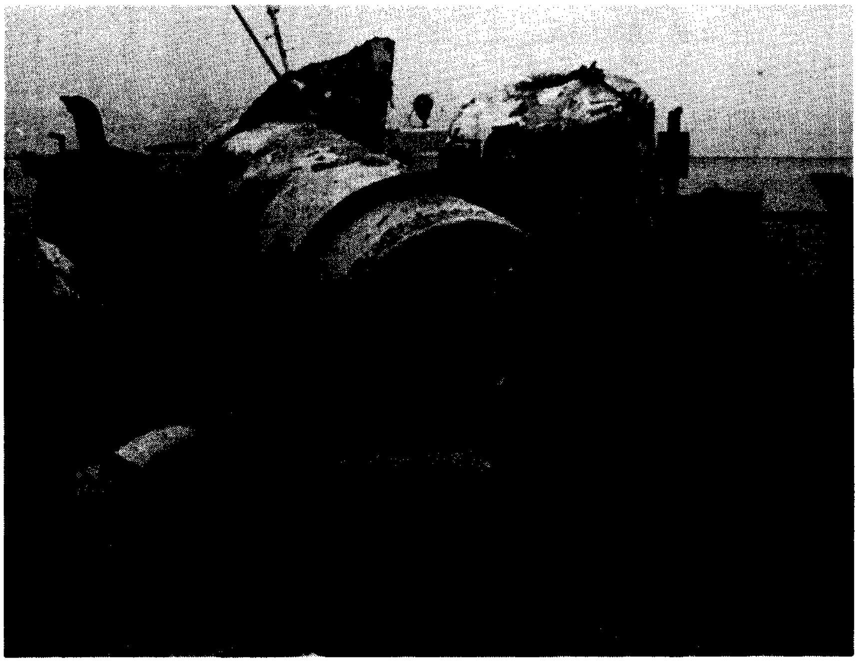
Teledyne MOVIBLE NO.II had a four-way hook on the jumbo block that could be rigged with two 3 inch 6 x 19 wire slings on each hook quadrant, making a lift feasible with eight 3 inch wire pendants. The Teledyne operating personnel would generally accept a load of 50 tons/ 3 inch pendant (400 tons). The attachment of the chain to the big crane pendants was made with 3 inch shackles. Photographs of one of the lifts so rigged is Upper F in Figure Number 54. The chain lengths were threaded by divers with the use of the messenger wires, then vertically strung by the 50 ton crane. The messengers were led through and connected to a crane whip pulling load from LIMA 400. The ends were tied off by light manilla at the boat deck level so they could be retrieved by divers during the lift connections to the 3" pendants from the big crane. Once the 2¼" chain ends had been shackled to the 3 inch pendants, the first pull rendered the chain through the lacing to even out the ends on each pendant leg.

The rigging scheme was modified over Phases II and III. If properly prepared, a 500 ton lift can be accomplished in current conditions up to 2.0 ft./sec. in less than 90 min., and a similar load up to 4.0 ft./sec. in less than 180 min.

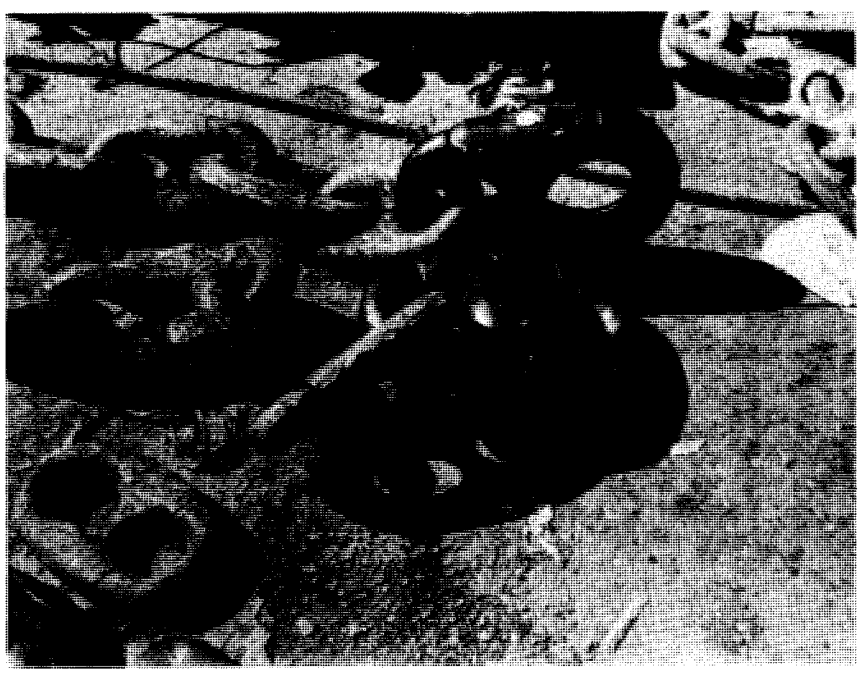
2.8.3 Big Crane Characteristics

- Lift Capacity

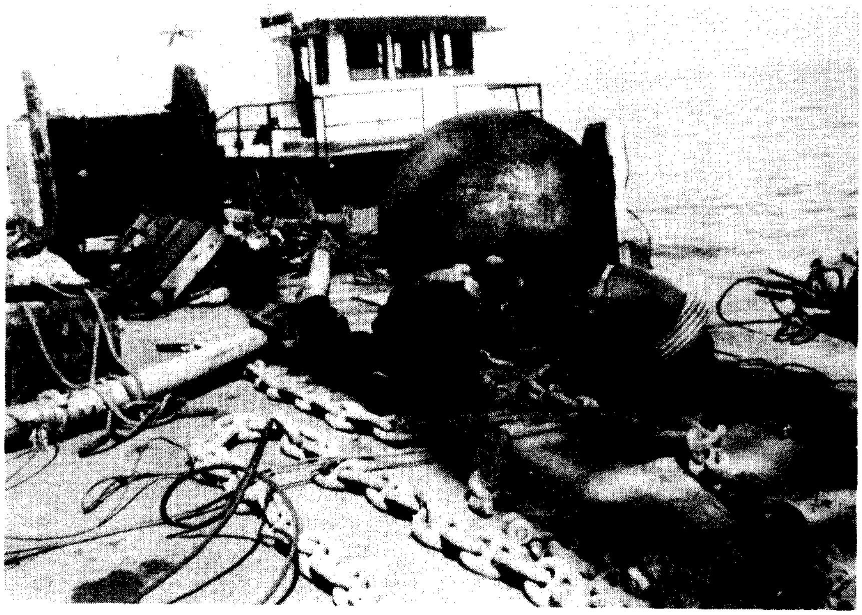
There were three potential crane contractors in the area that could provide a 500 ton lift capability: Brown & Roote, Teledyne and McDermott. Offshore derrick construction barges are classified for unrestricted ocean service and in general are about 350 ft. in length, 100 ft. in beam, with an operating draft of 14 feet and a gross tonnage in the order of 5,500 tons.



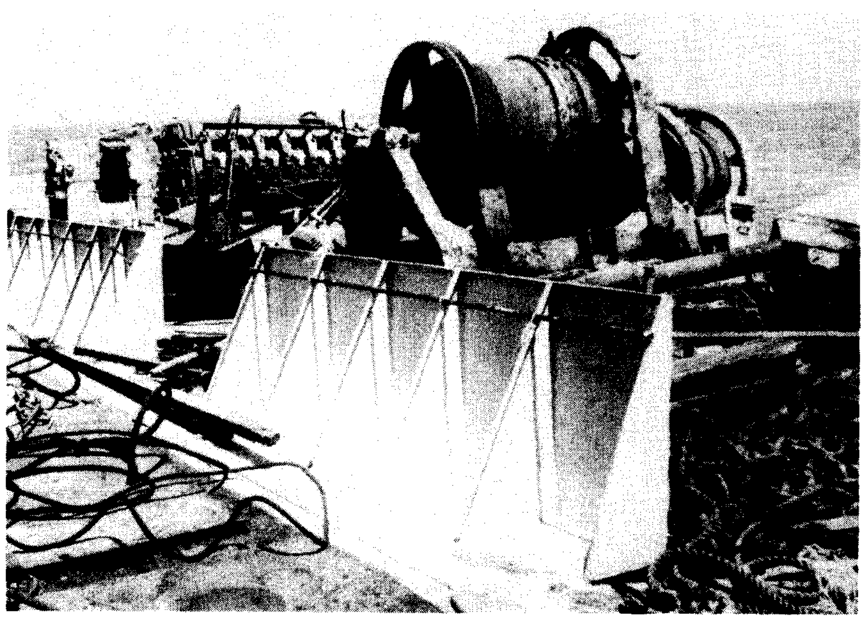
PHASE II TANKS OUT OF THE MACHINERY SPACES



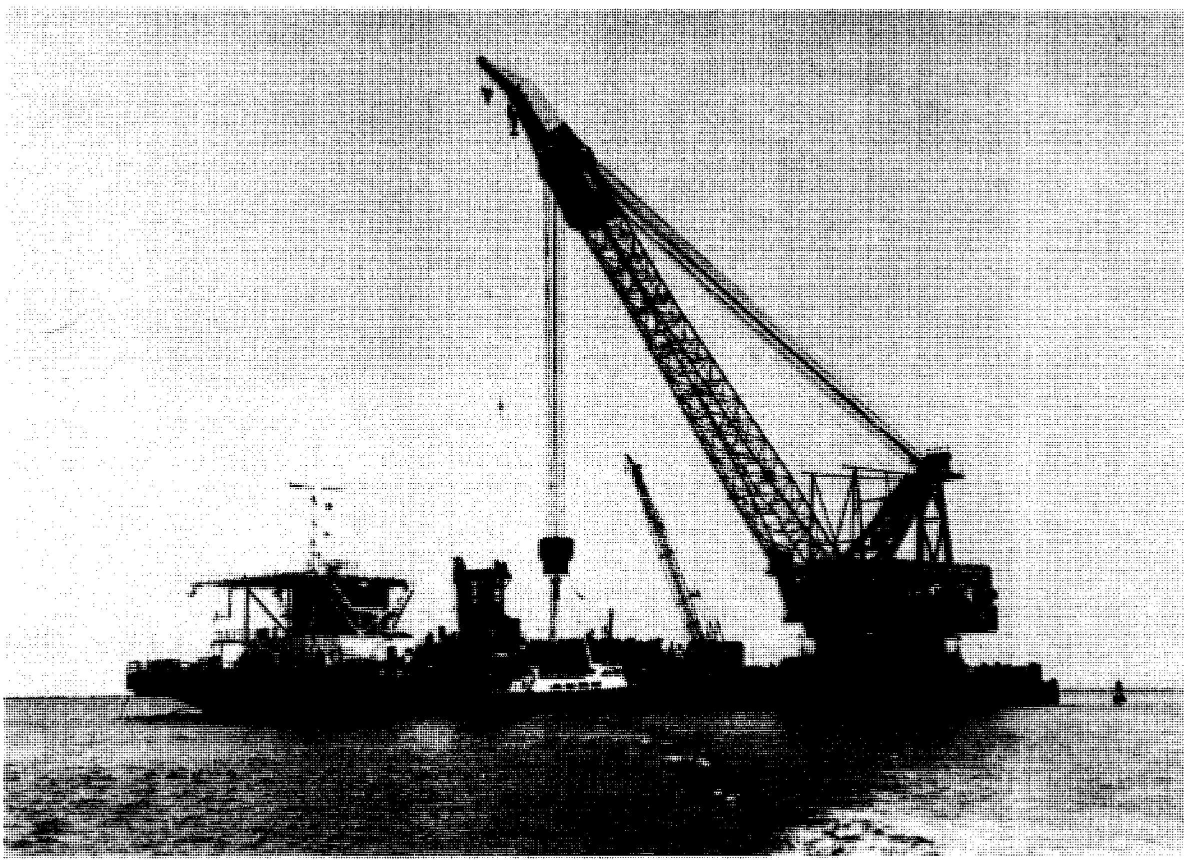
BALT 2¼" PEAR END LINKS



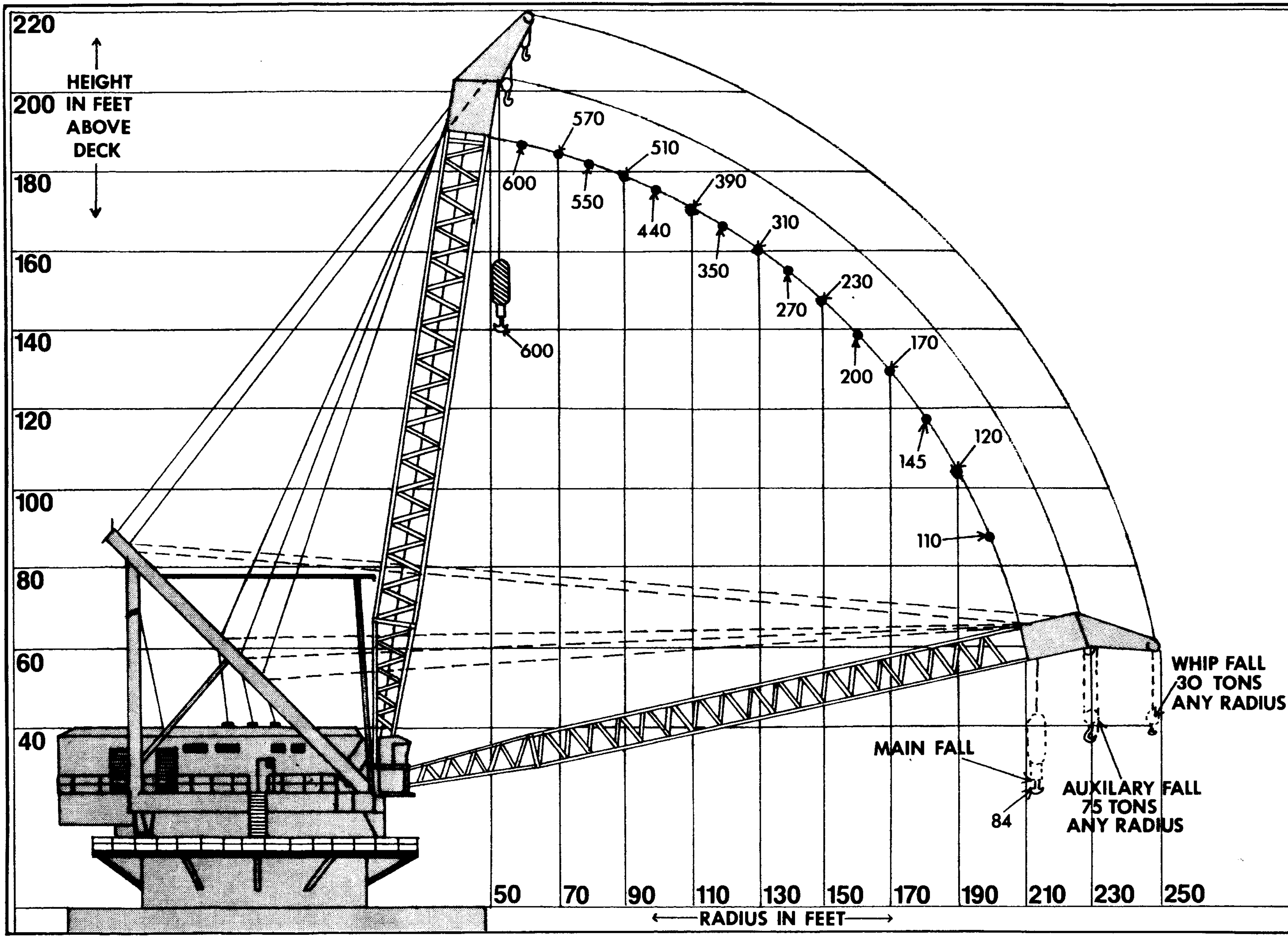
WORK BY THE LIMA 400 CREW CONNECTING A 1 5/8" DIELOCK CHAIN LEG TO THE SPHERICAL SPRING BORING FOR THE HEAVY LIFT BARGE HOOKUP IN PREPARATION FOR PHASE III ON 9 AUGUST 1974



MACHINERY REMOVALS FROM G SECTION REMOVED BY LIFTS FROM LIMA 400 ON 1 JULY 1974 BEING LOADED ON THE AIR FORCE WORK BARGE FOR TRANSFER TO FORT POINT.



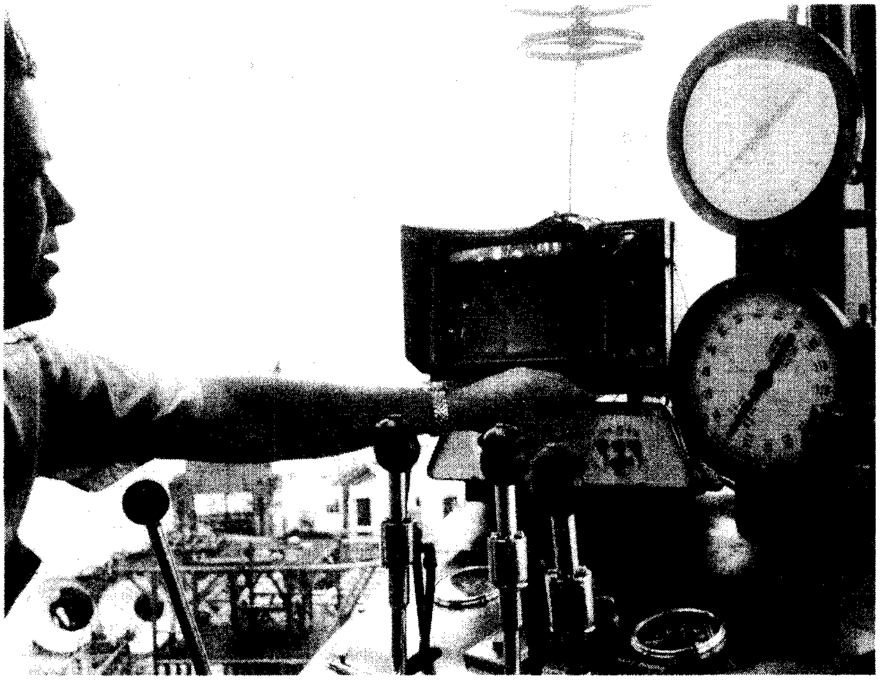
TELEDYNE MOVIBLE NO.II BEING POSITIONED IN THE MOOR FOR PHASE I LIFTS DURING THE MORNING OF 24 JUNE 1974



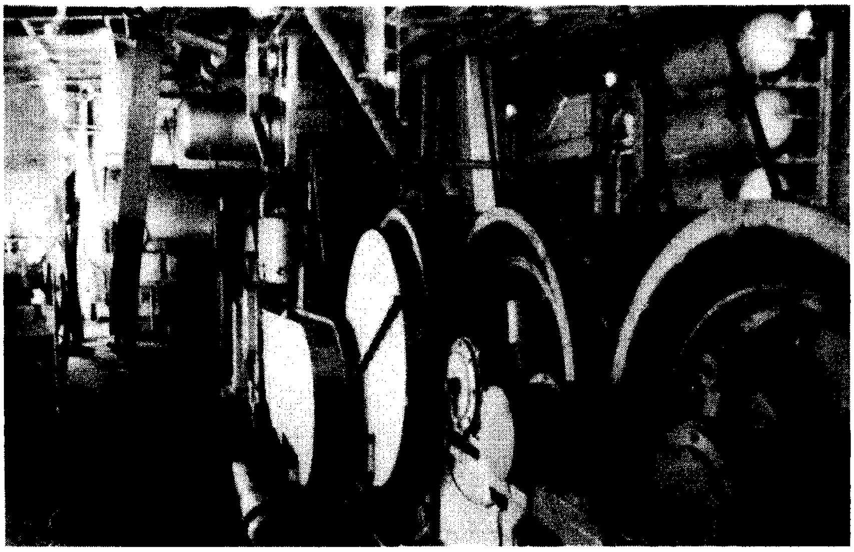
A. MACKENZIE SALVOPS

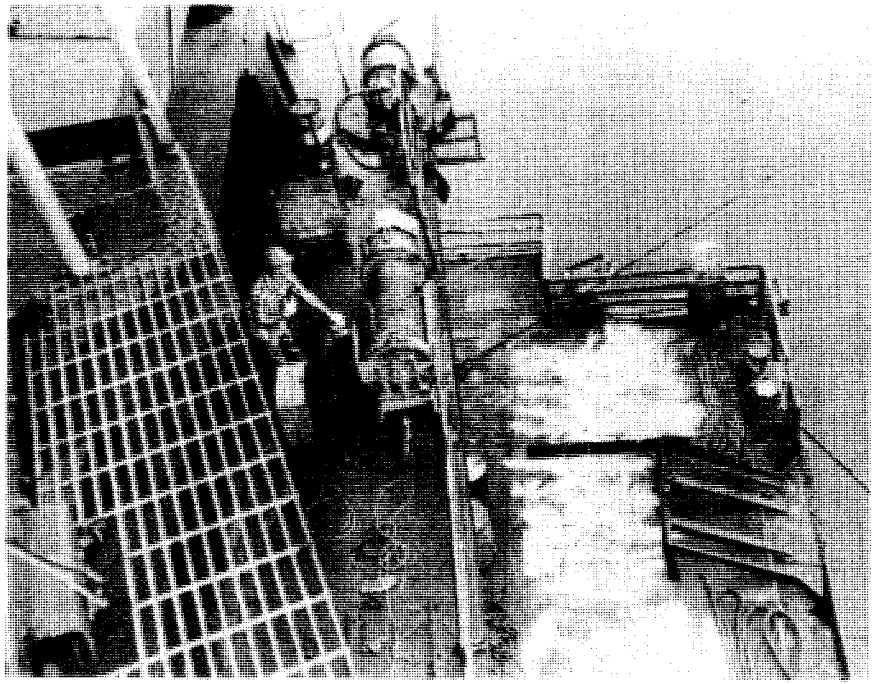
LIFT RADIUS

Figure Number 47

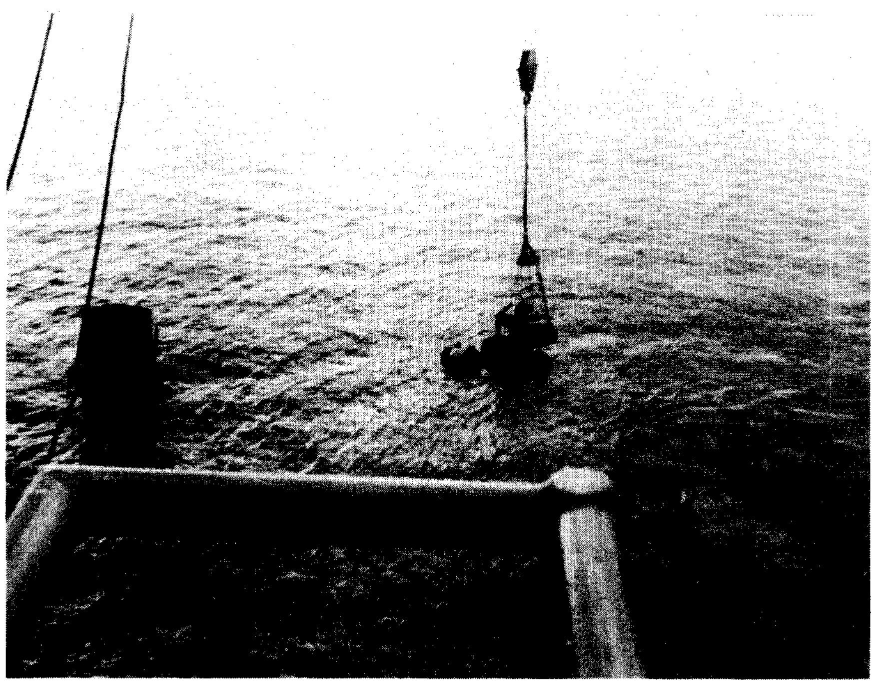


WHIP AND 150 TON BLOCK LOAD DIALS ON TELEDYNE MOVIBLE NO.II. DEWEY HOLMES, CRANE OPERATOR, IS ADJUSTING TV MONITOR TO VIEW THE HOISTING MACHINERY SPACE SHOWN BELOW.

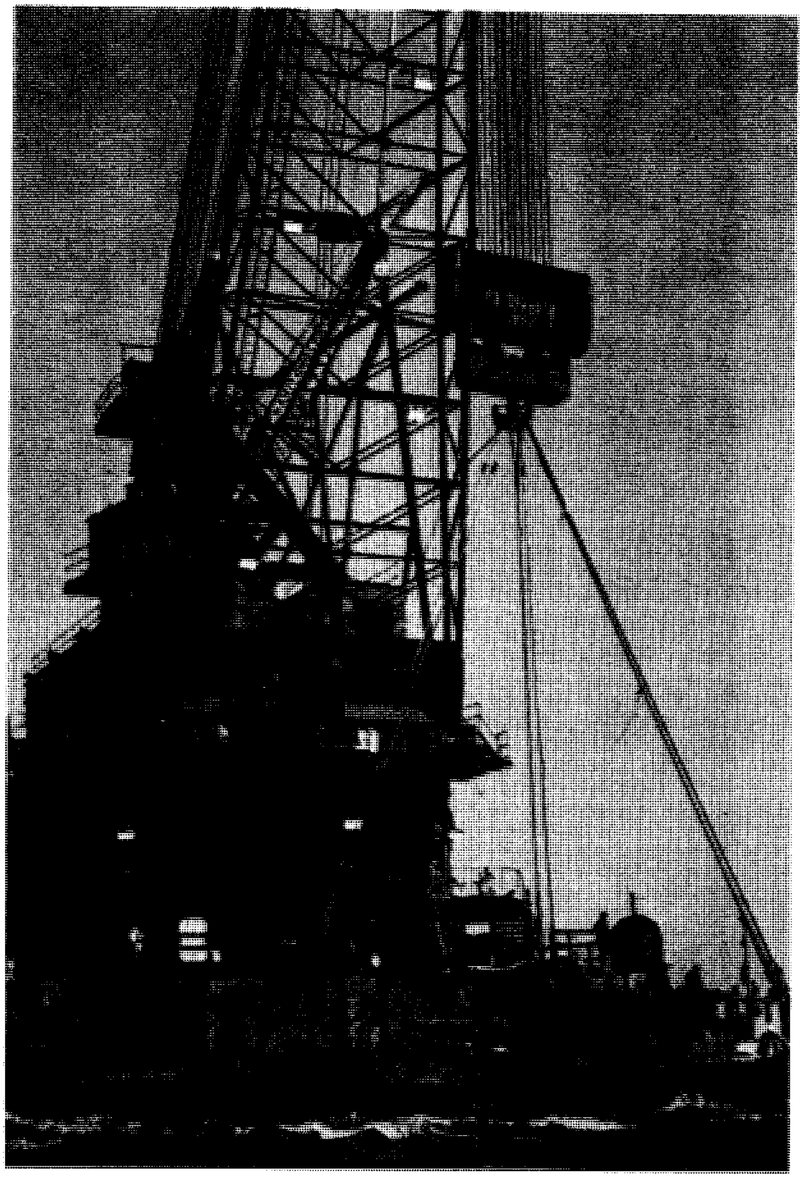




TELEDYNE OFFSHORE MOVIBLE NO.II - COMPRESSED AIR DRIVEN TUGGER WINCH FOR FINE CONTROL OF IN HAUL ON PERSONNEL BASKET.

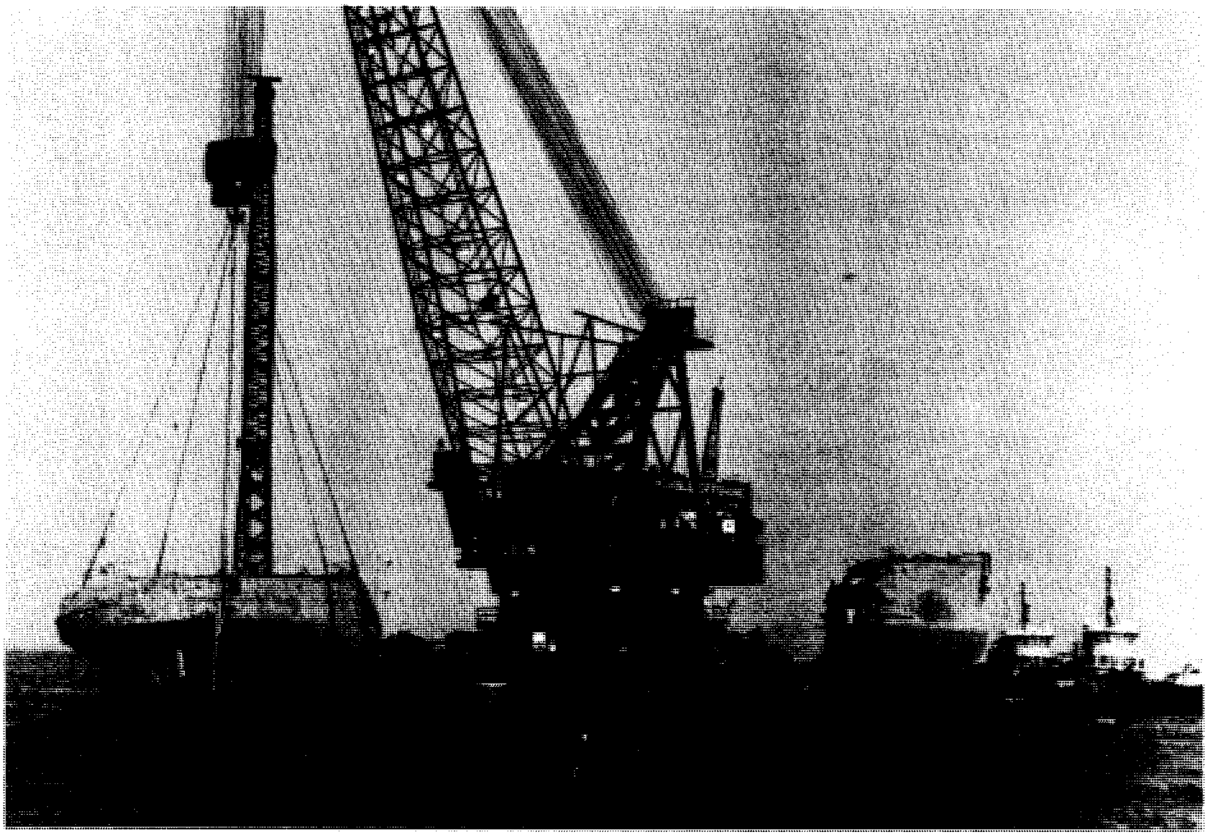


FASTENING MOORINGLINES FROM TELEDYNE OFFSHORE MOVIBLE NO.II TO THE SPRING BUOYS ON THE WRECK DURING PHASE III LIFT.

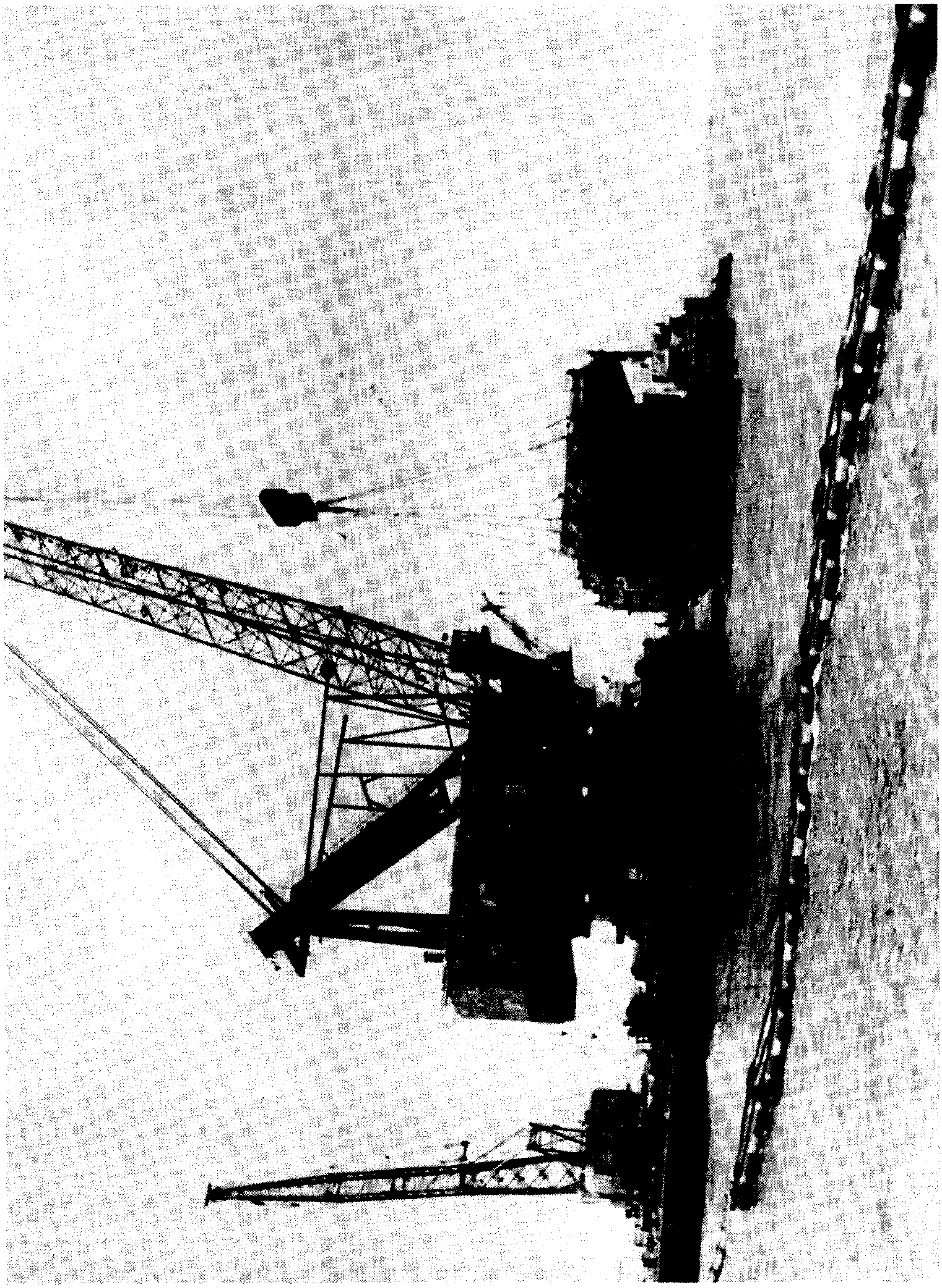


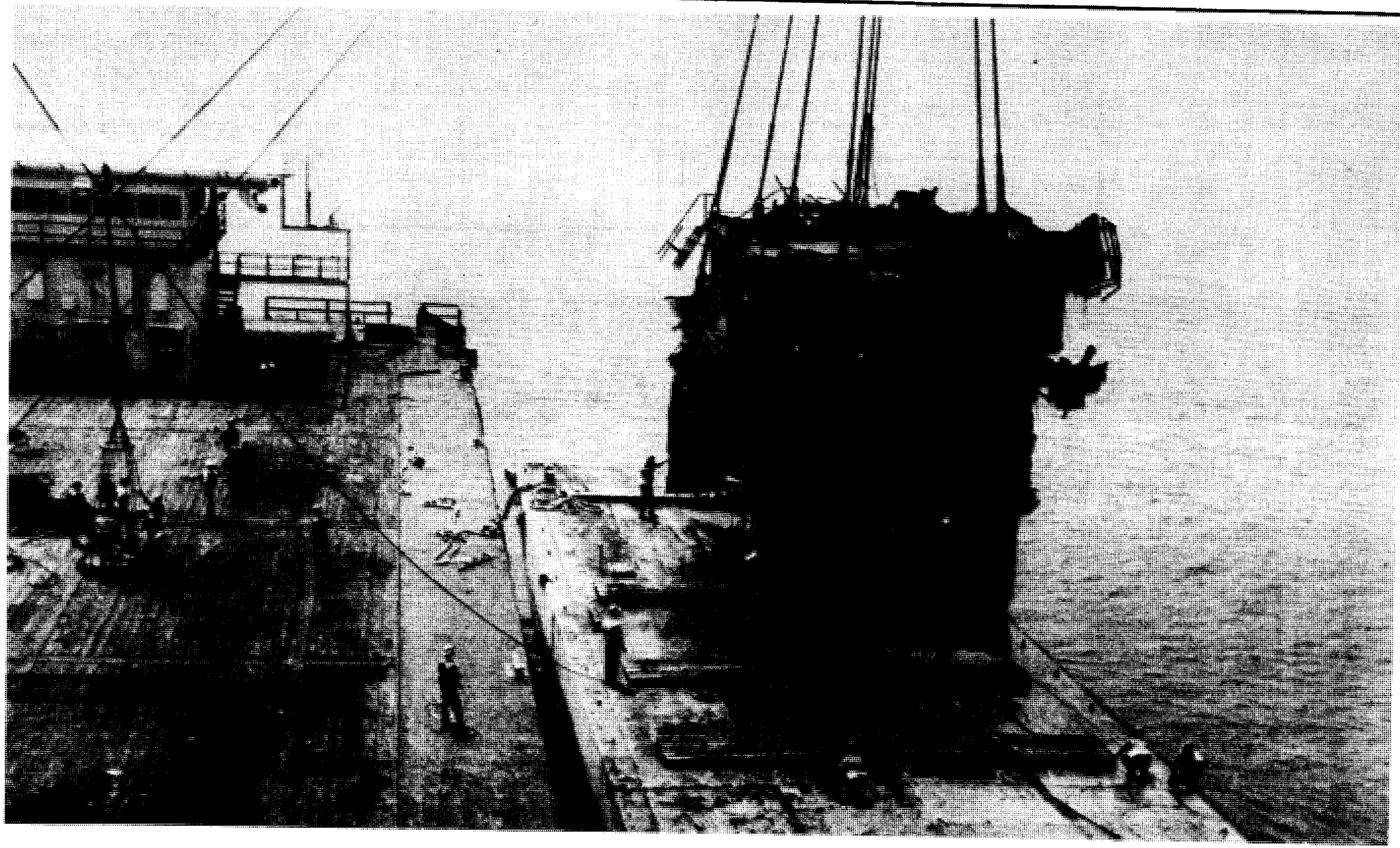
MOVIBLE NO.II WITH THE BOW SECTION OF MACKENZIE ON FIRST LIFT ATTEMPT AT 322 TONS ON 25 JUNE 1974

THE LIFT EFFORT ON THE BOW SECTION WAS ABANDONED AT THIS POINT AS THE LOAD EXCEEDED SAFE LIMITS ON THE 2½" SHACKLES ON 25 JUNE 1974.

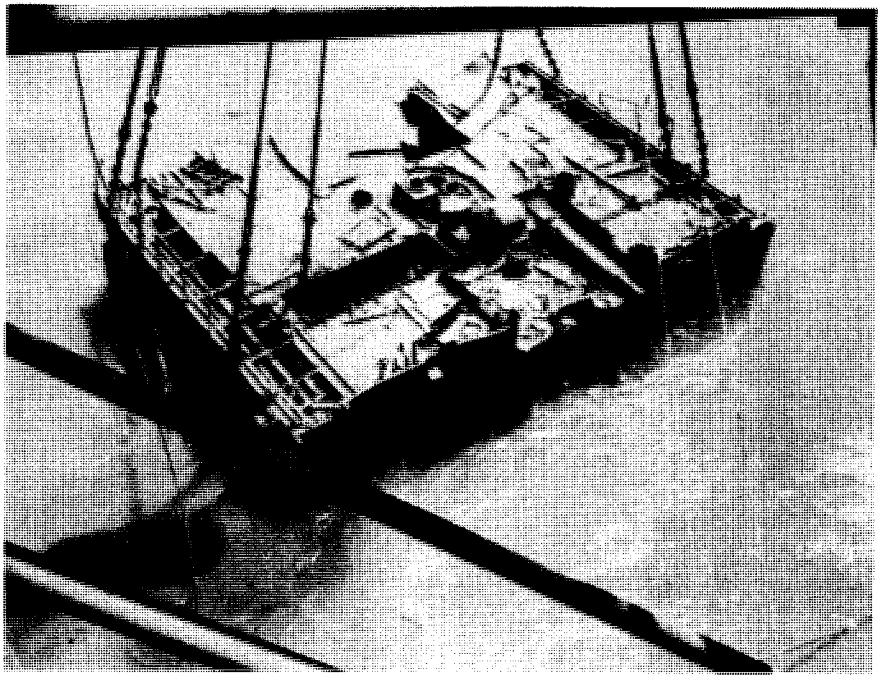


THE STERN SECTION COMING OUT ON THE SECOND AND FINAL LIFT OF PHASE I ON 27 JUNE 1974

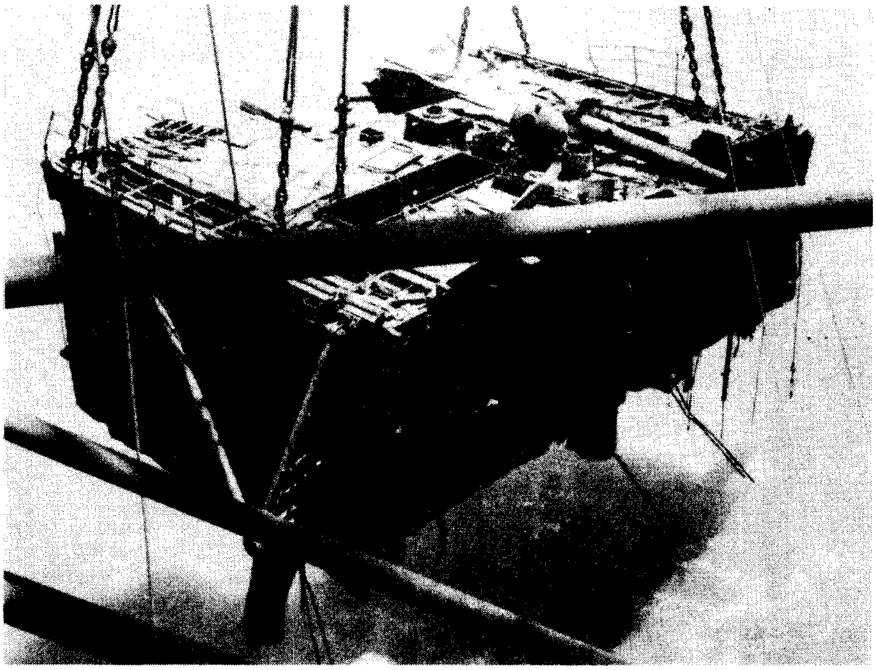




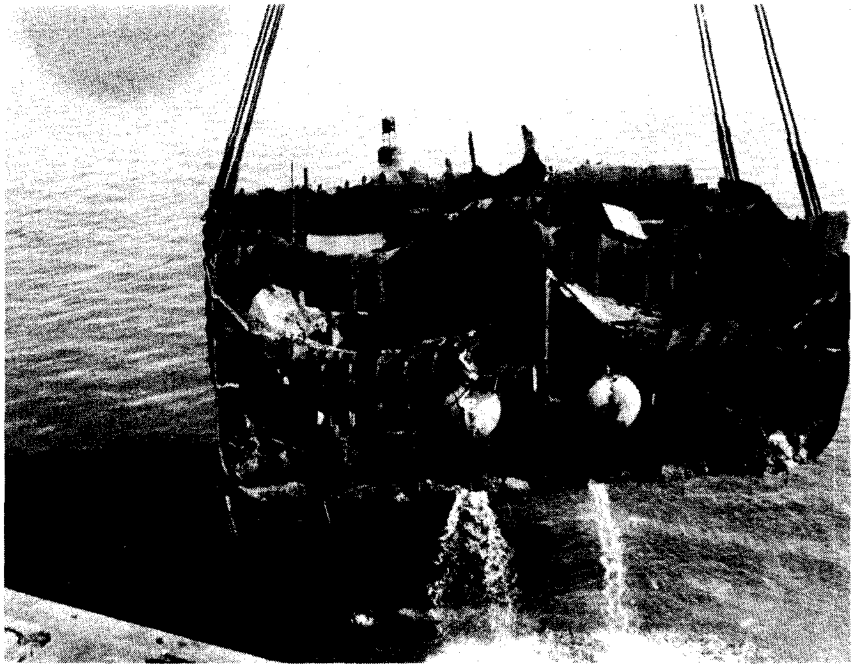
UPPER G SECTION LANDING AT 105 TONS ON ARMY BARGE DURING PHASE II AT 1145 ON 22 JULY 1974.



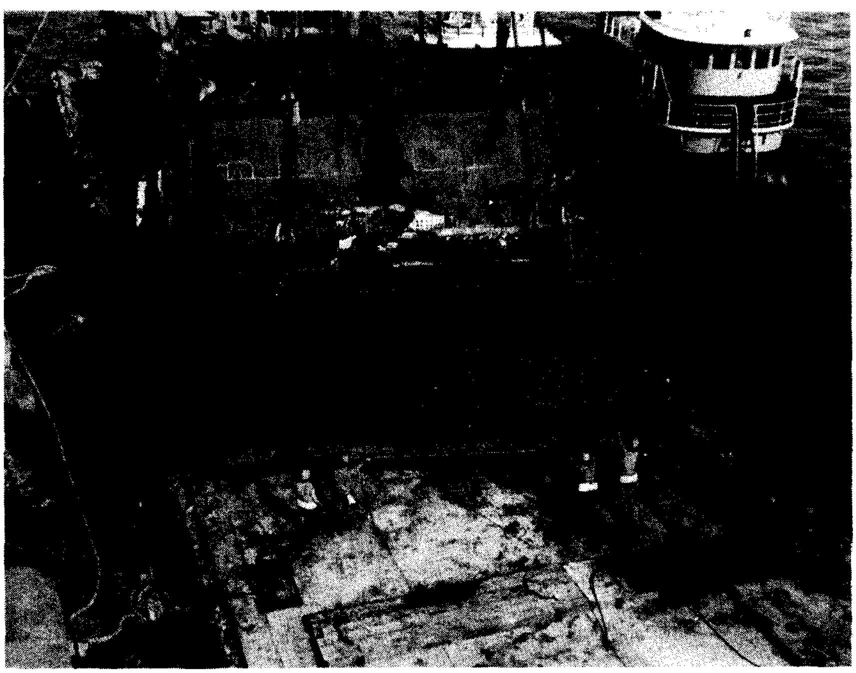
UPPER F COMING THROUGH THE INTERFACE AT 208 TONS BREAKOUT ON 19 AUGUST 1974.



UPPER F AT 160 TONS ON THE HOOK. UPPER AFTER HALF SECTION OF THE FORWARD PUMP ROOM LOOKING AT THE PORT SIDE ON 19 AUGUST 1974.



LOWER D RIGGED WITH FOUR ¼ SHOTS OF 2¼"
DIELOCK CHAIN ON 20 AUGUST 1974.



LOWER D LANDING ON ARMY WORK BARGE AT 375
SHORT TONS HOOK WEIGHT ON 20 AUGUST 1974.

- Mooring

During Lift Phase I, the eastern leg of the oil boom was left intact to trap fuel spills. In general, the pre-lift evolutions were to slip the LIMA 400 out of the moor the day before the arrival of the MOVIBLE NO.II. The upstream leg of the barge was run out by tug and the anchors on each of 3 quarters were run. The southeast quadrant was taken by an 8" nylon hauser run to a spherical 56" diameter net float spring connected by 1 5/8" dielock chain to the wreck. This later was reinforced by running a temporary anchor out across the southern channel when lifts were being made that required a heavy pull on the moor from the southeast. This was done at night when the channel was closed to traffic.

2.9 Underwater Work

2.9.1 Work Activity

A breakdown of the underwater work activity of the diving teams was taken from the Salvage Master's daily situation summaries. Underwater oxy-arc cutting was the most time consuming job, followed by rigging for heavy lifts, followed by clearance of top hamper and miscellaneous material.

2.9.2 Work Assignments

The assignment of work tasks was made by specific locations for specific divers. The Ocean Systems Inc. divers were assigned the forward portion of the wreck, and the Buck Steber Inc. divers were assigned the after end. Each crew had a diving supervisor who made working and inspection dives.

2.9.3 Diving Apparatus

Each diving contractor provided his own compressors, umbilicals, diving dress, communications and switch gear. The Buck Steber Inc. firm provided a double lock chamber that made deck decompression possible for working dives over 35 feet.

ESTIMATED DIVER ACTIVITY ANALYSIS

UNDERWATER TASK	ESTIMATED DIVER SHIFTS (INCLUDING STANDBY)	% ACTIVITY
Exploratory diving and survey reports	40	5.1
Clearance of top hamper, miscellaneous fittings and underwater rigging (includes Class III burning and rigging)	97	12,3
Oxy-arc burning Primarily Class I and II burning	242	30.6
Interior clearance and machinery removals (includes Class III burning and rigging)	27	3.4
Placement of explosives and survey of cut lines	58	7.3
Jetting and air lift	46	5.8
Rigging for heavy lifts, preparatory (includings Class III burning and rigging)	108	13.7
Shackling for heaving lifts to big barge and underwater work while big barge on scene	64	8.1
Bottom clean up	56	7.1
Lost time for weather and other causes (barge moves, etc.)	52	6.6
	790	Total Diver shifts available from 1 May through 1 September

2.9.4 Diving Safety

There were no lost time accidents on the diving operations. A diver's ear infection resulted in a two-shift loss; minor complaints from several men that DC currents in the cutting process were loosening the fillings of their teeth did not cause a work delay.

Several divers had open sores on their hands from scrapes, and one had a burn about the size of a five cent piece on the back of his hand from brushing against hot metal during cutting operations. The sores festered and did not appear to scab and heal quickly.

Continual efforts were made to patch and mend the diving gear. Ocean Systems Inc. renewed umbilicals during the midpoint of the operation.

The divers were generally down in pairs; with no serious loss of communications between divers and supervisors. During certain phases of internal diving operations, particularly where exit was difficult, divers made use of "come-home-bottles". These were small high pressure air tanks carried by the divers and connected to the second stage of their demand regulators.

Underwater times per twelve hour shift amounted to about three 1½ hour work turns per diver. Actual time in water per four man team was about 18 diver hours per 12 hour team shift.

A double lock chamber was available for decompression when bottom time required it. No incidents of bends occurred.

2.9.5 Access

The two stacks were modified by placing platforms on their top portions and placing gangways from the LIMA 400 work barge to the stack platforms. The divers were given a protected route into the wreck without being subjected to the heavy tidal currents. It is estimated that over 60% of total diver time on the wreck was spent inside. The major outside tasks were clearance of top hamper and rigging for heavy lifts.

2.10 Roll Up Procedure

2.10.1 Bottom Sweep

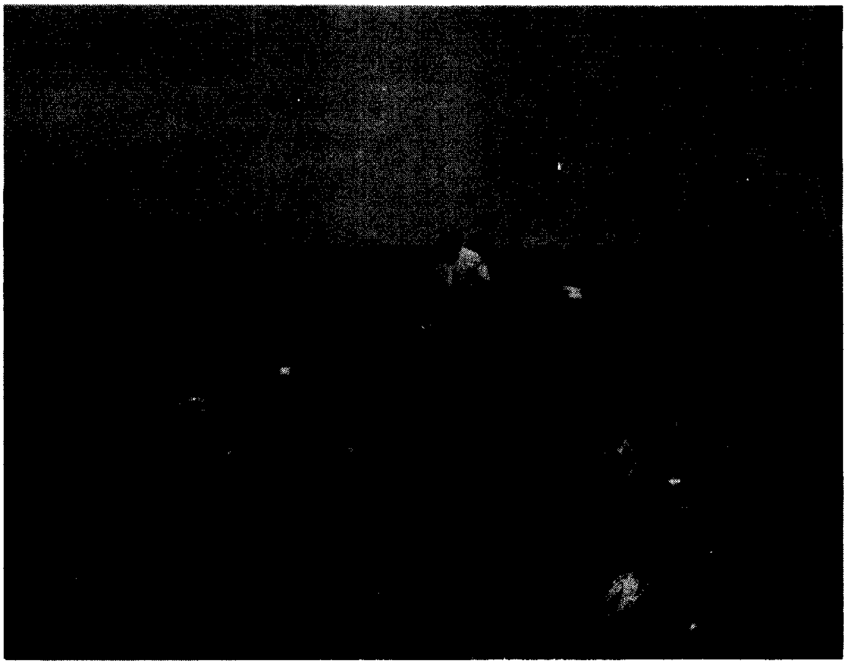
The extent of the final bottom cleanup was predicated on the knowledge that the area would be swept by the Corps of Engineers in channel dredging operations; a very careful effort was needed to remove all parts that could damage the dredge. It was initially intended to make a magnetic pickup sweep of the wreck site, but commercial sweep gear was unavailable when required. This meant that a carefully controlled diver search and monitoring effort was required to cover the work barge and wreck area to a 1 ft. x 1 ft. grid. This search was conducted by the Buck Steber Inc. team from 30 August until 4 September 1974.

To this end, a set of spherical floats were laid on the former keel line of the wreck at 50 ft. intervals. These markers formed the reference stations about which the divers made walking sweeps of the bottom. A large expanded metal basket was lowered by the LIMA 400 crane in the center of the target region. The basket had 40 ft. 3/8" wire pendants attached which were shackled to objects too large to return by hand. The basket would be hoisted to the surface with either deposited or attached debris.

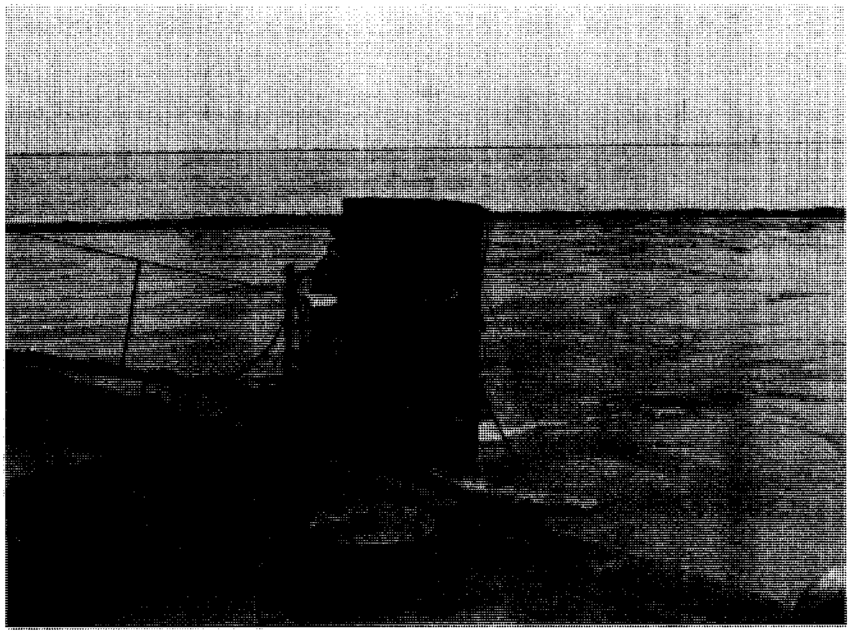
Although the search effort was slow and hampered by tidal currents; one complete walk of the area was completed. In addition, a rake drag was fabricated out of 2" x 1/4 angle bar to be pulled over the area to rake up pieces that the divers missed.

2.10.2 Logistic Returns

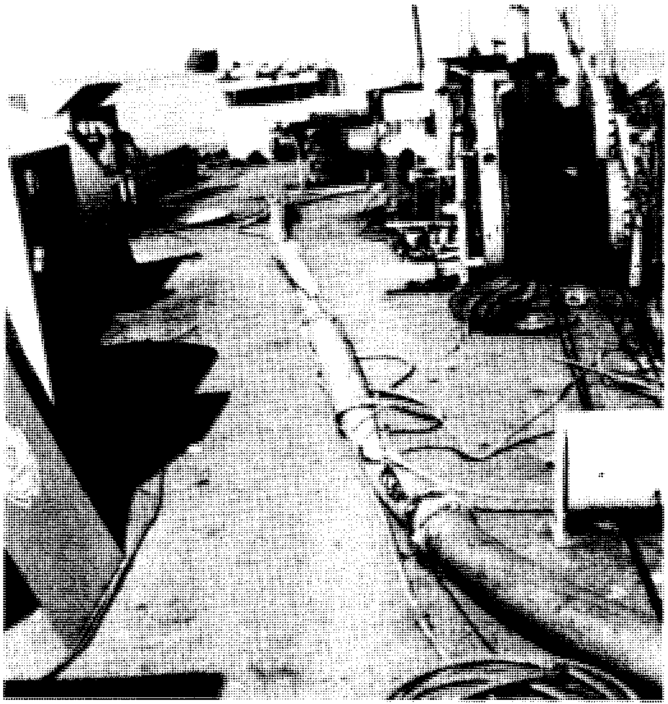
The roll up of the oil pollution boom was completed prior to the end of Phase III and the skimmer was pulled for painting and general maintenance. This material was returned to the warehouses in Jacksonville, Florida and Atlantic City, New Jersey in early August.



DIVERS' COMMUNICATION AND CONTROL STATIONED LOCATED ONBOARD THE LIMA 400.



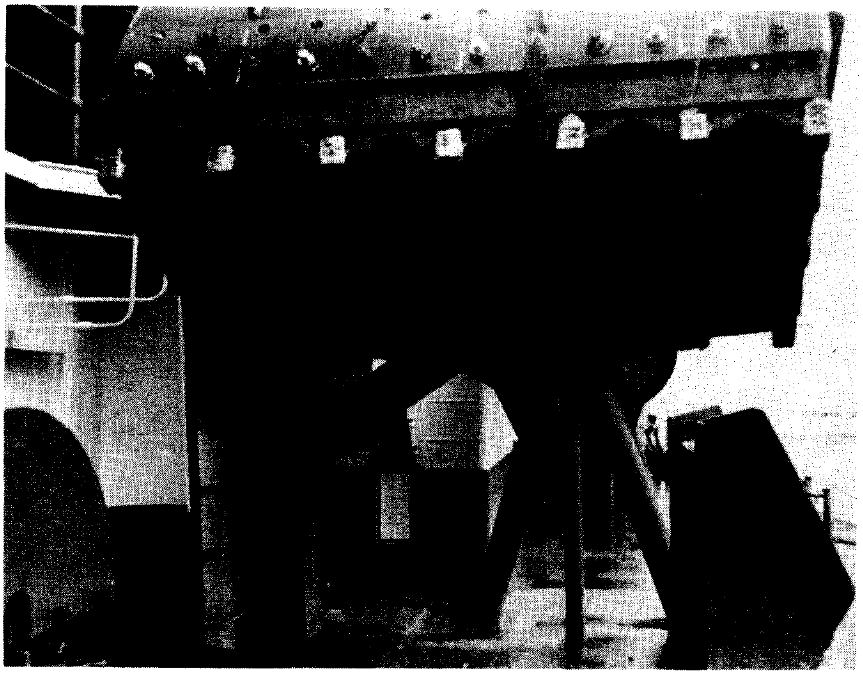
DIVER UP AND TAKING OFF HIS HELMET AFTER A BURNING WORK TURN.



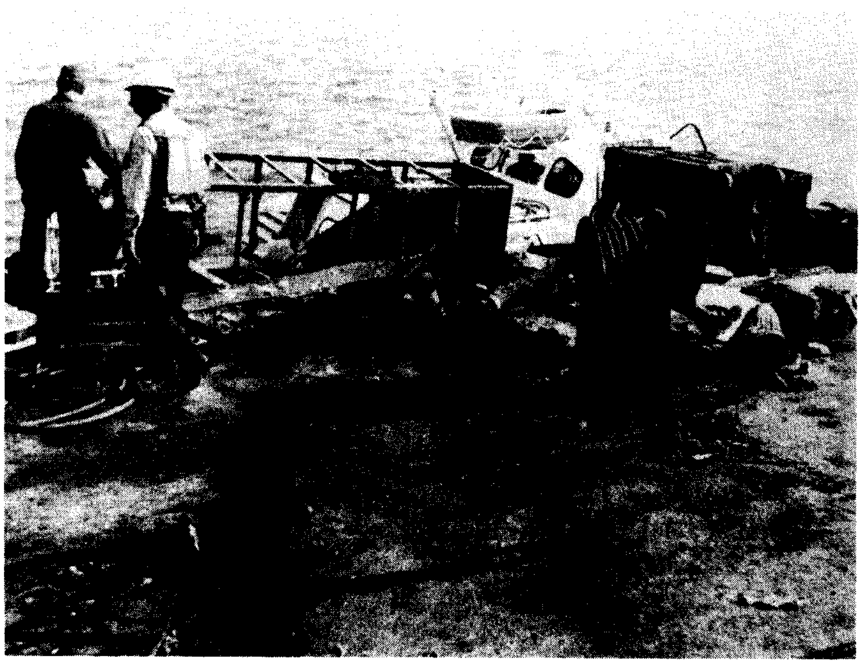
AIR LIFT RIGGED FOR REMOVING DREDGE SPOILS IN THE HOPPER AREAS IN PREPARATION FOR PHASE III LIFTS.

AIR, COMMUNICATIONS, DC POWER AND OXYGEN LINES BEING TENDED THROUGH THE FORWARD STACK. ONE DIVER IS BURNING WHILE ANOTHER IS JETTING.

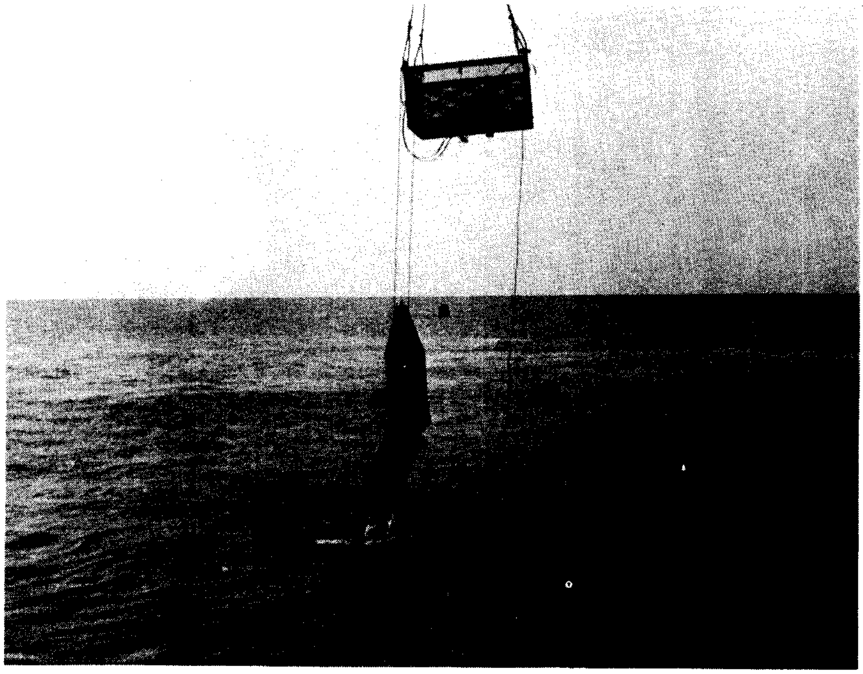
Figure Number 58



DREDGE HEAD ON MCFARLAND SHOWING OPENINGS TO PASS DEBRIS.



BOTTOM DEBRIS RECOVERED BY DIVERS DURING ROLL UP ON DECK OF LIMA 400 WORK BARGE ON 22 AUGUST 1974



BRINGING UP DEBRIS FROM THE WRECK AREA WITH BASKET AND PENDANT WIRES. WRECK BUOY CHANNEL MARKER IS TO THE SOUTH.

6 FT. SEVEN TINE ANGLE BAR RAKE USED FOR BOTTOM DRAG OF THE WRECK AREA DURING ROLL UP OPERATIONS

SECTION III LOGISTICS

3. Logistics

3.1 Introduction

Apart from the operational nature of carrying out the work to be done on the scene, both governmental and private groups provided the men and material required.

The U.S. Army Corps of Engineers through the Galveston District provided the operating base. Fort Point provided the material staging areas, the facilities for materials handling, the small craft for transport of personnel and equipment, the office space, the warehouse space, the telephone and the radio communications network. In addition, the Galveston District contracted for the heavy lift and support barge requirements.

The Navy, through the Supervisor of Salvage, provided material from Emergency Ship Salvage Stores and financial review of the Navy Contractors Expenditures.

Murphy Pacific Marine Salvage was the primary contractor responsible for the removal of the wreck. There were several second and third tier contractors to Murphy Pacific that had important roles in supplying the necessary personnel and equipment to carry on the operation in a timely fashion.

3.2 Logistics Support of U.S. Army Corps of Engineers

The Galveston District Engineer assigned a full-time resident engineer and staff on temporary additional duty at Fort Point to support the operation. The resident engineer, in his logistic role, supervised the shore support activities at Fort Point by providing the small craft, office facilities, warehouse facilities, yard crane, fuel supply, soils laboratory and design services, trucking and materials handling and sanitary services for the operation. In addition, the resident engineer prepared the bid packages that were processed through the Galveston District for working barge, heavy lift barge and transport barge services. The Galveston District made the contract with HUNTER FLORES for the work barge LIMA 400, the heavy lift services with Teledyne Offshore and contracted for the materials transfer barges from within U.S. Army inventory and from

Teledyne as a barge contractor.

The Fort Point boat pool provided 24 hour launch services between Fort Point and the wreck site, and also provided two small tugs for miscellaneous duties in moving barges and in pollution control. A list of the supporting craft used shows that most of the craft involved were obtained on Corps of Engineers contracts.

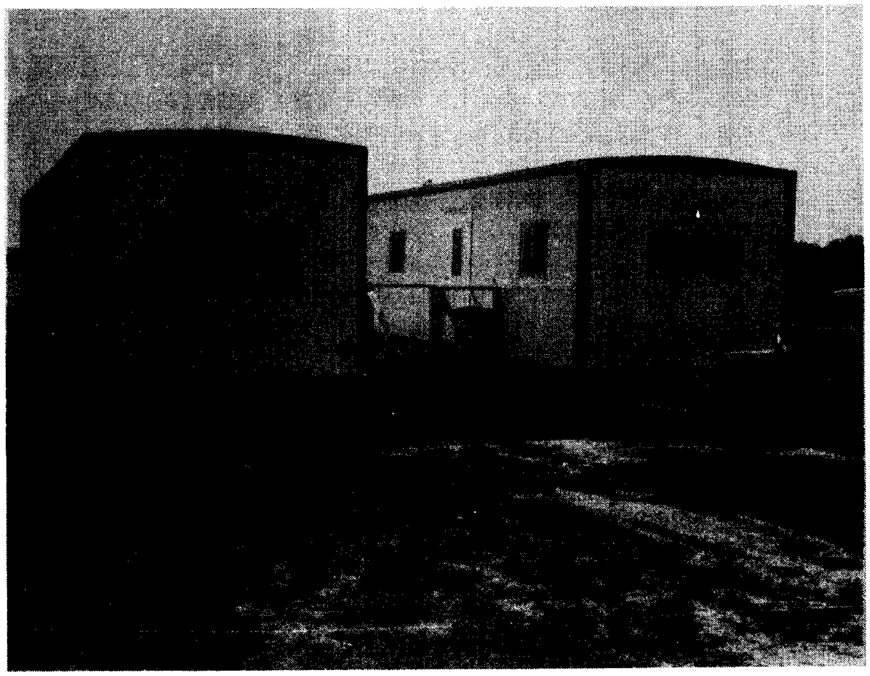
In addition, the Galveston District handled the contracting for the scrapping of the sections as they were removed from the wreck.

With the commencement of salvage operations to remove the top hamper, it immediately became apparent that disposal of the scrap was one of the first major problems to be resolved. Negotiations with various local scrap dealers were held. A contract with Intercontinental Steel Corporation of Houston, Texas, was negotiated for about 250 tons of scrap metal. Material was temporarily stored aboard the derrick barge and when sufficient quantities were on hand, the contractor furnished a barge to the site and the scrap was transferred to the barge. On 6 June 1974, a conference was held with the scrap dealers and the operations were discussed. Following this meeting, it was decided that Corps of Engineers would procure scrap barges as needed.

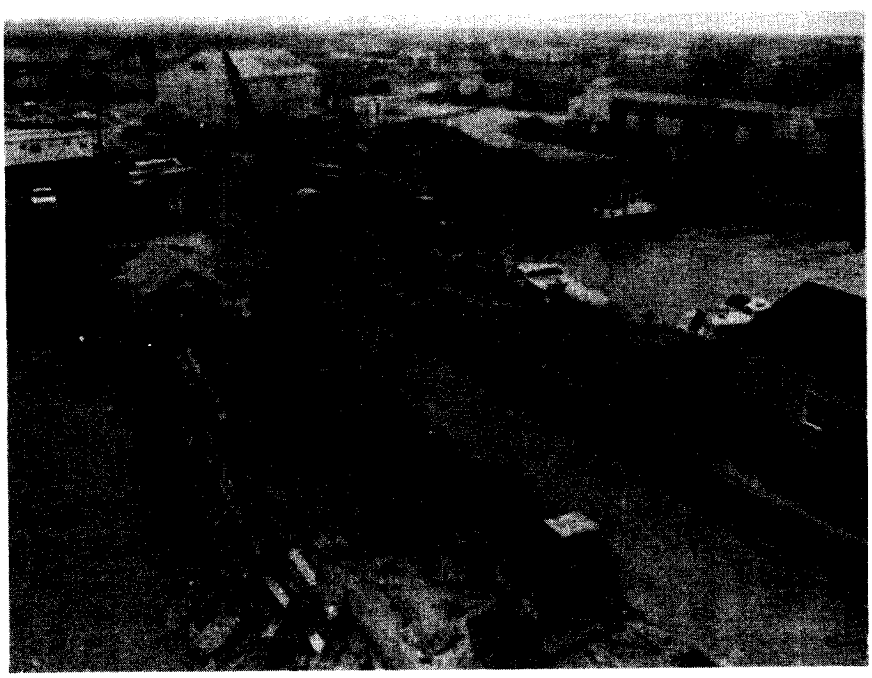
On 17 June 1974, a pre-bid conference was held with prospective bidders to discuss the salvage operation and the requirements for a 500 ton derrick barge. Brown & Root, Inc., of Houston, Texas, was the only prospective bidder to send a representative to the conference. The representative indicated his company was reluctant to bid on salvage work with its high risk factor.

Following the meeting, J. Ray McDermott and Teledyne Movible Offshore were contacted by telephone. McDermott indicated their derrick barges were committed for the period. Teledyne Movible Offshore stated they were interested in doing the work but not on a bid basis.

On 20 June 1974 at the time of bid opening, no bids were received. The first lift phase was scheduled to commence on 24 June 1974. Divers were completing the cuts at Frames 104 and 20 and the two severed sections were being rigged with lift chains. There was no doubt Murphy Pacific would be ready for a derrick barge on



FORT POINT TRAILER OFFICE SPACES, 20 JUNE 1974



ESSM MATERIAL STORED AT FORT POINT, 14 JULY 1974 schedule. On 21 June 1974, negotiations were held with Brown & Root, Inc., and Teledyne Movible Offshore of Lafayette, Louisiana. A contract was awarded by telegram on 22 June 1974 to Teledyne Movible Offshore.

After each lift phase, the scrap was moved to Fort Point Hopper Dredge Dock. Bidders were allowed to view the scrap, and bids were received on each lot of scrap as generated by each lift phase.

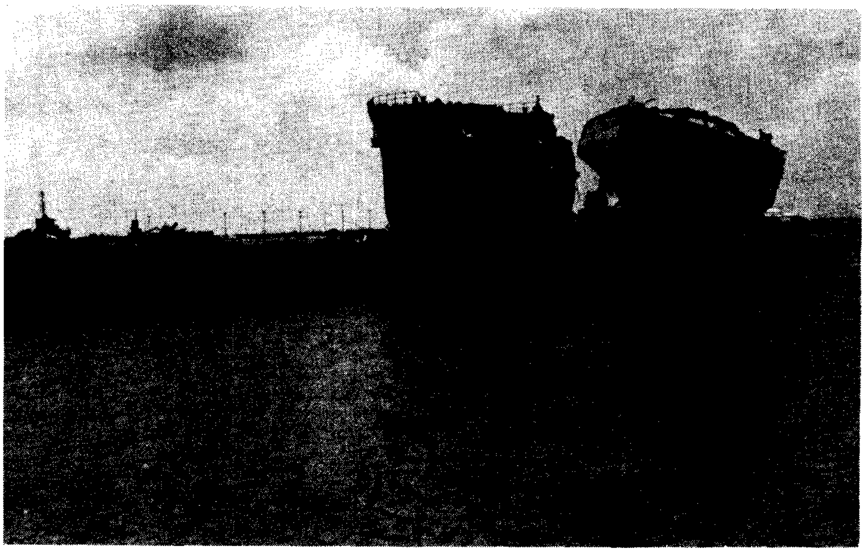
In addition to the scrap generated directly at the wreck site, a warehouse supply of items for the A. MACKENZIE was disposed of by sale. Altogether about 3427 tons of scrap were sold for $207,161.95.

3.3 Logistic Support U.S. Navy Supervisor of Salvage

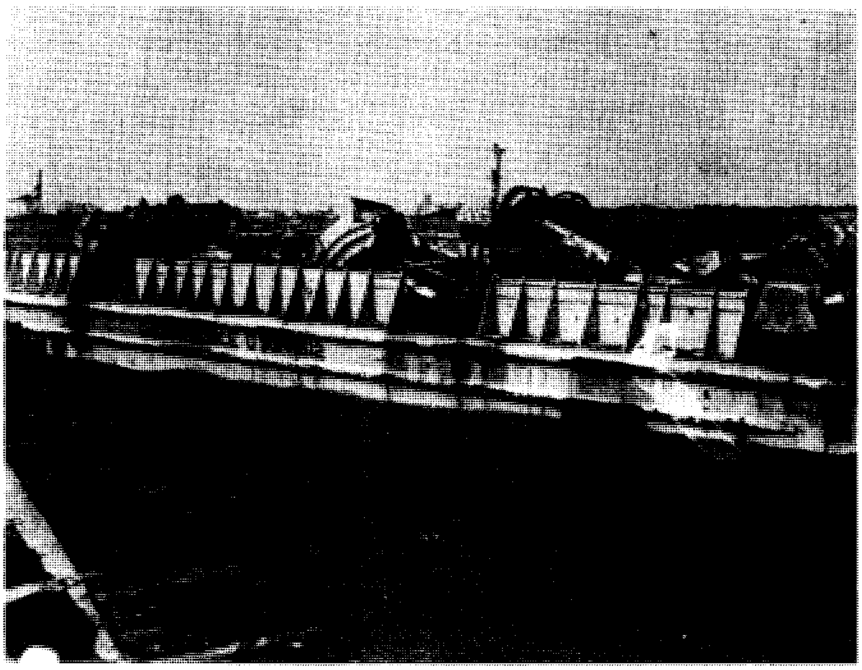
Two Navy contracts were required on the operation. The Murphy Pacific Marine Salvage Company, Merritt Division, was contracted for the major salvage efforts and Murphy Pacific Marine Salvage Company , West Coast Division, was contracted for oil pollution control. Material that supported the salvage operation from Navy sources came from the U.S. Navy Emergency Ship Salvage Material Pool; material that supported the oil pollution control operation came from U.S. Navy vendors.

Much of the ESSM pool material was made available from Charleston, South Carolina; the main usage of pool items was the 2¼" chain used for the lifting components. In addition, the U.S. Navy provided diesel driven compressors, welding generators, power generators and lighting banks that were used to outfit LIMA 400 as a work barge.

The U.S. Navy maintains stocks of ship salvage support items as prepositioned precautionary material to use in ship salvage operations. The U.S. Naval Shipyards and other sites maintain stocks of this material and the overall direction of the pool of Emergency Ships Salvage Material is made through the Office of the U.S. Navy Supervisor of Salvage from the Navy Department in Washington, D.C.



BOW AND STERN SECTIONS BEING TAKEN TO THE SCRAP DEALERS ON TELEDYNE 55X275' WORK BARGE, 2 JULY 1974



LOWER "F" AND "G" SECTIONS BEING DELIVERED TO FORT POINT PHASE II PREPARATION, 7 JULY 1974

SUMMARY OF SCRAP SALES

DATE	DESCRIPTION	UNIT PRICE	ESTIMATED UNITS	TOTAL AMOUNT
13 May 74	Top Hamper	$ 20.00	300 Tons	$ 6,000.00
1 Jul 74	Two Sections, Fr AP-20 & 104-FP	41.00	421 Tons	17,261.00
8 Jul 74	Two Pump Engines, Service Engines, Pump Motor, and Misc. Metal	76.81	90 Tons	6,912.90
26 Jul 74	Four Sections, Fr 20-32, Upper Fr 32-48, Upper Fr 92-104, Lower Fr 92-104	62.25	700 Tons	43,575.00
9 Aug 74	Warehouse Stock, Ferrous	67.25	115 Tons	7,733.75
	Warehouse Stock, Bronze	945.00	16 Tons	15,120.00
27 Aug 27	Seven Sections, Lower 32-48, Upper Fr 48-62, Lower Fr 48-62, Upper Fr 62-78, Lower Fr 62-78, Upper Fr 78-92, Lower Fr 78-92	61.66	1760 Tons	108,521.60
12 Sep 74	Miscellaneous Metal	34.50	25 Tons	862.50
22 Aug	Diesel Fuel Removed from Wreck	5.20	226 BBL.	1,175.20
			TOTAL	$207,161.95

LIST OF CRAFT REQUIRED
FOR A. MACKENZIE SALVOPS

	Function	Source	Prime Contractor
GERIG	Hopper Dredge	U.S. Army Corps of Engineers	Galveston District U.S. Army Corps of Engineers
MACFARLAND	Hopper Dredge	" "	" "
MOVIBLE DB II	Heavy lift	Teledyne Offshore	" "
LIMA 400	Work barge with 100 ton crane	HUNTER FLORES	" "
50 x 270 Work Barge	Wrecked Section transport	Teledyne Offshore	" "
40 x 155 Work Barge	" "	" "	" "
40 x 155 Work Barge	" "	" "	" "
45 x 240 Work Barge*	" "	U.S. Army Corps of Engineers	" "
30 x 90 Work Barge*	" "	U.S. Air Force	" "

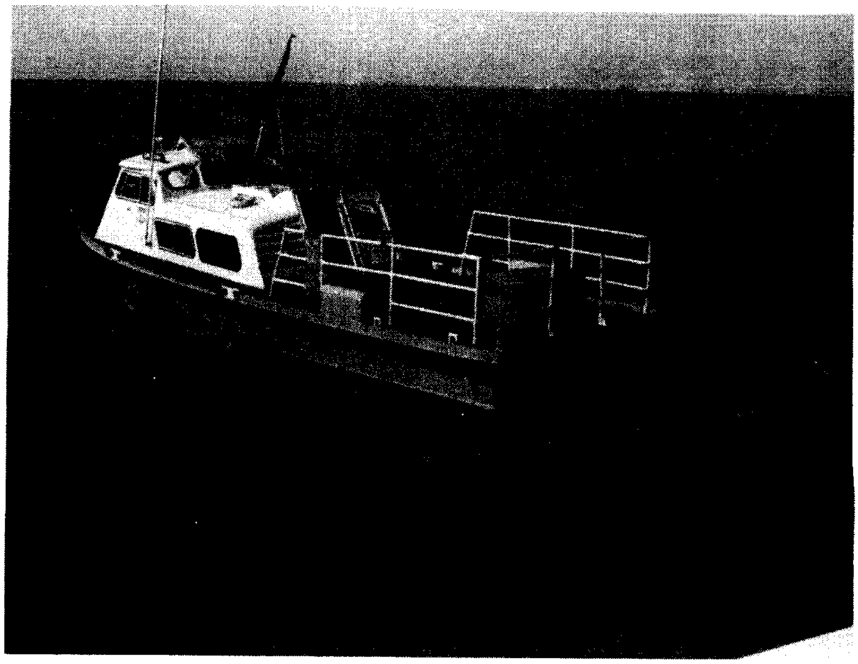
LIST OF CRAFT REQUIRED
FOR A. MACKENZIE SALVOPS
(cont'd)

	Function	Source	Prime Contractor
30 x 90 Fuel Barge*	Fuel, defueling and replenishment	U.S. Army Corps of Engineers	Galveston District U.S. Army Corps of Engineers
NECHES II YTL*	Yard tug	" "	" "
Air Force YTL*	" "	U.S. Air Force	" "
WOLFE II (pusher)	" "	HUNTER FLORES	" "
EDCO YTL	" "	" "	" "
GULF STORM YTB	Heavy lift barge support	Teledyne Offshore	" "
GULF STREAM YTB	" "	" "	" "
BRANDY STATION	" "	" "	" "
CM WOODS*	Personnel & mat'l. launch, explosive transport	U.S. Army Corps of Engineers	" "

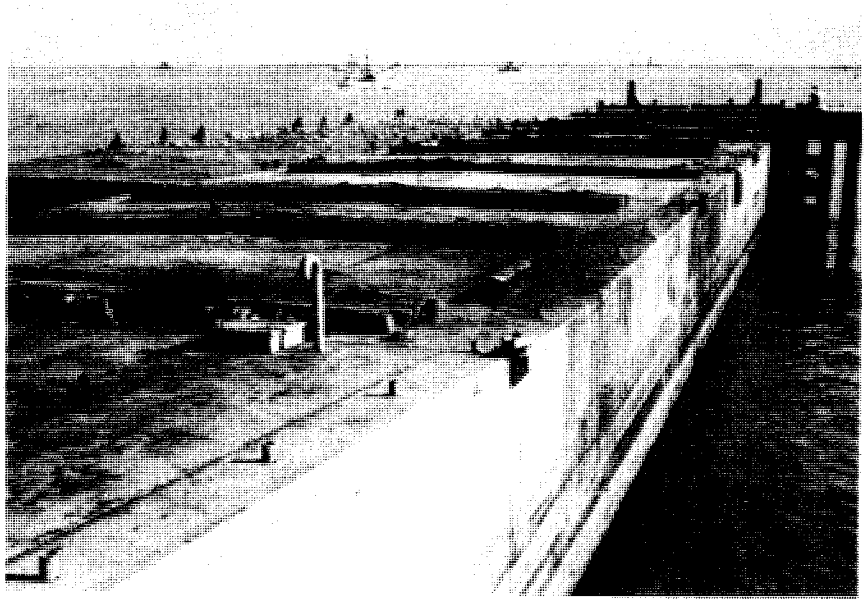
LIST OF CRAFT REQUIRED
FOR A. MACKENZIE SALVOPS
(cont'd)

	Function	Source	Prime Contractor
HEAGY*	Personnel & mat'l. launch, explosive transport	U.S. Army Corps of Engineers	Galveston District U.S. Army Corps of Engineers
ZODIAC	Oil pollution control	" "	" "
Oil Skimmer	" "	Murphy Pacific West Coast	U.S. Navy Sup. Salvage
14' punt	"	"	" "

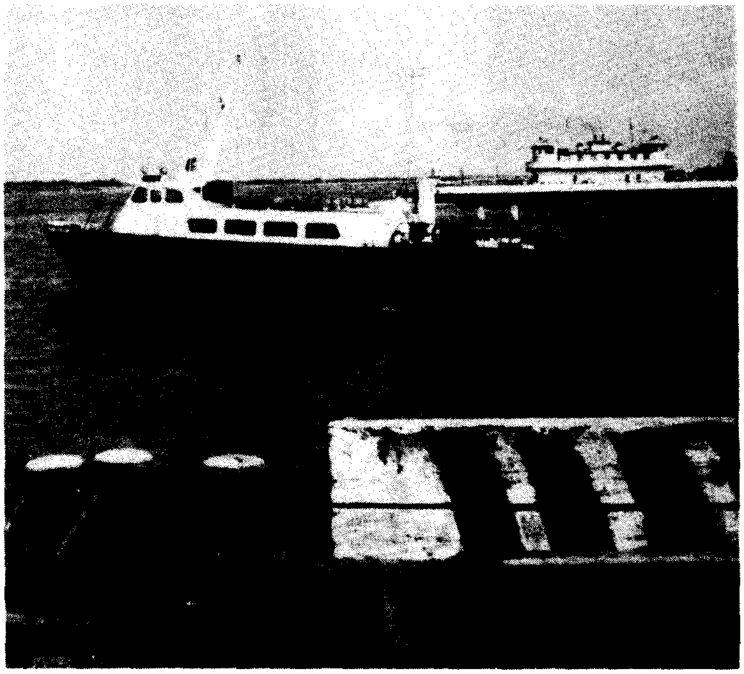
* Originally in Galveston District Corps of Engineers Inventory



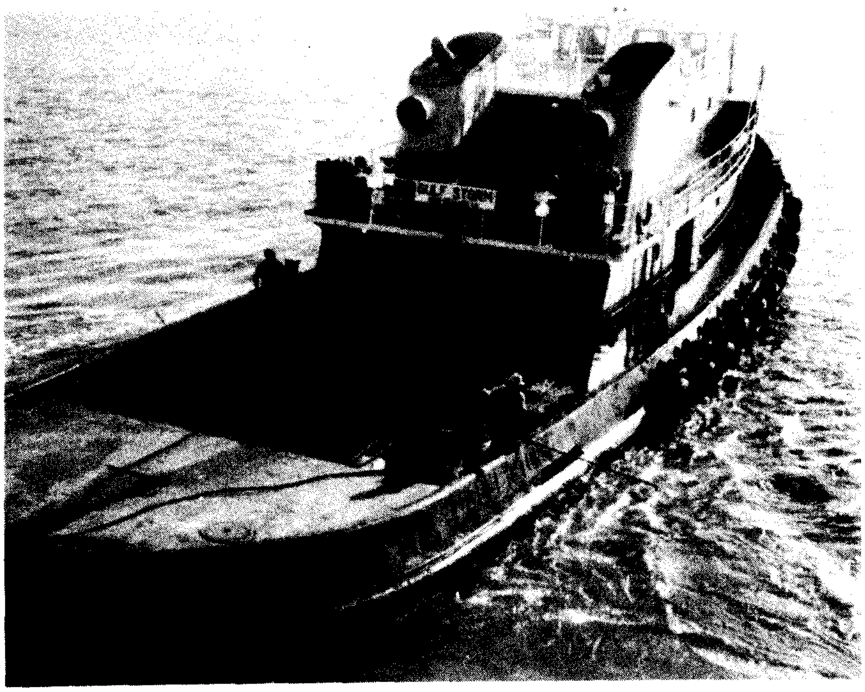
C.M. WOOD DELIVERING EXPLOSIVES TO LIMA 400



45 X 240' ARMY WORK BARGE OUTFITTED WITH
DRAGLINE PADS

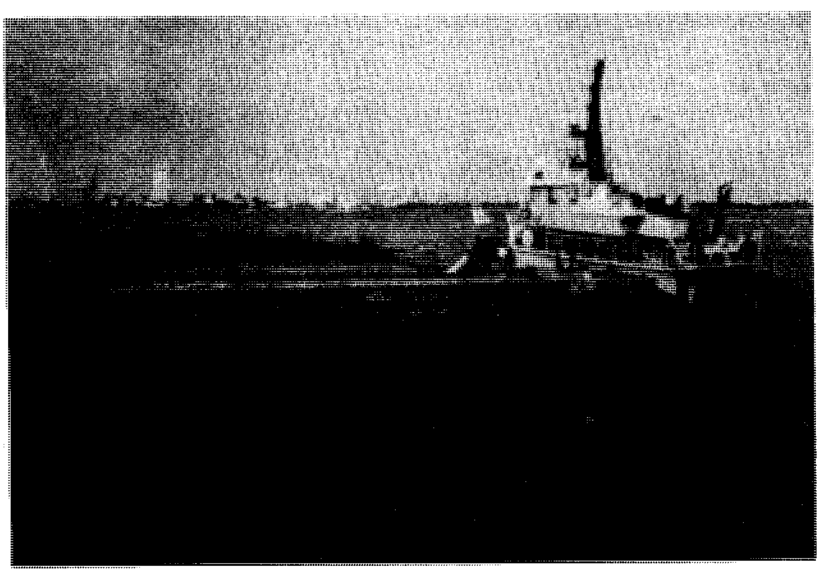


BRANDY STATION-PERSONNEL LAUNCH WITH TELEDYNE OFFSHORE MOVIBLE II



GULF STORM-ONE OF THE SUPPORTING TUGS WITH TELEDYNE OFFSHORE MOVIBLE II

SMALL TUG NECHES WORKING ON BOOM ARRAY
23 JUNE 1974



TELEDYNE 50 X 270' WORK BARGE AT FORT POINT PIER
24 JUNE 1974

3.4 Murphy Pacific Marine Salvage Company

Murphy Pacific acted as the prime contractor for the Ocean Systems Inc. and Buck Steber Inc. diving teams. In addition, Murphy Pacific made all the local material and labor contracts to rent tools and perform the odd backup jobs needed ashore. The major Murphy Pacific vendors were:

Technical Explosives, Harvey, Louisiana
Marine Machine Works, Galveston, Texas
Texas City Welding Supply, Galveston, Texas
HAS Construction, Inc., Galveston, Texas
Manpower, Inc., Galveston, Texas
Industrial Air Tool Service, Pasadena, Texas
Denton Welding, Galveston, Texas
Farmers Marine & Copper Works, Galveston, Texas
Blue Water Marine, Houston, Texas
TRELD, Houston, Texas
A. Rynecki, Sausalito, California

Major Suppliers were:

Flood & Calvert, Galveston, Texas
Craftsweld Corp., Long Island City, New York
Balt Chain, New Jersey
Welders Supply, Baltimore, Maryland

In general, either the vendors or the Corps of Engineers provided the materials handling and transportation required.

3.4.1 Storage and Transportation of Explosives

Murphy Pacific entered into a subcontract with Technical Explosives, Inc., Harvey, Louisiana, to furnish shaped explosive charges and technicians. On 28 May 1974, Technical Explosives personnel arrived on the job site and began acquiring the necessary permits to store and transport explosives to the wreck site.

All storage and transportation after arrival on the Government Reservation at Fort Point was carried out in accordance with EM 385-1-1 and U.S. Coast Guard Safety Regulations. Portable magazines were set up and barricaded. Prior to the arrival of the explosives, meetings were held with the contractor, Coast Guard and Corps of Engineers to assure utmost safety.

Due to the close proximity of inhabited buildings to the dock, strict compliance with handling procedures was dictated. Only 50 pounds of explosive could be carried across the dock at one time. A 24-hour, seven-days-per-week guard service was hired to prevent theft of the explosives and/or caps.

3.4.2 Preparation of Oxy-Arc Cutting Electrodes

During the early stages, considerable difficulty was experienced in obtaining underwater oxy-arc cutting electrodes. The Corps of Engineers purchased the first 1050 pounds of electrodes from Craftsweld Equipment Company, 2626 Jackson Avenue, Long Island City, New York. However, after the initial purchase, the supplier advised that no more could be purchased without a priority rating to insure replacement of the steel. Since there is no priority rating for civil projects, it appeared serious delays would result. The Navy exercised a priority rating available to the Supervisor of Salvage and supplied the electrodes. No delays were experienced; however, while this problem was being resolved, a shipment of another manufacturer's electrodes was obtained through the Navy ESSM pools.

These ARCO (ARC-AIRE) blue coated rods had superior resistance to water solubility but easily shorted out electronically; the gaseous shield effect was practically nil. Three wraps of masking tape and a dip in varnish enhanced the electrical insulation quality and improved the gaseous shield effect. The Craftsweld electrode, pink coated, by contrast had poor resistance to water solubility but the terra cotta coating provided an excellent gaseous shield around the cutting arc and had good electrical insulating qualities as long as the flux remained relatively free of absorbed water. These rods required a wrap of 3M plastic electrical tape to keep the coating intact.

3.5 Financial Aspects

3.5.1 Fiscal Procedures

The fiscal aspect of the salvage was of prime importance. It was expected that fiscal records would be scrutinized by representatives of the BOW ELM and IDA GREEN interests. With this in mind, the District engineer insisted that the

Galveston Resident Auditor be a member of the salvage organization with full control of the fiscal procedures and files.

Cost accounts were established in three major categories; namely, costs created by the sinking of the dredge; costs directly related to the insurance account; and costs in connection with dredging the by-pass channel.

Separate files by payee were set up to accumulate copies of all documents supporting payments made in connection with removal of the dredge. These files were in addition to the files maintained by the disbursing officer. The files include copies of requisitions, purchase orders, contracts, receiving reports, and time rolls. Copies of the computer printouts reflecting the entries in the accounting records were also put in the files.

On 15 May 1974, meetings were held with representatives of the U.S. Navy and Murphy Pacific Marine Salvage Company to establish the fiscal rules for payments from the Corps of Engineers to the Navy who would in turn make the payments to Murphy Pacific. Costs incurred by the Navy and Murphy Pacific were reported weekly by a Navy representative. Murphy Pacific costs were billed by the Navy on a Standard Form 1080, Voucher for Transfers Between Appropriations and/or Funds, supported by a copy of all invoices paid by the contractor. Separate SF 1080's for Navy in-house costs with supporting invoices and/or travel vouchers were submitted. In order to be sure that copies of all contractor expenditures were obtained, one copy was obtained from the contractor before they were mailed to the contractor's home office for processing. Each week the Resident Auditor prepared a cost report for review by the District Engineer. A typical report is shown in the Appendix Section.

3.5.2 Procurement

Immediately upon assignment, the Resident Engineer was appointed an ordering officer under Army Procurement Procedures and Engineer Contract Instructions I-452. Limits of $2,500 per transaction were established. In order to enter into a contract for the 500 ton derrick barge, special authorization by the Chief of Engineers was required for the Division Engineer and District Engineer. Also, in accordance with paragraph

7-5.8 of ER 755-2-1, the District Engineer was authorized to negotiate property sales exceeding $1000.00 for disposal of the Dredge A. MACKENZIE, including spare and repair parts.

During the period 24 April 1974 through 16 September 1974, a total of 14 contracts relating to the salvage operation were prepared and executed. Whenever possible, pre-bid conferences and advance agreements were utilized in order to minimize time intervals between solicitations and awards.

Maximum use of blanket purchase agreements with local firms was exercised. To minimize contractor delays at the job site awaiting supplies and equipment, requisitions were prepared and hand delivered for processing and top priority was given to both purchase orders and contracts upon their arrival in Procurement and Supply Division.

CONTRACTS EXECUTED

DATE	DESCRIPTION	CONTRACTOR
6 May 74	Lease of three office trailers	Space Rentals
25 Apr 74	Diving services	J & J Marine Diving Co. Inc.
13 May 74	Anchors, floats and marker buoys	Blue Water Marine Supply
6 May 74	Lease of crane on barge complete with tug boat, supporting equipment and operating personnel	Hunter Flores Inc.
14 May 74	Preparation of Cost Estimates and survey of vessel values for Galveston District CE	J.R. Bencal & Assoc. Inc.
11 Jun 74	Lease of crane on barge complete with tug boat and operating personnel	Hunter Flores, Inc.
22 Jun 74	Lease of 500 ton Derrick Barge complete with attendant plant and operating personnel	Teledyne Movible Offshore Inc.
10 Jul 74	Remove water ballast and gas; clean compartments of Corps of Engineers Fuel Barge 6012	Kelso Marine, Inc.
11 Jul 74	Furnish all plant, labor, and materials to convert Barge 6012 into a deck barge and fasten timbers to deck	Kelso Marine,Inc.

CONTRACTS EXECUTED

DATE	DESCRIPTION	CONTRACTOR
16 Jul 74	Furnishing on a rental basis dragline mats for temporary installation on Barge 6012	D & D Leasing Co.
19 Jul 74	Lease of 500 ton Derrick Barge	Teledyne Movible Offshore Inc.
14 Jul 74 (P.O. 14 May 74)	Furnishing one air compressor with diesel engine on a rental basis	Hunter Flores, Inc.
12 Aug 74	Lease of 500 ton Derrick Barge	Teledyne Movible Offshore Inc.
15 Aug 74	Lease of three cargo barges	Teledyne Movible Offshore Inc.

SECTION IV. CONCLUSIONS AND LESSONS LEARNED

4.1 Introduction

The purpose of this section is to sum up the conduct of a small but complex operation involving several governmental and private groups, each with its own particular mission and organizational structure, brought to bear upon a common ship salvage. The salvage of the A. MACKENZIE provided a test of the operational readiness of the peacetime military/industrial/maritime salvage service to respond to an emergency.

4.2 Conclusions

4.2.1 Definitions of the Tasks and Objectives

The traditional standing forces and material inventory to undertake offshore salvage is maintained by the U.S. Navy and a few private contractors while the U.S. Army, although having a responsibility, rarely undertakes peacetime inshore salvage tasks with its own forces and material. Rather, the job is contracted to other governmental agencies (U.S. Navy) or to qualified private contractors. The Army assigns its salvage responsibilities through the Corps of Engineers, which is funded as part of its legislated function to maintain the rivers and harbors of the country to specific standards.

The Corps of Engineers operates a fleet of vessels and craft in this activity which are continuously engaged in waterway maintenance. These vessels are considered necessary "tooling" to carry out this mission, and a portion of the cost of every cubic yard dredged in waterway maintenance goes for the upkeep, operation and replacement of the "tooling" used. The federal financial philosophy supporting the operations of the U.S. Army Corps of Engineers permits a wide latitude of administrative choice regarding the handling of casualties and the removal of navigational hazards. To the Corps of Engineers then, the sinking of the Hopper Dredge A. MACKENZIE, apart from the personnel problems concerned, presented a navigational hazard and a machine tool replacement consideration.

Apart from the operational objective of effecting the removal, quick action response and accurate accounting of removal costs were germane points in Corps of Engineering Task Decisions. As the Galveston District Staff was organized for the conduct of peacetime district tasks, the District Engineer had no specific expertise in personnel or special material resources to undertake salvage. However, the District could provide support to an operating unit through purchasing, storage and transport of material, provide a base of operations, floating services and technical and engineering aid. The accounting of all such activity could be directly charged to the clearance operation out of dredging accounts in hand that supported the maintenance of the Galveston Channel. Any work assignments outside of District capabilities were preferably in activities extraordinary to ongoing District work. The task definition then carried responsibility for work guidelines and assignment of sub-tasks. Those that the District could handle directly were retained. This situation emphasized the need for accurate cost accounting and the role of the District organization in the operation.

The initial estimate of the situation prepared by Searle Consultants set forth the alternatives for the technical procedures required. Although MACKENZIE was an effective and productive dredge at the time of her loss, the vessel was 50 years old; to salve, restore and return her to service, was technically feasible but uneconomical. The best economic solution then maximized the scrap returns and minimized the clearance costs.

Initial command decisions were devoted to reducing the immediate hazard by dredging a bypass and planning a clearance action that would efffectively employ District assets and minimize overall costs. By and large,this phase of the decision making was made between 25 April and 20 May 1974, in a period of about 25 days after the sinking. No real economic or operational hazard for channel usage existed after that time. By 20 May the alternatives for clearance and disposition had been sufficiently analyzed so that rational choices could be justified, and the remainder of the work was committed on the basis of greatest overall economy.

4.2.2 Organization of the Operational and Supporting Forces

Task	Primary Contractor	Secondary Support
Provision and Maintenance of Work Barge, Lift Crane and industrial ban on site	Hunter Flores to U.S. Army	District Eng. USA Sup. Salv. USN Murphy Pacific
Diving and underwater work	Ocean Systems Inc. Buck Steber Inc. to Murphy Pacific	Murphy Pacific Sup. Salv. USN
Explosive cutting	Technical Explosives to Murphy Pacific	Resident Eng. Murphy Pacific
Heavy Lifting	Teledyne to U.S. Army	Murphy Pacific Hunter Flores
Project Engineering	Alex Rynecki to Murphy Pacific	U.S. Navy; Rynecki / Saveker
	Primary CE Staff	
Base Support. launch service, materials	Resident Eng. at Fort Point	Murphy Pacific Sup. Salv. USN
Financial Review	District Eng. with Resident Eng.	Sup. Salv. USN Murphy Pacific
Operational Liaison NOTAMS, PIO	District Eng. with Resident Eng.	Sup. Salv. USN

The District Engineer held periodic meetings at Galveston District Headquarters to formally review cost and progress with the U.S. Navy Supervisor of Salvage Representative and Resident Engineer. The Salvage Master maintained a steady surveillance of activities on the site; all hands were responsive to the needs defined by the Salvage Master in progress of the work. The major scheduled events became the intervals of MOVIBLE NO.II lifts and all preparations were phased to these periods.

4.2.3 Operational Successes and Difficulties

In general the setting of the plan and its accomplishment was successful in each phase. There were some troublesome but minor technical problems , that were time consuming in their solution, even though they had no great bearing on the outcome.

The first of these had to do with the use of explosives as a cutting technique. During the first weeks of the cutting efforts major difficulties were encountered in maintaining efficient shot geometries, and the placement of the charges to make a clean cut was complicated by the lack of satisfactory attachment methods. One-half inch steel plate can be cut with less than 0.5 lb./ft. of explosive, provided there is no mechanical impedence between the plate and the explosive shock wave detonation front. As the explosive weight or total shock wave energy in the line charge is increased to overwhelm losses from explosive standoff, secondary phenomena begin to produce negative effects. In this instance, the use of heavier line charges induced secondary bubble pulsations that tore the dunnage, led to time consuming diver disorientation and complicated access for continuing diving operations. This objection was largely removed in later explosive cutting operations by using shorter length line charges, and by devising a fastening system with hooks and Bongee cords that permitted more accurate positioning. Had this technique been used initially, considerably more explosive cutting would have been achieved on the job.

There was some time loss on the first heavy lift phase caused by not initially rigging each piece to the full capacity of the big crane. Experience shows that this is fairly common in preparation for heavy lift evolutions. The advantages of basic preparatory precautions were fully realized on the next two heavy lift intervals.

There were no loss time accidents incurred during the whole operation. Safety standards were defined by the District Engineer and safety inspections by District Safety Inspectors were periodically made. Everyone wore the required life belts on the site, and a conscious effort was made by all hands to observe safety requirements.

The weather had a remarkably small negative effect on the conduct of operations. A review of the Salvage Master's situation summaries totals about 60 hours out of the 2172 hours time taken to do the overall job, or less than 3% down time for weather on the main salvage cutting and lifting effort. The fact that weather did not preclude a greater percentage of available time was fortunate, for a 10% contingency for this factor had been included in the original work analysis.

4.2.4 Performance Parameters and Overall Achievements

"Cutting in place" and rigging for removal was essentially a task for divers. Each diver requires time to learn his working area, as a blind man must put in mind all spatial and form features of his habitat. The diver's work must be layed out so that he becomes familiar with his routes. Underwater oxy-arc burning is the type of job that almost demands one man-one cut assignments. Approximately one third of all diver time was spent in oxy-arc cutting, and this was achieved at a rate of about 1.36 feet per diver shift hour. Actual cutting rate would approach 4 feet per hour when burning was underway. The assignments of the Ocean Systems divers to the forward areas of the wreck, and the Buck Steber team to the after end kept the assignments of contracted tasks on a well defined basis. It also placed the teams in comparative situations and challenged each diver's individual pride to accomplish specific objectives. Consequently, individual productivity was generally high.

At least one man and usually two were in the water during the time that diving operations were scheduled. This gave each diver about 4 to 5 working hours per 12 hour shift. It is estimated that about 18 man-hours of actual underwater work were accomplished per shift.

Could the process have been accelerated by the addition of diving teams? Considering the limited access through the stacks and the fact that the umbilical lines had to be tended from these positions, the incremental gain by having additional men assigned would have been small. There were enough divers to meet the initially projected schedule, and they shared equally in the assigned jobs. A one team additional increment per shift would not have made a 20% increase in work accomplished.

There were no significant delays for lack of men, material or tools on the site. The only critical supply item was oxy-arc cutting rod; although supplies were threatened from time to time, intervention by U.S. Navy Supervisor of Salvage Representative guaranteed a steady supply. The fact that the operation was conducted in an area that had wide ranging commercial capability to support the offshore oil and local ship building and petro-chemical industries made procurement of necessary equipment fairly easy. There were several local Galveston marine machine shops and marine contractors that lent responsive support to the operations' industrial needs. Direct maintenance, welding, burning and general rigging assistance was provided from Hunter Flores men in the LIMA 400 crew.

Daily purchasing and provisioning chores were handled by the Murphy Pacific Office Manager with the assistance of the District Resident Engineer's Office. Radio contact was maintained between the office trailers and the work site, and launch availability was provided on 15 minute call by the Resident Engineer on a 24 hour a day basis. Both of the Fort Point YTL's were available on call, and neither craft missed any task assignments for unscheduled repairs.

Oil pollution never became a serious problem; initial precautions to cap the vents and overflows were successful. The offloading accomplished in mid-May was the real solution to the problem. The deployment of the boom around the wreck and the occasional use of the skimmer was more a demonstration of readiness than a case of actual need.

4.3 Lessons Learned

- A careful initial survey and detailed planning is a requisite for an economically successful salvage operation.
- It is feasible to employ several different organizations on a salvage project, given a clear definition of the objectives of each group, and providing competent leadership of each group with clear responsibilities to an overall command.
- Adequate logistic support is required to bring the operational plan to a successful conclusion.
- Oxy-arc cutting in separating ship sections can be positively supplemented with explosive cutting.
- Rig to the capacity of the crane on every heavy lift.
- Cost accounting can be a positive tool to assure control of an operation.
- Stock up on long lead items.
- Find several responsive bidders and negotiate.
- Make every effort to cooperate with local environmentalists.
- Document each operational phase with photographs.
- Organize regular site visits for local and state officials.

SECTION 5. APPENDIX

5.1 Bibliography

5.1 BIBLIOGRAPHY

(1) U.S. Army Corps of Engineers, Galveston District "After-Action Report on Salvage of Hopper Dredge A. Mackenzie" 24 April - 16 September 1974.

(2) U.S. Naval Ordnance Laboratory Memorandum 9424 of 21 November 1947 "Report of Conference on the Effects of Explosions on Marine Life",5 September 1947.

(3) Hubbs, Rechnitzer "Reports on Experiments Designed to Determine Effects of Underwater Explosions on Fish Life", Scripps Institution of Oceanography New Series No. 576, March, 1952. California Fish and Game Quarterly, vol. 38, No. 3, July, 1952.

(4) Brown, Chas. L. "Effects of Underwater Demolition on the Environment in a Small Tropical Marine Cove" Naval Underwater Systems Center, Newport, R.I. 4459, 11 December 1972.

(5) Salvage Master's Report of Salvage Operations in the Case of Hopper Dredge A. Mackenzie from 6 May - 20 August 1974; Captain Cyrus E. Alleman. Salvage Master's Report of Bay Bottom Clean Up Phase; Captain U.E. Sweeting. Murphy Pacific, New York Division.

5.2 Documentation of Task Assignments

15 May 1974

MEMORANDUM OF UNDERSTANDING
BETWEEN
GALVESTON DISTRICT CORPS OF ENGINEERS, U. S. ARMY
AND
SUPERVISOR OF SALVAGE, U. S. NAVY

In recognition of the critical incident created by the accidental sinking of the Government-owned hopper dredge MACKENZIE in the Galveston Inner Bar Channel on 24 April 1974, the Supervisor of Salvage, U. S. Navy agreed to lend assistance to the Galveston District in removal of the vessel. In developing the most feasible plan to economically and expeditiously remove the sunken vessel, the capabilities of the two organizations will be utilized. This Memorandum of Understanding is written to verify the oral agreements that evolved in developing and implementing plans for salvage operations.

Task of Navy

Provide technical assistance to develop and execute salvage plan to remove the hopper dredge MACKENZIE from Galveston Inner Bar Channel as economically and expeditiously as possible to minimize delays to commercial vessel traffic and reduce danger of any further collision with sunken vessel. This is to be accomplished by utilizing Navy personnel, both military and civilian, and by utilizing the Navy's contractor, Murphy Pacific Marine Salvage Company, in performance of the task. The contractor, Murphy Pacific Marine Salvage Company, will work under the direct supervision of the Navy in accordance with the terms of established salvage contract.

The specific tasks are as follows:

1. Develop salvage plan and provide detailed cost estimate of equipment, materials, labor and technical supervision of the various phases of the operation.

2. Provide required Navy and contractor personnel, equipment, and materials to accomplish salvage operations. Utilize the logistical support of the Corps of Engineers as listed hereafter.

3. Provide required Navy and contractor equipment, and labor service to accomplish pollution control during salvage operations. Corps of Engineers personnel may be utilized when available.

4. Furnish weekly accounting of costs and obligations incurred in performance of the work and estimates of future costs.

5. Accomplish the task under the Corps of Engineers General Safety Requirements EM 385-1-1 or equivalent Navy requirements.

6. Maintain daily records of the operations for documentation of facts for testimony in future litigation concerning salvage operations.

Corps of Engineers Support

1. Furnish office space, available office equipment, communications (radio and telephone) and suitable office supplies that can be used for Navy and its contractor.

2. Provide Corps of Engineers floating plant consisting of launches, barges, tugs and miscellaneous equipment complete with operating personnel to support salvage operations.

3. Provide, by contract with private interests, derrick barges, cranes and tugs complete with personnel and supplies to lift and haul away salved materials and equipment.

4. Dispose of salvage materials and equipment removed from the sunken vessel through advertising and sale to private interests.

Cost Reimbursement to Navy

1. Navy personnel (civilian and military) - Per diem, transportation, and overtime.

2. Navy-owned equipment - Freight to and from Galveston, expense of repairs or replacement of equipment made unserviceable by salvage operations.

3. Murphy Pacific Marine Salvage Company contract costs - Schedule A costs as established in contract Nos. N00024-71-C-0234 (Salvage) and N00024-73-C-0273 (Pollution), reasonable non-schedule A costs incurred and 15 percent overhead applied to non-schedule A costs or as determined by audit before final payment is made plus a reasonable profit.

4. The Naval Material Command Support Activity (NMCSA), Webb Building, 4040 N. Fairfax Drive, Arlington, Virginia, 20360 performs and maintains official accounting records for the Naval Sea Systems Command. NMCSA will render Standard Form 1080's in accordance with its standard accounting and operating procedures. NMCSA forwards Standard Form 1080's on a monthly basis. NMCSA will submit a final billing when it is notified that it will receive no further vouchers citing costs incurred. The Supervisor of Salvage will endeavor to expedite the submission of vouchers to NMCSA, and will monitor their performance.

5. Since the accounting system used by NMCSA does not provide for detailed Standard Forms 1080 or for furnishing supporting vouchers, the Supervisor of Salvage will provide the Corps of Engineers with the following:

a. Copies of SF 1034 (Public Voucher for Purchases and Services Other than Personal) and back-up data substantiating the vouchers.

b. Copies of liquidated paid travel vouchers.

c. Copies of Government Bills of Lading or other transportation documents for shipment of equipment and salvage material.

6. Although reimbursement will not be made for regular time salaries of Navy personnel or for use of Navy equipment, records shall be matintained of these costs for use in litigation between the Federal Government and those responsible for the accident.

CDR USNR
Supervisor of Salvage
Naval Sea Systems Command
U. S. Navy

DON S. McCOY
Colonel, CE
Galveston District, Corps of Engineers, U. S. Army

Asst.
Director, Accounting Operations, Accounting Group
Naval Material Command Support Activity
U. S. Navy

DEPARTMENT OF THE NAVY
NAVAL SHIP SYSTEMS COMMAND
WASHINGTON D C 20360

TASK ASSIGNMENT

Contract Number	2. Task Number	3. Effective Date	Page	of
0024-71-C-0234	74-10	2 May 1974	1	2

Contractor	
Murphy Pacific Marine Salvage Company Suite 8833 One World Trade Center New York, New York 10048	5. Requisition Number 00C4-00C4-5-8090.96 6. Type of Task Per Diem

Appropriation Data 1741804.2472 000 00024 A 065872 2D 000000 009836000FZQ
Amount-$1,000,000.00. Funds are reimbursable to NAVSHIPS from Army Engineer District, Galveston, Texas MIPR SWDG-4001

Task Description

The Contractor is directed to assist the Supervisor of Salvage in the Salvage/Removal of the U.S. Army Corps of Engineers Dredge, A. MACKENZIE, which is sunk in the Houston/Galveston Ship Channel near Galveston, Texas. This assistance will include:

1. Preliminary Diver Surveys of the Dredge.
2. Off Loading of Remaining Bunkers.
3. Preparation of a detailed Salvage/Removal plan for approval by the Supervisor of Salvage.
4. Implementation of the approved plan.
5. Submission of weekly cost summaries for the salvage removal effort to the Supervisor of Salvage on-scene representative and Corps of Engineer personnel.
6. Submission of weekly progress reports on the operational and logistical aspects of the Salvage/Removal effort.

These services will be provided in the vicinity of Galveston, Texas.

This task will be directed by a Salvage Master. Additional Schedule "personnel and equipment will be provided as determined appropriate the Supervisor of Salvage Representative.

Government furnished equipment will be provided as determined appropriate by the Supervisor of Salvage on-scene representative.

No security clearance is required for the performance of this task.

Upon completion of the task fifty (50) copies of a detailed report

Contractor [ ] is [X] is not required to sign this document

Contractor | 11.

Name and Title of Signer | 13. Date | 14. | 15. Date 5 13 74

rphy Pacific Marine Salvage Company
ite 8835
e World Trade Center
w York, New York 10048

[illegible]-3-8090.96

Per Diem

. Task Description (Cont'd)

scribing the Salvage/Removal effort will be provided to the Super-
sor of Salvage.

. The desired completion date, including submission of the report,
30 October 1974.

DEPARTMENT OF THE NAVY
NAVAL SHIP SYSTEMS COMMAND
WASHINGTON, D. C. 20360

TASK ASSIGNMENT

Contract Number	2. Task Number	3. Effective Date	Page	Of
00024-73-C-0273	74-12	6 May 1974	1	2

Contractor	
urphy Pacific Marine Salvage Company 900 Powell Street eryville, California 94608	5. Requisition Number 00C4-00C4-2-8119.46
	6. Type of Task Per Diem

Appropriation Data 1741804.2472 000.00024 A 065872 2D 000000 009836000FZQ
mount-$100,000.00. This amount is the maximum liability of the governmen
d not the Contract price. Funds are reimbursable to NAVSHIPS from Army Engineer
strict, Galveston MIPR SWG-4C01.

Task Description

. The Contractor shall provide labor, services and material as required o support the pollution control phase of the Dredge McKenzie salvage oper tion in Galveston, Texas. Specific support requirements will be at the iscretion of the on-scene Supervisor of Salvage representative.

. Services are to be performed in the vicinity of Boston, Massachusetts; ewark, New Jersey; San Leandro, California; and Galveston, Texas.

. Government furnished equipment will be provided at the discretion of he on-scene Supervisor of Salvage representative.

. This task will require the services of the New Jersey warehouse super- isor (Mr. R. Allen), the Jacksonville warehouse supervisor (Mr. H. Green) nd any additional personnel as specified by the on-scene Supervisor of alvage representative. Mr. Green will proceed to Galveston in the ompany-leased warehouse vehicle. Both warehouse supervisors will proceed o the salvage site when so directed by the on-scene Supervisor of Salvage epresentative. Accounting procedures and billing for services provided b arehouse personnel shall be in accordance with the provisions of TA 73-2E

. Upon completion of the salvage operation, the contractor shall prepare d submit a report of the pollution control phase of the operation. In ddition to detailing operational aspects of the pollution control effort, he report should address problems and observations relative to the ship- ent and deployment of the prototype skimmer and containment boom employed

. No security clearances are required for the performance of this task.

Contractor [ ] is [X] is not required to sign this document.

Contractor	11. United States of America
. Name and Title of Signer	13. Date	14. A. K. Peasly, RAdm., USN Ass't. for Logistics and ...	15. Date /6/74

-160-

N00024-73-C-0273 74-12 6 May 1974

Murphy Pacific Marine Salvage Company
1900 Powell Street
Emeryville, California 94608

00C4-00C4-2-8119.46

Per Diem

8. Task Description (Cont'd)

G. The salvage of the Dredge McKenzie is expected to extend over a period of approximately three months. Pollution control support will be terminated at the discretion of the on-scene Supervisor of Salvage representative. The report specified in paragraph 8E above will be due 30 days after termination of pollution control operations.

5.3 Lift Weight Log Records, Phase I, II, III

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77550

29 June 1974

SUBJECT: Lifting Sequence on Bow and Stern Sections of Dredge A. Mackenzie

MEMORANDUM TO FILES

1. Attached is a tabulation of data obtained during the first major lifting phase of A. Mackenzie salvage operations.

2. The weight readings were obtained by monitoring the Martin-Decker gauge on the crane operator's control panel of the Teledyne Movible 500 ton derrick barge, Movible DB-2. The data is presented under a log type format and covers the entire lifting sequence.

1 Incl
Weight Readings

J. D. BISSELL
Resident Engineer
Mackenzie Salvage Operations

WEIGHT READINGS
LIFTING SEQUENCE - BOW & STERN SECTIONS
HOPPER DREDGE A. MACKENZIE

DATE & TIME	WEIGHTS & COMMENTS
24 Jun 74 /Monday/	
1700	Making final preparation to made lift of bow section.
1715	Holding (25T - 30T), 50T, 70T, 80T up to 100T and slack off / up & down between zero tonnage & 120T.
1737	130T jumps to 144T / slack off / up & down
1740	Appears that the bow is clearing bottom at approximately 140T with 144T break out.
1804	150T to 160T
1807	Surges 190T / holds at 170T / swing crane to left/ 160T swinging crane to left 170T.
1814	Up & Down/ all stop/ divers down.
2000	Coming up after divers' survey & cutting/ 20T, 40T 60T, 80T, 120T hold/ slack off / up & down.
2014	Coming up off bottom w/104T.
2045	Boomed up to 72^{o} from 60^{o}.
2107	Boomed up to 74^{o} / divers down to survey and cut as necessary.
0001 - Begin new day - 25 Jun 74 / Tuesday	
0052	Preparing to make lift / pulling divers out of water.
0107	Up & Down / 40T, 80T, 110T hold, 115T hold.
0110	170T, 230T, 240T / hold 225T
0113	233T, 240T, 250T
0114	290T
0115	295T, 298T, 300T & holding / weight goes up to 320T / slack off.
0118	boom down to 56^{o}.
0122	190T / all stop.

DATE & TIME	WEIGHTS & COMMENTS
25 Jun 74 (cont'd)	
0124	308T / weight shifts / unraveled one sling (port-aft sling) in top eye.
0130	Swinging crane to left w/160T
0131	Same as above
0132	210T / 212T
0140	Slack off & boom up to 72^{o} / 240T / 248T
0146	Slack off / on bottom / rigging up again with divers down.
1215	Making final preparations to make lift.
1244	324T & out of water w/bow lift
1253	Coming all the way up 320T/322T
1255	324T / swinging to left
1258	320T / coming over barge
1300	320T / over barge all the way
1335	Zero weight & anchoring down.
26 Jun 74 - Wednesday	
0750 :	Tug Gulf Storm pulling Southwest with 4 to 6 inch nylon rope & frees stern section w/216T on guage/ Stern section was pinned in wreckage when a mooring broke.
0800	Boat deck awash w/320T
0810	Main deck out of water / 325T
0815	Coming down / 335T / 340T (booming down)
0820	Port side / bow pick chain damaged w/possible failure resulting / examining
0830	Back down / 40T / all stop / holding 6T to zero weight & re-rig forward picks

DATE & TIME	WEIGHTS & COMMENTS
26 Jun 74 (cont'd)	
1751	Hooked up & coming up
1754	Holding 58T
1755	Booming up (62^{o}) / 116 T
1757	Air compressor & power down / 204T / hold
1759	Power & air compressor up (204T) building up pressure
1800	Coming up / 210T / 220T / 230T / 240T / 250T
1803	Breaks out of water / 258T / stern down & cut up / coming up
1805	Jumped from 280T to 332T / all stop
1812	Up a little bit / 322T
1815	Up a little / 328T / drops to 324T
1816	Coming left w/crane / let down & boom up/ 330T 62^{o} boom & letting down
1821	On bottom / holding 18T
1923	Coming down on 3 / zero weight / shortening stern lift chains
2100	Swinging left & coming up / 20T, 40T, 60T & 80T/ tight slings/ 90T / 100T / 110T / 120T / 130T / 140T / 160T / 170T / 180T / 190T / 200T/ 210T / 220T / 240T
2105	Holding 240 T & coming up
2106	240T boat deck awash
2107	250 / 254T / 258T / 260 / 274 T & hold / drops to 270T / undoing 4-6" nylon rope on starboard side & wire rope on port side

DATE & TIME	WEIGHTS & COMMENTS
26 Jun 74 (cont'd)	
2114	Coming up easy / 264T / 270T / 280T / 296T / 300T (boom at 62°)
2120	Main deck awash (310T) booming up
2122	62.5° / 330T / 340T / heavy silt run off indicated by very murky water
2127	Booming up / 63° / 346T
2134	340T (up a little) 346T / booming up to 63.5° / 348T
2147	Coming up 344T / booming up 63.75° / 360T / 380T & holding
2204	letting off to 320T / begin stripping stern boat deck of weight
0001 - Begin new day	27 Jun 74 / Thursday
0620	coming up 340T / 360T all stop
0624	Letting off/ stop 350T / coming up, stop 350T
0625	354T & holding
0630	Swinging left / 370T / coming up & booming up 360T / 370T / 375T & 64° on boom w/380T & stand-by / almost have bilge deck out of water
0650	Swinging right / 370T
0700	Holding 370T
0800	370T / Cy Alleman & Andy Webb on board stern section / hosing down & off-loading weight from machine shop
1315	Coming up 352T / 358T booming up (64.25°) 362T / 364T / 370T at 65°
1317	362T & holding
1322	Coming up easy / 358T & out of water
1325	Booming up 66° / 370T

DATE & TIME	WEIGHTS & COMMENTS
27 Jun 74 (cont'd)	
1327	Swinging left & booming up 370T / 372T / 378T 68.5° / 380T / 69.5° all stop
1329	71° / 380T / swinging left / 382T
1333	Coming over barge w/370T / 72° boom
1337	Touched down on barge / weight now at 200T / 73.5° boom angle.
1445	Zero weight

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77550

24 July 1974

SUBJECT: Lifting Sequence on Second Lift Phase of Dredge A. MACKENZIE

MEMORANDUM TO FILES

1. Attached is a tabulation of data obtained during the second major lifting phase of A. MACKENZIE salvage operstions.

2. The weight readings were obtained by monitoring the Martin-Decker gauge on the crane operator's control panel of the Teledyne Movible 500 ton derrick barge, Movible DB-2. The data is presented under a log type format and covers the entire lifting sequence.

1 Inc.
Weight Readings

J. D. BISSELL
Resident Engineer

WEIGHT READINGS
LIFTING SEQUENCE - SECOND LIFT PHASE
HOPPER DREDGE A. MACKENZIE

DATE & TIME	WEIGHTS & COMMENTS
22 Jul 74 /Monday/	
1300	Divers making up first two of 8 pendants
1310	Forward Port pair connected
1325	Forward Starboard pair connected
1350	Aft Starboard pair connected
1352	GULF VIKING with Army work barge standing off the big barge. GULF STORM standing by to assist.
1403	Hooking up final leg Port Aft.
1415	Final leg hooked up.
1425	Divers and tenders evacuated - coming up 40T = Barge alongside.
1427	At surface 80T, tugs away from barge.
1428	Wheelhouse out, surge - 100T. No trapped water.
1430	Clear - 105T - No great appearance of silt - trailing piping and wiring
1446	Slack - load on forward end of Army barge.
1505	Teledyne rigging crew aboard the wreck section removing slings. Pipe stanchions being fitted to stabilize the load.
1540	Slings clear of wreck.
1550	Making ready to dive on lower G
1600	Diver in water.
1700	Forward Port pair attached. First diver out, 2nd working.
1740	Slack tide, wind drift Northerly at surface
1748	Rigging 3rd sling, one sling to go.
1813	Connections made. Diver out.

DATE & TIME	WEIGHTS & COMMENTS	
22 Jul 74 (cont'd)		
1815	Securing from diving - bringing diving party off stack	
1817	Started lift lower G.	
1810	120 S/T	
1825	Broke free at 140 ton	Boom angle at 72°
1827	Broke surface at 180 ton and draining	
1831	Free from water at 180 tons	
1838	Set down on barge.	
1914	Slings free from lift	
1916	Tide on Flood between 1 -2 knots.	
1919	Rigging to put another anchor out.	
1947	Hooking to anchor	
2011	Dropping anchor in order to change barge position.	
2056	Diver in water to hook up to C-upper, Port side.	
2138	Secured Port side hook up and starting hook up to starboard side.	
2208	Change divers	
2221	Second diver in the water	
2251	Three slings hooked and hooking last sling	
2314	All slings hooked up	
2315	Diver out of water	
2316	Coming up	
2323	Coming up and free from bottom at 75 tons	Boom angle at 65°
2324	Free from surface at 105 tons	
2357	C-upper on barge and being unhooked.	

DATE & TIME	WEIGHTS & COMMENTS
23 Jul 74 /Tuesday/	
0016	Unhooked from C-upper
0041	Divers in water to hook up aft section B.
0120	Two slings hooked up.
0320	Starting on the last sling.
0336	Divers out of water
0345	One diver back into the water
0413	Second diver back into the water
0421	Both divers out of water. All slings hooked
0425	Free from bottom at 160 tons - boom angle 65^{o}
0428	Free from water at 300 tons - boom angle 67^{o}
0515	Temporarily stored on DB-2
	Section B transferred to small cargo barge later in the morning after scrap barges were switched out at Fort Point Boatyard.

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77550

22 August 1974

SUBJECT: Lifting Sequence on Third and Final Lift Phase of Dredge A. MACKENZIE

MEMORANDUM TO FILES

1. Attached is a tabulation of data obtained during the third and final major lifting phase of A. MACKENZIE.

2. The weight readings were obtained by monitoring the Martin-Deck gauge on the crane operator's control panel of the Teledyne Movible 500 ton derrick barge, Movible DB-2. The data is presented under a log type format and covers the entire lifting sequence.

1 Incl.
Weight Readings

J. D. BISSELL
Resident Engineer

WEIGHT READINGS
LIFTING SEQUENCE - THIRD & FINAL LIFT PHASE
HOPPER DREDGE A. MACKENZIE

DATE & TIME	WEIGHTS & COMMENTS
m	SECTION F (Upper)
19 August 1974	
1217	208T
1218	Something breaks loose - 165T
1220	1 sling slack; turning; 160T, 165T; booming up 68.5°
1221	172T, 188T
1222	184T; coming up; boom up 70°
1223	190T; 2 slings slack;
1224	194T; 198T stop; 200T; silt drain-off is heavy
1227	Coming up; 190T
1228	190T; stop and hold; now turning to port; swing around
1229	Coming over barge, 188T
1231	Over barge & setting down, 188T
1237	Trying to set down on barge with weight distributed evenly, 220T on guage.
1238	Set down; holding 62T
1240	Coming down, 30T
1254	Zero weight.
	SECTION F (Lower)
1525	Divers down to rig up
1710	Boom up 50°; no weight
1729	Coming up 10T; 20T; slack off; divers out; up
1730	Booming up 54°; 30T; 57°
1731	Booming up 61°; 65°

WEIGHT READINGS
LIFTING SEQUENCE - THIRD & FINAL LIFT PHASE
HOPPER DREDGE A. MACKENZIE

DATE & TIME	WEIGHTS & COMMENTS
19 August 1974 -	SECTION F (lower) (Cont'd)
1732	Coming up; boom up 68^{o}; 190T; 200T
1733	210T; 230T; 240; 244T; 69^{o} boom angle.
1734	Holding 238T; waiting on rig foreman; coming up; 232T; 220T; broke free; holding 220T
1735	218T
1737	216T; breaks surface of water
1738	220T; 230T;
1739	227T; coming up
1740	All stop; jumped to 268T
1742	Coming up; 269T; jumps 312T
1743	300T; section clears water; 69^{o} boom angle
1744	310T holding and swinging left; 315T; 310T
1745	325T; 315T
1746	Swinging over barge; 320T
1747	Over barge; 312T; boom down to 68.5^{o}
1748	Setting down--no true reading, bouncing to set down.
1751	Booming & letting down 66^{o}; 240T
1752	Re-start main hoist engine
1754	95T; letting off
1755	58T; on barge
1756	Zero Weight

WEIGHT READINGS
LIFTING SEQUENCE - THIRD & FINAL LIFT PHASE
HOPPER DREDGE A. MACKENZIE

DATE & TIME	WEIGHTS & COMMENTS
m	SECTION F (Upper)
19 August 1974	
1217	208T
1218	Something breaks loose - 165T
1220	1 sling slack; turning; 160T, 165T; booming up 68.5°
1221	172T, 188T
1222	184T; coming up; boom up 70°
1223	190T; 2 slings slack;
1224	194T; 198T stop; 200T; silt drain-off is heavy
1227	Coming up; 190T
1228	190T; stop and hold; now turning to port; swing around
1229	Coming over barge, 188T
1231	Over barge & setting down, 188T
1237	Trying to set down on barge with weight distributed evenly, 220T on guage.
1238	Set down; holding 62T
1240	Coming down, 30T
1254	Zero weight.
	SECTION F (Lower)
1525	Divers down to rig up
1710	Boom up 50°; no weight
1729	Coming up 10T; 20T; slack off; divers out; up
1730	Booming up 54°; 30T; 57°
1731	Booming up 61°; 65°

WEIGHT READINGS
LIFTING SEQUENCE - THIRD & FINAL LIFT PHASE
HOPPER DREDGE A. MACKENZIE

DATE & TIME	WEIGHTS & COMMENTS
19 August 1974	SECTION E (Upper)
1830	Divers in water to connect
1903	Boom angle 59°. No load
1925	Boom angle 50°. No load
2014	Boom angle 49°. No load
2025	Divers out of water
2029	Booming up 15T; boom angle 50°
2030	55°; 40T
2031	80T; boom angle 59°
2032	Coming up; angle 64°; 90T; 88T broke off bottom
2035	Broke top of water 88T; angle 64°; holding at 94T
2040	Coming up 90T; angle 64°; 98T
2041	Cleared water 100T
2042	Holding 98T
2043	Swinging 125T
2045 :	Setting down on crane barge 130T; angle 64° Waiting on barge
2142	Barge arrived; swinging over 128T, 64°
2145	Booming down 61°; 128T
2146	Booming down 59°; 120T
2149	Coming down 57°, 110T
2153	Zero weight.

WEIGHT READINGS
LIFTING SEQUENCE - THIRD & FINAL LIFT PHASE
HOPPER DREDGE A. MACKENZIE

DATE & TIME	WEIGHTS & COMMENTS
19 August 1974	SECTION E (Lower)
2236	Diver in water
20 August 1974	
0005	Diver up - connected
0006	Coming up 10T, boom angle 60°
0007	Booming up 63°; 140T
0008	240T; 320T; 280T; holding; 300T; 320T
0009	Holding at 320T; boom angle 64°
0010	Booming up 67°; 300T
0011	Holding at 210T; 220T; angle 69°
0012	Coming up at 225T; boom angle 69°
0014	Broke water at 220T
0015	All stop at 235T, angle 69°
0016	Coming up at 252T; holding 252T
0018	Coming up at 270T; holding 270T
0021	Coming up at 260T; 270T; 280T; holding at 295T boom angle 69°
0025	Coming up at 290T; 300T holding
0027	Coming up at 310T; 320T; 330T holding. Cleared water surface
0034	Coming up at 320T
0035	320T, coming up; 360T holding
0036	Swing to barge 345T
0037	360T; 390T; boom angle 74° 380T holding
0045	Zero weight

WEIGHT READINGS
LIFTING SEQUENCE - THIRD & FINAL LIFT PHASE
HOPPER DREDGE A. MACKENZIE

DATE & TIME	WEIGHTS & COMMENTS
20 August 1974	SECTION D (Upper)
0114	Divers in water
0400	Divers out of water; booming up 50°; no load; 52°; 53°; 57°
0405	Boom angle 60°,20T; 66°; 68°, 30T; 40T; 50T
0406	Coming up, boom angle 68°, 75T
0407	Broke water surface 80T, boom angle 68°
0410	Cleared water surface 85T, boom angle 68°
0412	Swinging over barge 85T
0420	Holding 105T, boom angle 36°
0430	Zero weight
	SECTION D (Lower)
0505	Divers entered water
0615	Tide running strong; difficult to hook up; divers out of water
0745	Diver down
0905	Swing left; 15 ton; slack off; 3 out of 4 legs hooked up
0921	Diver out of water
0922	Coming up
0924	62° boom angle; 120T; 160T; 170T; 180T; 200T; 220T; 240T; 270T; all stop
0925	320T; 340T; all stop; coming down; 300T
0926	80T; boom up; 120T 66° boom angle
0927	240T; 280T; 320T; jumps to 352T

WEIGHT READINGS
LIFTING SEQUENCE - THIRD & FINAL LIFT PHASE
HOPPER DREDGE A. MACKENZIE

DATE & TIME	WEIGHTS & COMMENTS
20 August 1974	SECTION D (Lower) Cont'd
0928	Loose; weight drops 320T; section turning in water; 275T
0929	270T; 66° boom angle; 265T
0920	268T; holding to drain off silt and water
0936	Coming up again, 316T; holding for water and silt drain off
0940	312T; coming up; 310T; 338T and holding; draining one tank and bilge area; heavy silt run off
0946	Coming up; 324T; section completely out of water
0949	Swing left; 320T
0950	334T; coming over scrap barge
0952	370T over barge and letting down (good weight)
0954	Set on barge; 138T
	SECTION C (Lower)
1230	Hooking up last shackle, strong tide
1241	Pulling divers out of water
1246	Moving Lima 400 Hunter Flores barge out to anchorage area
1253	Booming up from 54° angle
1254	40T at 62° boom angle
1255	98T; 65.5° boom angle; stop booming; coming up 170T; 180T; 190T, broke free
1256	Booming up 68° angle; 190T
1257	68.5° boom angle; 190T section breaks surface of water
1259	Still coming up slow; 200T; 205T; 210T; 225T; all stop

WEIGHT READINGS
LIFTING SEQUENCE - THIRD & FINAL LIFT PHASE
HOPPER DREDGE A. MACKENZIE

DATE & TIME	WEIGHTS & COMMENTS
20 August 1974	SECTION C (lower) Cont'd
1300	Coming up 225%; 228T
1301	Booming up 230T; 240T; 250T; 262T; 69° boom angle; picking up 260T; section completely out of water
1302	280T; 290T; 300T; all stop: swinging left
1303	Swing left and booming up 310T; 70.5°; 312T holding - draining silt and water - heavy silt runoff.
1310	Coming up 290T
1312	Swinging left eash; 312T--good weight.
1314	Coming over barge 312T; easing down
1316	Over scrap barge and letting down
1318	30T and touch down firm on scrap barge
1321	Zero weight

5.4 Report of Salvage Operations

Captain Cyrus E. Alleman
Captain U.E. Sweeting

REPORT OF SALVAGE OPERATIONS
In the Case of
HOPPER DREDGE A. MACKENZIE

Sunk in the harbor channel approach to Galveston, Texas in 49 feet of water.
Position 29° 20' 45" N 94° 43' 10" W.

Length - - - - - - - - - -	268'
Breadth - - - - - - - - - -	47'
Moulded Depth - - - - - - -	22' 6"
Mean Draft (Light)- - - -	14'
Displacement - - - - - - - -	3580 L/Tons
Owner - - - - - - - - - - - -	U.S. Govt. Army Corp Engineers
Flag- - - - - - - - - - --	U.S.A.

Salvage Master
Cyrus E. Alleman

On 24 April 1974 the Hopper Dredge A. MACKENZIE was involved in a three ship collision in which the tanker vessel BOW ELM, maneuvering to avoid the Exploration vessel IDA GREEN, rammed A. MACKENZIE bow on into the engine room at frame 42 starboard side. The stricken dredge sank with her hull nearly at right angles to the N.E. half main ship channel restricting traffic enroute to and from the busy ports of Galveston and Houston, Texas.

On 3 May 1974 I received a radio message from Capt. Madeo advising that Capt. H. Crusoe would relieve me when M/V Rescue arrived in Cristobal Panama with SEAFORD in tow. I would then proceed as soon as possible to Galveston, Texas and assume responsibilities as Salvage Master for removing the A. MACKENZIE from her sunken position as listed above.

I departed M/V Rescue at midnight on 5 May leaving her at anchorage in Cristobal harbor and journeyed via Panama City and Miami, arriving in Galveston in late PM the same day.

At 2218 I checked in at Gaido's Motel on west beach and immediately contacted Capt. R. Belsher and A. Rynecki. We discussed the A. MACKENZIE situation in brief and made plans to survey the wreck on the following day.

Monday 6 May 1974

0930 In company with Mr. J. Walker and A. Rynecki, I paid a brief visit to the local officer of the Army Corp of Engineers in order to meet the persons in charge and to obtain additional blue prints of the wreck.

1008-1115 Mr. Walker and I visited the wreck site in company with Mr. Rynecki. Calveston channel was quite choppy with the strong S.E. wind and opposing Ebb tide and it was immediately apparent that there would be problems with diving and in mooring the work vessels in relation to the heavy tide action.

1408 Commenced loading diving and mooring equipment on board the work barge LIMA-400, a vessel provided for by AEC through a separate contract to be utilized during the oil removal phase. LIMA-400 is a vessel 196 feet in length with a 48 foot beam. Her deck machinery has the capacity to accomodate a 4 point moor and her whirley crane can be rigged to pick an honest 50 tons with her 110' boom.

1700 Completed loading and rigging LIMA-400 work barge.

Note Three diver tender teams from Ocean Systems Inc. with Gerald Todd in charge as diving supervisor had been previously engaged by Capt. R. Belsher to accomplish the underwater survey and remove the remaining fuel from the vessel.

Tuesday 7 May 1974

0700 Departed the AEC dock embarked in the LIMA-400 work barge accompanied by tugs EDCO and WOLF II.

1110 After considerable maneuvering and one false start the LIMA-400 was moored in a three point system with her bow adjacent to A. MACKENZIE's port side.

1245 Divers commenced underwater survey of the A. MACKENZIE.

The vessel was found to be resting in 49 feet of water on near even keel but trimmed about five feet by the stern. Diver's depth gauges read 21 feet at the boat deck level aft and 15 feet forward at the same designer's water line plane. Generally the bottom was found to be medium hard clay and sand with considerable shell embedment. The wreck appeared to be resting firmly on the bottom along her entire length with her bow section resting on and embedded in the North East channel bank and the stern projecting nearly to the edge of the South West section of the channel. Attempts to dredge a detour channel to the north were currently in progress but only partially successful.

The collision damage consisted mainly of a "V" shaped gash in the starboard side of A. MACKENZIE, extending from the boat deck to the top edge of the bilge strake and centered at about frame 42.

Divers made a complete survey around the hull finding no additional damage worthy of note.

During the PM I was able to spend considerable time with the A. MACKENZIE's chief engineer Mr. Carl Hoffman, gleaning information from him concerning fuel and lube oil remaining on board the sunken vessel.

The remaining ship's life boat was removed during the afternoon and divers removed the ship's plaque from the bridge house.

1700 Secured diving operations for the day.

During the late PM I attended a meeting in company with A. Rynecki and several U. S. Navy representatives from the office of the Supervisor of Salvage. We formulated and agreed to a tentative salvage plan for cutting off the top hamper and then severing the vessel into three pieces.

The center portion (the hopper spaces) would be cut in place and lifted to scrap barges while the remaining end portions would be raised with some form or combination of internal buoyancy. I enlisted the aid of Mr. Rynecki in making a study of the buoyancy requirements allowing for a permability factor of 30%

2330 I received a telephone call from Mr. P. S. Barracca during which we discussed the general situation related to A. MACKENZIE.

Wednesday 8 May 1974

0700 Departed AEC docks in launch with salvage crew on board. Weather mostly cloudy with moderate wind and sea from East South East.

0725 Arrived at wreck site. On boarding the work barge it became immediately apparent that the incoming tide (estimated velocity 2.5 knots) would present serious problems to the divers working on the exterior of the sunken vessel.

The first diver to enter the water was swept under the work barge and had to be hauled back to the surface. On the second attempt he was able to hold himself on the boat deck of the wreck but was not able to accomplish any worthwhile work.

1000 The work barge was shifted along the wreck until it was adjacent to the pilot house area to facilitate burning off the above water top hamper (tri-pod fore mast).

During the course of the days work divers removed the ship's bell, the steering wheel and other small items requested by AEC.

Although the starboard launch was reportedly still in place on the boat deck starboard aft, divers were unable to find any trace of the small craft and it was assumed that strong tidal currents must have carried the little vessel away.

Commander B. Moss visited the wreck site during the AM and returned again in the mid PM hours with an AEC (flag rank) officer who circled the wreck close by in a launch but did not come on board.

Although the salvage plan was discussed again in the evening meeting with SUPSALV representatives and Mr. Rynecki, no significant changes or modifications were noted.

Thursday 9 May 1974

0725 On arrival at the wreck site we found that the work barge stern anchor wire had parted during the night; apparently having been cut by the propeller of some small craft with a shaft diameter of about 5-6 inches. The incident reportedly occurred at 0050 hours at a time when the attending tug boat personnel were not in the pilot house.

The crew of tug WOLF II said that they felt a surge and the impact from the tug being thrown against the crane barge at about the same time the anchor wire was thought to have parted. The strong ebb tide then pushed the barge and attending tug around the bow of the wreck fouling the remaining mooring wires. The crane barge was remoored and by 1300 hours the divers were rigged and ready to commence burning operations again. A section of dredge pipe davit was removed during the PM, approximate weight 5.5 tons.

Divers also investigated the after section of the vessel in way of the diesel fuel tanks in preparation for removing all remaining bunker materials. Assuming that the near collision the previous night may have been partially due to a poor showing of signals from the LIMA-400, the necessary day shapes, flags and night signal lights were obtained and rigged during the day.

1745 Secured diving operations for the day. Later in the evening I met with Mr. P. S. Barracca to discuss management organization for the A. MACKENZIE and to briefly outline our tentative salvage plan.

Friday 10 May 1974

At 0700 the salvage crew departed AEC docks. A rain storm moving in with strong winds from the South East gave promise of inclement weather for the days operation.

0810 Divers in the water but unable to accomplish work outside the hull due to the strong flood tide. Divers and crew working at rigging stages and removing usable fittings from A. MACKENZIE's rigging.

0830 The chief engineer (Mr. Carl Hoffman) of A. MACKENZIE came on board to answer questions concerning the status of bunker fuel remaining on board the vessel.

1130 I returned to shore for a brief meeting with Mr. P. S. Barracca concerning weather and tide conditions at the wreck site and the possibility of using foam buoyancy to refloat the vessel.

1315 I returned to the wreck site in company with Lt. Hoppe, USCG, to arrange for a diver's inspection related to the position of certain watertight doors and fittings on board the vessel; information which could be of value to the board of investigation for the collision incident.

Weather continued very rough during the PM but was able to work divers in the lee to port and cut of the port drag pipe.

2000 Continued discussions with the project engineer and SUPSALV representative concerning the tentative salvage plan.

Saturday 11 May 1974

Weather continued overcast but the strong winds of the previous day had moderated somewhat and shifting around to a light breeze from the north.

0720 On arrival at the wreck site the tide was just commencing to flood after a reportedly strong ebb during the hours of darkness.

It was obvious at this time that A. MACKENZIE was settling lower into the bottom, especially at the bow, which was originally embedded in the North East bank of the channel. Diver's depth gauge recordings at the boat deck level now indicate that the wreck is now on nearly even trim.

1000 Ceased diving operations externally due to strong tide action.

1030 Mr. Walker and Lt. Hoppe USCG on board to continue investigation of the water tight integrity on A. MACKENZIE.

1200 Mr. J. Walker and party returned to shore leaving Lt.Hoppe and R. Calhoun on board to continue the investigation.

During the PM the divers completed the survey of water tight fittings for Lt. Hoppe and rigged the port drag pipe for pick up.

1830-2000 Continued discussions with the project manager and project engineer concerning the tentative salvage plan.

Sunday 12 May 1974

On arrival at the wreck site at 0740, weather and tide conditions were found to be favorable.

During the work day divers were able to burn off the port forward dredge pipe davit and make an internal inspection of the hopper section, finding #3 and #4 hoppers starboard to be full of mud.

Messrs. J. Walker, A. Rynecki and F. Smith on board to discuss progress and the tentative salvage plan.

2000 I attended another evening meeting of engineers and project manager to continue discussions of the salvage plan with the ideas of cutting away the hopper section and inducing foam buoyancy into the remaining bow and stern sections.

Monday 13 May 1974

Bad weather and tide conditions this day were adverse with a flood tide in excess of 3 knots at the wreck site and strong winds from the South East. The decision to gain vertical access into the wreck through the smoke stacks proved to be of considerable value so I contracted to cut the stacks to about 3' above the water line and fabricate work platforms for the divers and their tenders across the stack structure.

The oil polution control team were on site to lay out and deploy the oil boom and related mooring equipment.

1510 I departed the wreck site to attend to business matters ashore.

I telephoned Merritt keeping them informed of progress, discussed the salvage plan and the need for a proficient office manager on the beach.

1630 Attended a meeting with the Corp of Engineers to discuss the tentative salvage plans; Col. McCoy not present.

2000 At dinner with the project manager and project engineer it was learned that the AEC may have strong objections to raising the vessel with foam buoyancy and would much prefer to cut in place and sell the vessel for scrap.

Tuesday 14 May 1974
The diver teams arrived at wreck site at the usual time but I remained on shore for a brief meeting with the project engineer concerning problems related to A. MACKENZIE SALVOPS.

0825 On arrival at the wreck site I found weather conditions to be somewhat adverse with 18-20 knot winds and a choppy sea running from the South East. During the work day divers removed the port drag control house, the port drag arm pipe and one drag arm davit also; from the port side.

1105 USCG buoy tender on site rigging and laying anchors and buoys for the oil containment boom.

1618 Tug KEVIN "T" with scrap barge pushing ahead arrived at wreck site to off load scrap taken from A. MACKENZIE.

Secured diving operations for the day for safety reasons while transferring scrap metal.

1810 Completed loading scrap and ceased all salvage operations for the day.

1840 Attended another meeting with the project manager and project engineer concerning the salvage plan for A. MACKENZIE. All aspects of the problem considered, it became increasingly apparent that cutting the vessel in place would be the safest, most certain and most expedient method of removal.

2205 After a brief telephone conversation with Capt. Madeo, I met with Mr. P. S. Barracca to discuss the outlined salvage plan for cutting A. MACKENZIE in place.

Wednesday 15 May 1974
Weather and tide conditions this date for most part remained favorable. The work barge was shifted toward the stern of the wreck to facilitate work on the fuel tank units in preparation for removal of residual fuel from A. MACKENZIE. The LIMA-400 barge crew commenced alterations to the after stack for conversion to a divers access platform and tug NECHES commenced laying out the east leg of the oil containment boom around the wreck.

1330 Diver Andy Webb and tender from Buck Steber Inc. arrived at wreck site, set up gear and commenced diving the after section of the wreck. During the PM divers removed the after mast (king post) and related 5 ton boom and rigging.

Thursday 16 May 1974
Weather overcast today but wind and tide conditions remain favorable with a moderate to fresh South East wind holding the flood tide at near slack water.

Divers commenced cutting away the pilot house and removed the forward mast (king post) and boom.

1215 The oil polution control team completed laying the North West leg of the oil containment boom. The work barge crew completed assembly of oil removal piping and assisted the oil polution gang in placing the North East leg of the containment boom.

The South East wind picked up to 25 knots during the PM, resulting in heavy swells and choppy seas, and considerably hampered salvage operations.

Friday 17 May 1974
With weather conditions somewhat improved over the previous evening, the under water work was concentrated on preparations for removal of fuel oil remaining in A. MACKENZIE.

1020 Oil polution control team completed installation of oil containment boom around the wreck.

1630 The fuel barge from AEC arrived alongside the LIMA-400.

1705 Commenced off loading fuel from A. MACKENZIE to AEC fuel barge.

1815 Secured operations for the night, leaving the fuel barge moored alongside LIMA-400.

1905 During a brief meeting with Mr. J. Walker I agreed to make every reasonable effort to comply with safety regulations of the Army Corp of Engineers including every man wearing life jackets while engaged in the salvage operations.

Saturday 18 May 1974
0741 At wreck site and continued removal of fuel from the sunken vessel, using a combination of water displacement and air lift methods.

0955 Ceased pumping via the center line fuel tank vent. Water now coming from the discharge hose instead of fuel; between 9,000 and 10,000 gallons of diesel fuel having been transferred from the wreck to the fuel barge.

The fuel suction hose was transferred to each of the remaining fuel tank vent valves; in turn each of which was siphoned off for a period of 45 minutes, receiving mostly water from the discharge hose. The salt water displacement system was utilized in each tank through the ship's sluice valves to insure complete removal of fuel from each compartment.

1650 The tug EDCO with AEC fuel barge in tow departed the wreck site marking an end to the fuel removal phase of A. MACKENZIE SALVOPS.

Sunday 19 May 1974
The weather again favorable today and the work barge was shifted to the area adjacent to the forward stack and pilot house and divers commenced burning off the upper bridge structure and the deck house drag tenders quarters.

1220 LIMA-400 barge crew completed rigging the forward and after stacks as diver access stations; which allows the divers to gain access vertically into the engine room and main machinery space forward without exposing themselves to extreme tide conditions. The 8" air lift was rigged during the day and divers commenced removal of mud from the cargo hoppers.

Monday 20 May 1974
On arrival at the wreck site about 0720 the tide conditions were found to be extreme with the flood in progress at about 3.5 knots.

Due to the above condition, divers were sent into the ship through the stack access openings. Surveys were made of both engine room spaces forward and aft from the view point of accessibility for making both transverse and longitudinal cuts. For most part the cut lines appeared to be clear but with considerable interference in way of shelving, piping installations and floor plating in the main machinery lower levels.

A. MACKENZIE SALVOPS

Monday 20 May 1974 (cont'd from Part I)

1255 After lunch the divers were able to continue work outside the hull but in a limited manner due to the choppy sea and continuing heavy swell rolling up the S.E. channel. Bad weather continued throughout the afternoon with 20-25 knot winds and rain squalls from the S.S.E.

Tuesday 21 May 1974

The weather today showed considerable improvement and tide conditions were favorable for divers to work outside the wreck burning away exterior fittings and deck house structure.

1430-1550 I attended a meeting of Army Corps of Engineers and U.S. Navy officials concerning the proposed salvage plan. After a presentation by Mr. J.Walker and Mr. A. Rynecki, a decision was made by Col. McCoy to cut the vessel in place and scrap the hull materials. The cutting was to be accomplished by use of arc-oxygen and explosive shaped charges. During the late PM I had dinner with Mr. P. Kenny and Mel Cotter, Technical Explosives Inc., to discuss contractual arrangements.

Previously, during the work day, I had discussed the idea of going into a 24 hour per day diving operation; giving O.S.I. divers the 12-24 shift under supervision of Jerry Todd and alloting the 00-12 shift to B.S.I. divers under Andy Webb.

Wednesday 22 May 1974

Technical Explosives Inc. personnel at wreck early this date to evaluate the job at hand. Strong tides again forced the diving operation inside the wreck for arc-oxygen cutting and internal survey work. Divers removed the drag tender house centered at frame 79 on the boat deck and continued cutting the top portion of the pilot house during the period of slack tide in late PM.

The oil polution control teams were on wreck site during the PM to make minor adjustments to the oil boom.

In the evening I met again with Technical Explosives Inc. personnel to discuss possible contractual arrangements for blowing A. MACKENZIE apart.

Thursday 23 May 1974

Weather and tide conditions were favorable again today and divers were able to sever the starboard drag pipe and related stanchions and davits.

The O.S.I. diving team continued cutting along the upper pilot house.

Attempts to place a bow anchor from the work barge today were unsuccessful; probably due to the anchor and wire fouling on the starboard drag pipe which lay along the bottom.

Friday 24 May 1974

On arrival at the wreck site, tide conditions were again found to be unfavorable for working divers outside the hull so efforts were directed at clearing away debris from proposed transverse cuts inside the vessel.

Approximately 52 tons of scrap were loaded from the LIMA-400 to a small barge and towed away during the work day.

1650 An additional mooring anchor was rigged to S.E. of the wreck to facilitate holding LIMA-400 in the desired position along side the wreck.

Saturday 25 May 1974

Although tidal conditions were adverse at the beginning of the work day, the situation improved during the early afternoon and divers were able to continue work outside the wreck burning access openings across the main deck level in way of proposed transverse cuts.

An AEC electrician reported to the wreck site to commence rigging lights for night work.

In the late afternoon I made a survey of conditions under and alongside the wreck under water. I found that the strong tidal currents had scoured away the clay and sand bottom at the stern up to about frame 32 and at the bow to frame 102. The attitude of the wreck had already changed considerably since the sinking date, project depth having changed from 42' to 52' in the forward engine room bilge area. The problem was presented to the project engineer that should the scouring action continue, then some drastic change in A. MACKENZIE's attitude could be expected; even to the extent of sustaining a midship fracture in the hull girder.

At 2138 I telephoned Mr. Pat Kenny of Technical Explosives Inc., gave him verbal confirmation for the contract of demolishing A. MACKENZIE with explosives.

Sunday 26 May 1974

Although wind and tide presented some problems this was generally a good work day weatherwise.

Divers were able to remove another section of the pilot house structure and clear the starboard drag pipe for lifting.

Monday 27 May 1974

A copy of the Technical Explosives Inc. contract for the explosive phase was received from Pat Kenny and the following diver personnel arrived for work at A. MACKENZIE wreck site.

Pete Rayot	Diver	Buck Steber Inc.
Mike Ambros	Diver	" " "
Frank Peterson	Tender	" " "
Pete Cinnet	Tender	" " "
James Mitchell	Diver	Ocean Systems Inc.
Elmer Mullican	Tender	" " "

0831 With the flood tide running at more than 2 knots, divers were forced to work inside the wreck only.

1110 Electricians completed rigging lights for night shift on the LIMA-400 work barge.

Attempts to remove the remaining portion of the pilot house were only partially successful and the hoisting slings remained attached over night.

1930 I signed a contract with Technical Explosives Inc. for the demolition of A. MACKENZIE in which they agreed to furnish the explosives, equipment and technicians for the job.

2200 Mr. Melvin Cotter, explosives expert for Technical Explosives Inc. arrived in Galveston.

Tuesday 28 May 1974

Tide and weather conditions remain favorable today and divers were able to continue work outside the A. MACKENZIE hull.

Another portion of the pilot house was removed (the final portion) and was lowered back to the bottom to await arrival of the scrap barge.

The large steel hatch was removed from boat deck port allowing free entry into the forward machinery space.

During the evening I attended a meeting with the project engineer to discuss the local (Galveston) problems for storing and handling explosives; also the need to comply with USCG rules and Texas State Law.

Wednesday 29 May 1974

Departed AEC docks with the 00-12 shift; this being the beginning of night operations.

Divers of B.S.I., under the supervision of Andy Webb, continued burning access openings in way of transverse cut lines across the main deck at frames $20\frac{1}{2}$, 32 and 47.

1200 B.S. I. divers were relieved by the 12-24 shift consisting of O.S.I. divers under the supervision of Gerald Todd.

During the PM Mr. E. Lynn Geralds of J. Ray McDermott came on board LIMA-400 to discuss heavy lift capabilities in relation to the salvage plan for A. MACKENZIE.

The O.S.I. divers continued cleaning and cutting across transverse cut lines.

Thursday 30 May 1974

Weather and tide conditions continued favorable and divers continued working along proposed transverse cut lines taking advantage of slack tide periods to work outside the wreck.

Mr. W. W. Frazier of Brown and Root at wreck site today to discuss availability of heavy lift craft in relation to A. MACKENZIE SALVOPS. He gave the impression that suitable lift craft could be made available through July but could not be promised during the month of August.

Friday 31 May 1974

0700 I departed the AEC docks in the launch C. M. WOOD in inclement weather with heavy rain squalls and near gale force winds from S.S.E.

On arrival at the wreck site at about 0735, I found the weather and sea condition very adverse. Diving operations had ceased due to the strong flood tide and choppy seas.

The after stack access had partially broken away during the night and although remaining upright and above water, horizontal movement in relation to sea action was quite obvious.

0815 I secured the 00-12 diver shift and sent them ashore in launch C. M. WOOD.

1200 The weather continued rough and very erratic with wind changes of 90° or more occurring within a matter of minutes.

By 1500 the weather had moderated sufficiently to warrant calling out the 12-24 shift of divers. They arrived at 1610 but were soon confronted with more squalls and strong winds from the N.E.

The strong ebb tide forced the work barge to the N.E. and canted toward the bow of the wreck and very little underwater work was accomplished during the remainder of the day.

1900 Secured diving operations and suspended the 24 hour operation pending repair of the after stack access and arrival of another salvage master to assist with night operations.

Saturday 01 June 1974

0700 Departed the AEC docks with all divers and the demolition crew on board. The adverse weather of the previous day had cleared and on arrival at wreck site the tide was just commencing to ebb.

0815 Divers commenced: B.S.I. rerigging after stack guys and O.S.I. removing forward skylight cover over the machinery space.

Explosive technicians preparing a test shot of C-4 shaped charge for use on the main deck at frame 104½ port.

1001 Made radio communication with LCDR Bartholomew setting up the explosive tests for 1600 today.

1215 Divers completed rerigging guys to damaged after stack.

1600 Executed a test blast of C-4 shaped charge; Weight 9 lbs.; size 2" x 2" x 4'. U.S. Coast Guard, Army Corps of Engineers and Ecology personnel were present to witness the blast effect, related fish kill and to observe any oil polution effects.

The blast threw up some debris, a few fish casualties and a small quantity of oil from inside the wreck. Conversation with various officials after the blast confirmed that the test shot results were considered acceptable and that the demolition phase of the project would be allowed to continue within the limits of local and Government regulations pertaining to polution and safety.

The test charge opened up the main deck plating along the cut line at frame 104½ for a distance of 5 feet and a width of 18 inches.

Sunday 02 June 1974
Continued test shots of C-4 today along the port side plating at frame 20½ and on the wood boat deck at frame 107½ starboard.

For these tests the work barge was moved back about 100 feet to the north and oil skimmer groups were deployed to pick up debris and small amounts of petroleum products resulting from the shots.

1440 The work barge crew ran out an additional anchor to the north of the wreck making for a 5 point moor system.

Divers removed the after engine room skylight for easier access to the machinery spaces.

Monday 03 June 1974
With favorable weather and tide conditions, serious blasting efforts were commenced this date. At frame 47 linear shaped charges 2"x2"x4' were placed across the entire width of the vessel. A total of about 135 lbs. of C-4 was set off at one time removing the wood and asphalt deck coverings for a width of 6-8 feet along the cut line. With the wood deck covering removed, the longitudinal stiffners were exposed and rendered accessible to the divers for arc-oxygen cutting.

After the blast, divers inspecting the cut line were somewhat discouraged by the amount of debris thrown up by the blast. I resolved to make a thorough underwater inspection personally, prior to making any decision as to whether heavy blasting should be continued.

1815 Secured diving and salvage operations for the day.

Tuesday 04 June 1974
Weather again favorable today, except for the ebb tide, which was running at 2.1 knots for most of the AM. Divers of Both B.S.I. and O.S.I. working inside the wreck with the arc-oxygen torch along proposed cut lines.

0915 LCDR Bartholomew and Mr. Bissel at the wreck site to discuss safety precautions, especially the wearing of life jackets on and around the vicinity of the work barge.

1350 Barge loaded with scrap and attending tug departed the wreck site with the remaining items of top hamper from A. MACKENZIE, including the starboard drag pipe and the pilot house.

1315-1500 This writer made exploratory dives inside the ship, alongside the bottom port hull and under the ship forward and aft to evaluate the scouring and settling effect. At frame 47 I was able to follow the transverse cut line at the main deck level along its entire length; and, while there was some interference from debris, which was easily moved by hand, there was no evidence of damage to the hull girder (main deck plating).

Considering the above, I made the decision to shoot C-4 again tomorrow across the boat deck at frame 20½.

Wednesday 05 June 1974

Effective today LCDR Bartholomew relieved Mr. Jim Walker as project manager for A. MACKENZIE SALVOPS.

0725 Arrived at wreck site with divers and explosives crew. Weather adverse with near gale force winds from the south and the flood tide running at 2.9 knots.

0840 With the wind now gusting up to more than 40 knots, I decided to secure the diving crew except for two diver and tender crews who remained on board the work barge to work at equipment maintenance and hope for a break in the weather.

1400 With winds continuing to blow at near gale force I decided to secure the entire diving crew and allow the work barge crew the much needed down time necessary to renew the topping lift on their whirley crane boom.

1530 I returned to the MPMSC trailer office to confirm requirements for specification for the 500 Ton lift craft for picking up A. MACKENZIE hull section.

Friday 07 June 1974

Small craft warnings still in effect in Galveston Bay area and according to weather reports there is very little hope for immediate improvement in the weather. Notwithstanding, I brought the entire crew to the wreck site at 0725 and continued maintenance work until slack tide.

At 1200 the tide had slacked sufficiently to permit divers outside the wreck and to facilitate rigging additional mooring lines. O.S.I divers already working in the forward engine room while B.S.I divers concentrated on rigging a 6" nylon howser from the starboard bow of the work barge to the stern of the wreck.

By 1700 divers had completed placing charges in both the forward and after engine rooms in way of difficult cut areas along the transverse lines at frames 20½ and 104½.

1727 Fired the charges as listed above.

1735 A misfire in the lower portion of the forward engine room resulted in some time loss but the explosive unit detonated properly on the second attempt.

1907 Arrived AEC docks and secured operations for the day.

Saturday 08 June 1974

The weather conditions today continued to worsen with strong gusty winds from the South and seas in Galveston channel building up to 5-7 feet in height. Tides in the bay ranged 3-4 feet above normal and seas breaking over the diver access stations on both stacks caused considerable discomfort to the tender personnel and hampered diving operations.

Capt. U. M. Sweeting reported on board during the PM, arriving from the Key West Salvage Station to share responsibilities as Salvage Master on A. MACKENZIE SALVOPS.

Although adverse weather conditions persisted throughout the day, some worthwhile underwater work was accomplished and small charges were set off in the after engine room at frame 20½ to sever the large vertical floors in way of the transverse cut line.

1630 With wind and sea increasing so as to create hazardous working conditions for the diver-tender teams, I suspended operations for the day. The work barge was moored to best advantage for riding out the blow and the salvage crew departed the wreck site leaving the small flotilla in the hands of tug WOLF II and crew.

<u>Sunday 09 June 1974</u>
The weather this date is still rough with a strong swell 5-6 feet in height running up Galveston Channel. The south wind, although still blowing up to 25 knots, shows signs of moderating with patches of blue sky commencing to show in the South West. Heavy rough seas during the night had carried away most of the structure on the divers access platforms forward and aft so diving operations were delayed while repairs were in progress. At 0846 the weather had moderated sufficiently to permit diving inside the vessel and continue arc-oxygen cutting.

By noon the high tide was commencing to ebb strongly, the wind had dropped to about 7 knots and the heavy swell, although still running, was commencing to subside.

Concerned about cut continuity in both the bow and stern sections, I discussed the matter with O.S.I and B.S.I. diving supervisors, calling for a complete cut survey and strict control of diver activity on both shifts during the forthcoming 24 hour per day operation.

<u>Monday 10 June 1974</u>
Although small craft warnings are still in effect over Galveston Bay, weather conditions have improved considerably. Light winds from the N.E. and a flood tide of .9 knots during the AM permitted diving both inside and outside of the wreck. Diver Webb, cutting in the after machinery space, reports better results using the 400 amphere machine in comparison with the lighter capacity 300 amphere unit; especially where the blue coated Arc-Aire rods are in use.

Considering the above, another 400 amphere machine was requested for delivery as soon as possible.

The late shift of divers completed the bottom cut at frame 104½ sufficiently to observe a definite deflection of longitudinal hull girders across the cut.

<u>Tuesday 11 June 1974</u>
This is another good weather day but with strong tides running during the AM. Divers completed cutting across the boat deck at frame 20½ and confirmed the deflection of hull girder members along the cut at frame 104½.

Difficulty was encountered in the after engine room where the machine shop platform deck extends across the cut line at frame 20½, resulting in an additional 30 feet of arc-oxygen cutting.

Favorable tide conditions in the PM permitted divers to work outside of the bow and commence burning access holes for the lift chains.

Wednesday 12 June 1974
Another day of good weather but with a strong ebb tide running in the afternoon. Adjustments were made to the oil containment boom and the project engineer, Mr. A. Rynecki, commenced work preparing cutting rod for divers - ARC-AIRE blue coat rod being altered by coatings of masking tape and varnish.

Thursday 13 June 1974
The weather remains fine today with only a few scattered thunder showers. Divers of both shifts continued arc-oxygen cutting in the transverse break lines and opened up joiner doors along the living spaces to allow free draining of the severed sections.

1020-1146 Conducted experiments with ARC-AIRE (blue coat) cutting rod as prepared by the project engineer.

Two layers of masking tape covered by spar varnish proved the most proficient cutting tool as related to the improvised coatings. Later in the day divers of the other shift conducted similar experiments but while they approved of the varnished rod, they preferred three wraps of masking tape and one coat of glyptol.

Also during the PM, divers investigated under the bow and found 2 feet of clearance at frame 118 skin of ship to mud bottom. Considering this, a decision was made to cut additional structure above the main deck level at frame 106 to allow the bow freedom to move without locking when cut free.

Friday 14 June 1974
Another day of good weather with the exception of thunder showers in the nearby vicinity.

After a diver survey under the ship at frame 20½ it was decided to blast across the bottom of the vessel to complete the transverse cut line.

Also divers continued arc-oxygen cutting to sever both the bow and stern sections for lifting.

Saturday 15 June 1974
Light winds from the N.N.W. continued today but strong tides running and commencing to ebb at 0945 resulted in aborting an attempt to place charges along the bottom of the cut at frame 20½. O.S.I divers completed installation of chain through the bow section under the main deck and just aft of frame 126. Both ends of the chain were brought up on deck and stopped off to await hookup of the heavy lift crane.

The project engineer continued work with cutting rod coatings, experimenting with different wraps of masking tape and rubber tape with considerable success and the pink flux rubber (plastic) combination being favored over all others available.

Sunday 16 June 1974

Another day of good weather but strong tides which slowed work progress outside the wreck. B.S.I divers completed rigging chain under the after end of the wreck going through, under and forward of the rudder port, and bringing both ends of the chain up on the boat deck to secure for lifting. O.S.I divers continued cutting along the transverse line at frame 104½ and set off charges in the 2nd deck bow spaces to facilitate draining water from the vessel when the forward portion is picked up.

Monday 17 June 1974

B.S.I. diving team completed rigging chain through forward end of after section of hull today and O.S.I divers continued cutting along transverse lines at frames 106 and 104½.

1300 Attended prospective bidders meeting at AEC offices; Brown and Root representatives present to glean information pertaining to lifting the hull of A. MACKENZIE. It appears that Brown and Root may be the the only company interested in lifting the wreckage sections with 500 Ton capacity crane barges.

In the late PM the ebb tide exceeded 3 knots, forcing the divers to work inside the wreck and precluded rigging additional lift chain or setting charges.

Tuesday 18 June 1974

The flood tide slacked at about 0825 sufficiently to allow B.S.I. divers to plant charges port and starboard in the stern section to facilitate draining the fuel tanks and compartments when the section clears the water when being hoisted. The B.S.I. divers also reported good results in cutting the lower hull with the pink coated arc-oxygen cutting rods.

In the afternoon O.S.I. divers completed rigging chain port and starboard at frame 105 just below the main deck and rigged and tested the 4" jet pump.

Wednesday 19 June 1974

During the night shift, B.S.I divers completed burning the machine shop platform deck and all related longitudinals at frame 20½.

O.S.I. divers had completed burning all main deck longitudinals at frame 104½ on the previous 12-24 shift.

1124 Fired C-4 charges in the after section to drain the steering flat. Investigation of the blasts from yesterday along the bottom aft showed about 80% effectiveness with no penetration into the two wing tanks due to diver error in placing the charges.

In the afternoon B.S.I divers tunneled (jetted) under the bow to complete severance of the bottom plating and detonated C-4 charges across the main deck to complete the cut at frame 104½. For some reason the charges across the main deck were only about 40% effective and the cut had to be completed by arc-oxygen cutting.

Thursday 20 June 1974
O.S.I divers placed 2"x4' (C-4) shaped charges across the main deck and down "G" and "H" strakes port and starboard, resulting in complete severance of the stern section, which dropped nearly clear listing 3° to port and canting to starboard 1.5°.

The 12-24 shift of O.S.I divers planted charges to complete separation of the bow section; an operation which appeared to be successful but the resultant change in attitude was not nearly so great as occurred when the stern section parted with the main hull.

Friday 21 June 1974
Divers investigation of the after section shows the piece completely severed including positive clearance between the propellor shafts.

The forward lift chain on the stern section was disturbed sufficiently at the pick point to warrant repositioning and rerigging through new access holes at frame 14.

At about 1300 hours, O.S.I divers planted charges both port and starboard under the bow to blast drain holes in the forward tanks and compartments.

Saturday 22 June 1974
This day was spent by both shifts of divers in checking and, where necessary, rerigging the $2\frac{1}{4}$" lift chains. When this evaluation was complete, arc-oxygen cutting was continued at frames 32 and 94.

Sunday 23 June 1974
Mooring buoys with pendants of 1 5/8" chain were rigged along A. MACKENZIE's port side to facilitate mooring the heavy lift craft while making picks of the bow and stern sections and to avoid blocking the south channel.

In the afternoon the side legs of the LIMA-400 barge were cast off in preparation for vacating the wreck site in favor of Teledyne lift craft MOVIBLE NO. II.

In the late PM word was received that MOVIBLE NO. II would arrive at wreck site about 0830 on 24 June.

2330 As the diver shifts changed so did the weather, with gusty winds and thunder showers moving in from N.N.E.

Monday 24 June 1974
Bad weather continued throughout the AM with winds gusting up to 30 knots and veering from East to West.

0930 Teledyne heavy lift craft on scene; MOVIBLE NO. II, with Capt. Thomasee as master.

In mid AM I met with Capt. Thomasee to discuss the mooring plan for the heavy rig and at 1130 we both attended a briefing with Houston Pilots and USCG officials regarding ship channel restrictions. (Closing the north channel entirely and possibly blocking the south channel at brief intervals).

The LIMA-400 barge was removed from the wreck site and the MOVIBLE NO. II was brought in to port and from N.N.E, laying mooring anchors across the north channel enroute.

With the heavy lift rig riding to a five point moor alongside to port of the sunken A. MACKENZIE, the LIMA-400 barge was brought alongside MOVIBLE NO. II to the south.

The forward lift chains of the bow section were picked up with intent of using leverage to break the bow away from the main hull. First lift attempts were unsuccessful because of a 6 inch pipe which had been left uncut in the upper portion of the forward engine room.

After this pipe was cut, the bow was brought to the surface and separation of that section from the main hull was ascertained.

All four slings were then hooked up to the bow section and another attempt to lift was made; this time intending to pick the portion clear of the water. The bow proved to be much heavier than anticipated, exceeding 330 short tons at one point of the operation. One $2\frac{1}{2}$" sling was damaged early in the operation so the bow was lowered again for rerigging.

Tuesday 25 June 1974

Operations continued throughout the night and the damaged sling was replaced at periods of slack tide by divers.

Just after first light the bow section was lifted clear of the water and allowed considerable time for drainage.

At about 1017 the weight reading had dropped to 322 short tons and the load was rotated toward the scrap (cargo) barge.

1050 The bow section of A. MACKENZIE was landed on the cargo barge.

When the slings were clear of the bow, the heavy lift craft was moved aft along the wreck.

The $2\frac{1}{2}$" slings were replaced by 3" x 70' units and in case of the stern section it was decided to bring the piece straight up off the bottom, using all four slings. The lift attempt was made as planned but the starboard side plating became involved with the main hull structure and the piece had to be lowered back to the bottom.

Wednesday 26 June 1974

Again the operation continued throughout the night and at 0731 a tug boat was employed to lever the starboard side clear of the main hull.

Another lift was attempted but, when the main deck level came clear of the water, a partial failure of the die lock chain was observed in a link which bore full weight up and across the knuckle of the port main deck structure.

Resulting from the above, the stern section was lowered back to the bottom and two additional lift chains were rigged across the forward corners under the main deck.

Thursday 27 June 1974
When rigging of the additional chains was complete, another lift was attempted; but, as the machine shop platform came clear of the water, the recorded weight was 390 short tons and the MOVIBLE No. II master deemed the piece too heavy to lift with the existing rig.

All loose debris and wood deck planking was removed from the boat deck, but total weight of the section at 0640 was still unacceptable to the lift master.

I boarded the section in company with B.S.I. divers and found an average of one (1) foot of mud throughout the main and 2nd deck levels. We proceeded to cut access (drainage) holes in the hull and the mud was washed out with 2½" fire hose. The lathe and other heavy machine shop equipment was also removed during this period; an estimated 62 long tons of material were removed.

1230 With demudding operations complete, the stern section was picked free of the water weighing 362 short tons.

1350 The stern section of A. MACKENZIE was loaded on the cargo barge.

The LIMA-400 work barge was moved away to anchorage on the mud flats to the north while the heavy lift craft cleared her moorings from the wreck site.

Friday 28 June 1974
Combating adverse tide conditions nearly throughout the entire day, the LIMA-400 was brought back into her normal moorings at the wreck site. However, this was only achieved after many difficult tug and barge maneuvers and the moor was not finalized until nearly midnight.

Saturday 29 June 1974
With the B.S.I. divers shift coming on at midnight, full cutting operations were resumed along transverse lines at frames 32 and 47½ and O.S.I. divers picked up their cuts at frame 94 and worked at removal of forward machinery units and drag winches. A small scrap barge was brought alongside to port of LIMA-400 and remaining scrap materials were transferred on board.

Sunday 30 June 1974
Cutting operations and machinery removal continued as before, with two medium charges of C-4 detonated at frame 32 starboard to remove wood planking from the boat deck.

The side moorings for LIMA-400 were adjusted to allow better clearance for the stack access platforms and the cutting proceeded according to plan.

Attempts to remove the main pump diesel generators from the forward engine room were not successful.

Monday 01 July 1974
Mud core samples taken by divers in the main deck crew's recreation space and from the forward engine room bilge were carried to the local laboratory for processing and weight assessment.

The samples, when settled out, were found to weigh 90 lbs. per cubic foot.

C-4 charges were set across the boat deck at frame 32 to remove wood planking in way of the transverse cut.

O.S.I. divers succeeded in removing the port main dredge pump generator from the forward engine room.

Tuesday 02 July 1974

0700 On departing the AEC docks the weather showed cloudy with occasional rain squalls and gusty winds from the S.W. The rough weather caused some difficulty during the night at the wreck site involving the LIMA-400 and the Air Force scrap barge, but the vessels were able to remain in their moorings.

The port stern anchor from LIMA-400 was repositioned during the day and both auxiliary diesel generators were removed from the after engine room by B.S.I. divers.

In the late PM, O.S.I. divers successfully removed the starboard main dredge pump diesel generator from the forward engine room.

Experimental test shots with coiled primacord failed to cut sample specimen of 20.4 lb steel plate.

Wednesday 03 July 1974

Both diver crews continued cutting along frames 32 and 94 transversely to sever sections "B" and "G".

Tug WOLF II towed away the Air Force scrap barge with approximately 70 long tons of scrap on board.

O.S.I divers reported about 1.5 feet of mud in the forward engine room bilge.

Thursday 04 July 1974

Weather remained favorable in the Galveston area and work at the A. MACKENZIE wreck site continued; with each shift shortened by 3 hours in observance of Independence Day. O.S.I. diving supervisor, investigating under the bow, observed considerable mud build up along frame 104 and also some significant mud build up along the floor plates in the forward engine room.

Friday 05 July 1974

Another day of good but generally overcast weather with thunder showers in the background. Both O.S.I and B.S.I divers continued cutting along transverse cut lines to sever "B", "C" and "G" sections with due attention to bottom time and the use of the 50 foot decompression table accordingly.

1020-1105 I made an inspection dive along the port side and under both the bow and the stern of the wreck. At the stern I was able to crawl completely under the ship at frame 28, indicative of increased scouring action in that area. At the bow, except at the extreme turn of the bilge (frame 104), no scouring was evident.

In fact, at the center line, the mud appears to have built up somewhat; compounded with lumps of clay thrown up by the break-away of the bow section.

Saturday 06 July 1974
B.S.I. divers removing pipe and debris in way of cut at frame 32 and arc-oxygen cutting to the limit of diver bottom time. O.S.I. personnel rigged a small 3 inch gem line air lift and removed sand and mud to some extent along the cut line in the bilge at frame 94 with some success.

Sunday 07 July 1974
At midnight only two men of the B.S.I. 00-12 shift came to the wreck site to report for work.

Reportedly pay checks for all of this group have been delayed for some time and are now more than a week overdue; also their per diem subsistence is not being paid on time.

Divers Webb and Jones worked through most of the shift carrying most of the work load for the missing personnel.

1200 O.S.I. divers came on and continued work at severing "G" section, air lifting and cutting in the bilge area at frame 94.

O.S.I. supervisor Jerry Todd off for the day.

Phone communication with Merritt Division duty officer A. Barracca gaining permission to give advance subsistence money to B.S.I. divers until the pay situation there can be resolved.

Received word from Buck Steber that he would arrive in Galveston in the late PM.

1900 I met with Buck Steber and learned that he would be able to meet the necessary financial arrangements to satisfy the monetary needs of his diver and tender personnel.

Monday 08 July 1974
Weather conditions remain favorable today with all hands back on full work schedule two 12-hour shifts.

Photographers from Face Plate magazine were on board during the day to survey the A. MACKENZIE Salvage operation for their publication.

Also the district safety engineer for AEC was on board briefly but found no major safety hazards.

Demudding and arc cutting operation continue to sever hull sections "B", "C" and "G".

Steel bolsters 6"x6"x30" arrived at wreck site to be used to strengthen the pick points in the lower hull sections.

Tuesday 09 July 1974
Demudding and arc cutting operations continue and the weather remains favorable.

The AEC suction dredge MCFARLAND has arrived in Galveston Bay and is working both the north and south channels adjacent to the A. MACKENZIE wreck site.

During the 12-24 shift O.S.I. divers encountered difficulties in cutting at frame 94 C/L due to bars of steel ballast across the cut line. The bars, weighing about 100 lbs. each, are tack welded in place and are difficult to remove.

Wednesday 10 July 1974
Cutting operations continue and weather remains favorable. The almost unpredictable tides in Galveston channel continue to hamper divers work outside the hull and deposit clay and mud sediment inside the remains of A. MACKENZIE.

The suction dredge MCFARLAND continues to operate close by the wreck site stirring up mud; some of which may increase the rate of mud fill in A. MACKENZIE, and will certainly decrease underwater visibility.

Thursday 11 July 1974
Lube oil tanks in the way of transverse cut at frame 32 were removed and the bottom of that cut was inspected and pronounced complete. C-4 charges were detonated in the major living spaces main deck "B" section and a circular charge was used to blow a 4'x2" hole in the "B" section bilge to facilitate mud removal during the lift phase.

An error in cutting cost the O.S.I. Divers some time loss at frame 94 but they recovered quickly and succeeded in installing two lift chains port and starboard in the forward end of section "G-1".

The pear shaped links for 2¼" chain were received (16) each and were installed on chains related to the heavier lifts.

Friday 12 July 1974
The weather again remains favorable, cloudy with light variable winds.

B.S.I. divers blasted "B" section completely away from the main hull. Separation appears to be complete, with the severed portion settling to the bottom a distance averaging about 10".

In the PM, O.S.I. divers blasted the lower portion of "G" section at frame 94 and again separation appeared to be complete, but with a smaller change in attitude of the severed portion, which dropped about 5".

On completion of demolition O.S.I. divers continued work cutting the longitudinal lines to separate "G-1" and "G-2" sections.

Saturday 13 July 1974
Fine weather again today with favorable tide conditions in the AM.

B.S.I. divers busy at installing lift chains in "B" section; three total installed and ready prior to end of shift.

After midday O.S.I. divers placed charges to blast mud drain holes in main deck spaces in section "G-1" and continued arc-oxygen cutting to sever "G-1" from "G-2".

Sunday 14 July 1974
B.S.I. divers completed rigging lift chains in section "B" and fired one small hose charge of C-4 in the main deck store room area at frame 24.

Attempts to blast holes through the starboard bilge from the outside were only partially successful.

O.S.I. divers had similar results during the afternoon in trying to blast drain holes under section "G-2".

Piping interference in the way of rigging the pick points in section "G-2" is being removed by divers but with considerable difficulty.

Monday 15 July 1974
Hot muggy weather and unpredictable thunder showers joined the tidal effects to hamper work at the wreck site.

B.S.I. divers completed the longitudinal cuts between "C-1" and "C-2" and burned holes for the lift chains in that section "C-1".

O.S.I. divers completed rigging lift chains on the after corners of section "G-1".

Tuesday 16 July 1974
The hot humid weather continues along the Texas Gulf coast with some severe thunder squalls and scattered tornado action.

B.S.I. divers engaged in cutting pipe and other interference in way of cuts to sever section "G-1" from "C-2" and "D-1".

The Air Force scrap barge (in use by the AEC) came alongside the LIMA-400 to facilitate removal of small amounts of scrap recently removed from A. MACKENZIE.

O.S.I. divers completed arc cutting of sections "G-1" and "G-2" and shifted their operation aft to assist B.S.I. personnel in cutting section "C-2".

Heavy thunder squalls and gusty winds caused some loss of work time on the late 12-24 shift.

Wednesday 17 July 1974
Thunder squalls continue through the AM, raining sufficiently hard to result in compressor and other equipment mal-function.

At 1100 diving operations were temporarily suspended for reasons of safety.

After the noon hour the weather improved considerably and allowed O.S.I. divers to plant charges to complete severance of sections "C-1" and "C-2" longitudinally. After a cursory inspection to ensure the above operation was successful O.S.I. personnel resumed cutting along frame 47 in the bilge area.

During the late PM the ebb tide ran in excess of three knots, probably due to heavy rain run off and northerly winds.

The attending tug experienced mooring difficulties in relation to the ebb tide and the work barge and the flotilla dragged the north mooring anchor sufficiently to bring the work barge into contact with A. MACKENZIE's after stack for a brief period. The result was a regretable loss of diver bottom time.

Thursday 18 July 1974

On arrival at wreck site in the early AM it was immediately apparent that the previous night's ebb tides had displaced the oil control boom and adjacent channel marker buoys from their proper positions near the wreck. Cognizant authorities were notified and the oil boom was removed from the wreck area. The navigational aids were dragged to their proper locations along the channel boundaries.

Lift chains were rigged on hull section "C-1" and arc oxygen cutting continued along frame 47 to sever hull section "C-2" from section "D".

FINI PART II

Byron E Alleman
Salvage master

A. MACKENZIE SALVOPS

Continued from part II

Friday 19 July 1974

The weather remains favorable today. At 0805 I received word from the project Engineer that a heavy lift craft would most definitely arrive in Galveston Bay 220800 July. Considering the above I altered the work plan sufficiently to ensure complete readiness of hull sections E, C-1, G-1 and G-2 for pick up during lift phase two. Cutting in the bilge at frame 47 was temporarily suspended until the work outlined above was ascertained to be complete. Attempts to blast drain holes in the main deck spaces of section C-1 were only partially successful and that project was abandoned.

Saturday 20 July 1974

Strong tides continue to hamper diving operations but the weather remains favorable.

At 1113 C-4 charges were detonated along the main deck transversely at frame 47 and longitudionally along the side skin plating to completely sever hull section C-1 from C-2. These shots were apparently successfull.

Mooring chains for the heavy lift craft were rigged from the port side of the wreck and additional underwater inspections were made to ensure complete seperation of pertinent hull sections.

Sunday 21 July 1974

With the after stack in the process of being removed and with strong tides running throughout most of the day it was necessary for both shifts of divers to work through the forward stack in order to fully utilize diver bottom time.

In the late afternoon the after stack was removed from section C-1 and was transferred to the deck of the work barge.

Monday 22 July 1974

At first light the heavy lift craft was observed making her way up Galveston main ship channel. Moorings were broken on the Lima-400 work barge and that vessel was moved out of the way to make room for the Teledyne Movible II lift derrick.

At 0710 I boarded the lift craft and met with Capt. Thomasie to discuss the pending lift project. Also I remained on board to assist in bringing the vessel into suitable moorings at the wreck site.

By 1141 Movible II was completely moored alongside the wreck to port with Lima-400 moored alongside her to the South.

At 1440 OSI divers had completed rigging lift slings to hull section G-1 and that piece was hoisted to the deck of the scrap barge quickly and without notable incident.

Tide conditions continued to be favorable fluxuating between a weak ebb and ~~[illegible] and~~ then a weaker flood condition.

1831 A. Mackenzie hull section G-2 was lifted to the deck of the scrap barge with no apparent involvement with F-2 along the transverse cut line at frame 94 or bottom suction effect during the breakout interval.

Favorable tide conditions continued to aid the divers in their work and at 2351 OSI divers completed rigging section C-1 which was also hoisted to the scrap barge without notable incident.

Comment: It is considered worthy of note that section C-1 was lifted vertically from between sections B-1 and D-1 with very little clearance along the transverse cut lines where the sections were severed.

Tuesday 23 July 1974

0010 BSI divers arrived to commence the 00 - 12 shift and immediately became engaged in rigging sections B-1 and B-2 which had not been severed longitudionally. By 0125 the ebb tide had increased to 1.4 knots resulting in a notable adverse effect on diver proficiency. The first team of divers succeded in hooking up the Port set of slings to section B-1. Diver fatigue resulted in the use of a second team of divers who finally completed hooking up the stbd slings and sections B-1 and B-2 were hoisted together to the deck of the scrap barge at 0510.

During the nite both ship channels had been closed to traffic because of possible interference with Movible II's anchors. Now with the lift phase complete attending tug boats recovered the mooring system quickly and the South channel was reopened prior to the beginning of first lite.

All lift chains were relocated back on board the Lima - 400 and that vessel pulled away from Movible II to await complete recovery of the heavy lift craft's mooring system.

1215 The Lima-400 work barge completed remooring at the wreck site. The heavy lift craft was now clear of the wreck area and proceeding under tow toward the Galveston Sea buoy.

OSI divers continued the salvage operation attempting to remove the main dredge pump from the forward engine room bilge.

Wednesday 24 July 1974

This day begins with favorable weather and the diving and salvage operation continues nearly on schedule. BSI divers used up most of the work day relocating the after stack over the hopper section at frame 63 stbd.

OSI divers abandoned the project of removing the main dredge pump because of adjacent engine mount interference and continued work on the transverse cut at frame 78 in the forward engine room.

Thursday 25 July 1974

Thunder squalls in the Galveston Bay area with light variable winds is the weather pattern for today. Underwater cutting operations continue in the remains of A Mackenzie's hull along the transverse cut lines at frames 47, 63, and 78.

Some adjustments were necessary to the newly relocated after stack but work progress during the day was generally satisfactory.

Friday 26 July 1974

Scattered thunder squalls again today but for most part favorable weather conditions prevail at the wreck site.

The OSI diving team continued cutting along the transverse line at frame 78 while BSI personnel worked their way into the port bilge area at frame 63.

Saturday 27 July 1974

Underwater cutting operations continue in the A Mackenzie hull with good weather conditions in the Galveston Bay area.

A test shot of 400 grain primacord was detonated in the hopper spaces to help in removing rust and protective coatings in way of the longitudional cut lines.

Sunday 28 July 1974

Very hot and humid weather over galveston bay today with very light and variable winds.

BSI divers continued cutting along the transverse cut line at frame 47 and in the hoppers no's 3 nad 4 port longitudionally.

Another primacord cleaner shot was fired in the hoppers but these shots including yesterdays test were evaluated as in-effective for most part and the explosive cleaning project was abandoned.

Monday 29 July 1974

Weather continues favorable at the wreck site with light to fresh variable winds and no thunder squalls to threaten the salvage operation.

BSI divers continued to concentrate on the bilge area at frame 47 and appear to be making good progress.

OSI divers ran into excessive interference in way of the transverse cut at frame 78 and a decision was made to jog the top portion of the cut aft to frame 77 1/2 extending from the 15' DWL to the boat deck and running up thru the hopper section.

Test holes along the transverse cut line on bulkhead 78 show multiple layers of plating between the forward hoppers and the forward engine room. Thus it was decided to cut this area by using 2 1/2" x 4' shaped charges of C-4 explosive.

Tuesday 30 July 1974

The weather has turned very hot and humid again today with light variable winds.

BSI divers continued to work in the bilge at frame 47 and proceeded with the longitudional cuts in the after hopper section.

OSI personnel continued cutting in the bilge at frame 78 and in the forward hoppers at frame 77 1/2

Wednesday 31 July 1974

Severe thunder squalls and minor tornado action in the Galveston bay area resulted in about four hours work time loss for the entire project over a period of 24 hours.

C - 4 charges were detonated successfully allng the cut line at frame 47 to completely sever section C-2 from D-2.

OSI personnel continued cleaning and cutting along the transverse and vertical cut line at frame 78 and 77 1/2.

Thursday 1 August 1974

Hot and humid weather again today with light variable winds and comparatively mild thunder squalls.

BSI divers engaged in cutting longitudionally in the after hopper section.

Divers inspection of the cut between sections C-2 and D-2 indicate complete seperation the minimum distance between the two being about 5 inches.

Further examination of the bilge area at frame 63 shows the transverse cut line there to be relatively clear of interference.

OSI divers completed the bilge cut at frame 78.

At 1735 U S Army officers General Mc Ginnis and Colonel McCOY visited the wreck site for a cursory inspection and according to Project manager Ldr Bartholomew the party departed satisfied with current progress related to the salvage of A Mackenzie

Friday 2 August 1974

Generally cloudy with scattered thunder storms along the Texas gulf coast again today.

The arc-oxygen cutting process seems to be going well for the BSI team in the hopper section and as the tide slacked at about 0900 rigging of lift chains in hull section C-2 was commenced. By 1200 the forward lift chains were completely installed in section C-2.

During the late afternoon OSI personnel detonated C-4 charges along the bilge cut at frame 78 to ensure complete seperation of hull sections E-2 and F-2.

Saturday 3 August 1974

The weather today remains cloudy and hot with scattered thunder storm activity.

BSI divers engaged in removal of mud cargo remaining in the hopper section and continued the transverse cut at frame 63.

OSI divers used C-4 explosives to complete the transverse cut across bulkhead 78 and continued cutting with the arc-oxygen torch to seperate sections F-1 and F-2 longitudionally.

))

Sunday 4 August 1974

Heavy rains and severe thunder storm activity in the Galveston bay area today. The torrential rains continued throughout the AM adversely effectin the operation of diving air compressors and resulting in some loss of diver work time.

BSI divers completed air lifting mud from the No. 3 stbd hopper and continued the transverse cut at frame 63.

OSI divers picked up thier shift at noon and commenced rigging lift chains in the stbd side of section F-2.

The weather moderated during the PM and the rains ceased at approximately 1400.

Monday 5 August 1974

Mostly overcast today with light winds from the East and generally favorable weather.

BSI divers continued the removal of mud cargo from hopper No. 4 and resumed arc-oxygen cutting at frame 63.

Small charges of C-4 were fired of in the hoppers aft hoping to remove some of the rust scale but subsequent inspection by divers showed negative results and the explosive cleaning process was terminated for duration of the project.

OSI divers continued cutting to sever sections F-1 and F-2 and completed rigging all four lift chains in section F-2.

Tuesday 6 August 1974

Heavy rains and gusty variable winds dominated the weather pattern for Galveston bay again today.

Arc-Oxygen cutting was continued by both teams of divers although there was some loss of work time due the inclement weather conditions.

Wednesday 7 August 1974

Torrential rains again today resulting in complete stoppage of diver work during the early morning hours.

At 0900 the rain storm had slackened sufficiently to allow BSI divers to resume arc-oxygen cutting in the hopper section and to complete the installation of lift chains in hull section C-2.

By 1230 the ebb tide was running at 2.8 knots and OSI divers were forced to abandon rigging lift chains in section F-1 and spend the remainder of their shift working inside the wreck.

Thursday 8 August 1974

Weather conditions are vastly improved today with mostly clear sky and fresh winds from the S.E.

BSI divers installed two lift chains in section D-2 during the 00-12 shift and completed the transvers cut in the bilge at frame 63.

By 1230 OSI divers had installed one lift chian in hull section F-1 before the strong ebb tide again forced them inside the wreck.

During the late PM the ebb slacked sufficiently to allow the installation of one additional lift chain in section F-1 port fwd side.

Friday 9 August 1974

Favorable weather again today with scattered clouds and a fresh breeze from the S E.

OSI divers installed one additional lift chain in section F-1 and another in E-1 during the PM.

Operations for removing remaining mud cargo continued along with arc-oxygen cutting to complete the seperation of sections D and E.

Saturday 10 August 1974

Another day of good weather along the Texas gulf coast with mostly clear sky and light winds from the SSE.

BSI divers completed the installation of lift chains in section D-2 and continued cutting in the hopper section.

It was necessary to disassemble and clean the six inch air lift during the Am as it had become plugged with sand and debris during the previous night shift.

OSI divers continued air lifting to off load mud cargo and resumed cutting in the hopper section at frame 63 above the main deck.

Sunday 11 August 1974

The weather remains favorable with light winds from the SW and scattered thunder showers in the Galveston bay area.

The 00-12 shift of BSI divers completed cutting longitudionally to seven sections D-1 and D2 and resumed cutting the upper structure to seperate D-1 from E-1 and to remove the spoils distribution system which is located directly across the cut line at frame 63.

OSI personnel continued cutting to seperate sections E-1 from E-2 and cut some of the boat deck structure at frame 63.

Monday 12 August 1974

Another day of fine weather with scattered clouds and light wind from the SSW.

BSI divers removed one section of the spoils distribution system

Relatively heavy charges of C-4 explosive were detonated to accomplish the following:

a. To cut bulkhead 47 transversely at the 17' DWL after all vertical stiffners had been pre-cut.

b. To rupture drain holes in the four large freshwater tanks located in the hopper sections lower bilge areas.

c. To ensure complete seperation of the heavy longitudional flooring structure along the bilge cut line at frame 63.

In the PM OSI personnel resumed air lifting of mud from hopper No. 2 Stbd. and continued cutting transversely under the boat deck at frame 63.

Tuesday 13 August 1974

Mostly cloudy with light winds from the South is the prevailing weather pattern for today.

BSI divers removed the stbd. spoils distribution system and continued cutting the boat deck structure at frame 63.

OSI divers installed lift chains in the port forward corners of sections E-1 and E-2 and continued cutting in the hopper section to ensure the longitudional sepeartion of E-1 and E-2.

Wednesday 14 August 1974

Today's weather is favorable and BSI divers virtually completed the transverse cut at frame 63 during the 00-12 shift.

Investigation of the C-4 blast across the bulkhead at frame 47 and in the bilge at frame 63 show positive results with good seperation and deflection in all pertinent areas of cut.

OSI divers rigged two additional lift chains in the stbd. side of section E-2 and detonated approximately 92 lbs of C-4 at apparent tight spots in the longitudional cut lines to ensure complete seperation of hull sections F-1, F-2, E-1 and E-2.

Thursday 15 August 1974

Scattered clouds and light winds from the SSW today and Hurricane Alma is reportedly wending her way along the North coast of South America. A weak storm with an SOA of 28 Knots.

By noon time BSI divers had completed rigging lift chains in section D-1 except for the forward stbd corner. Earlier during theer shift they burned chain holes in the port side of section C-2 to accomodate 1 5/8" mooring chains for the heavy lift craft.

The 12-24 shift of OSI divers completed rigging lift chains in sections E-1 and E-2 and continued removing mud from hopper No. 2 stbd.

Friday 16 August 1974

Weather favorable with light variable winds from SSW.

BSI divers completed rigging lift chains in section D-1 and rigged one mooring chain in the port after corner of section C-2.

Arc-oxygen cutting of odd bits of metal to ensure seperation along the transverse cut lines continues.

Friday 16 August Contd.

Only minor work projects remain to be accomplished prior to the arrival of the heavy lift craft.

During the PM OSI divers cut the outboard bilge keels at frame 78 port and stbd and at frame 63 stbd.

Saturday 17 August 1974

Another hot and humid day with a near calm wind condition.

BSI divers completed air lifting mud from No. 2 stbd hopper and fired additional C-4 charges to ensure positive seperation of the upper transverse cut at frame 63. They also completed rigging the mooring chains for the heavy lift craft along the port side of section C-2.

OSI divers completed air lifting all mud cargo from the hopper section and continued checking for possible cross cut line involvement.

During the PM period of slack tide divers commenced the bottom clean up phase and recovered the large fresh water tank which was originally located at frame 104 in the forward engine room.

Sunday 18 August 1974

Very hot and humid again today with near calm wind condition

At the wreck site BSI divers engaged in repeated inspection dives to ensure complete and proper preparation for the final lift phase.

Unrigging of the air lift and other equipments which are no longer essential to the salvage operation was commenced by the work barge crew. They also began construction of an expanded metal basket for containing debris picked up from the bottom during the final clean up phase.

At 1355 the Lima-400 work barge pulled away from the wreck site and moved to anchorage on the North flats of Galveston Bay to await arrival of the heavy lift craft.

The diving crews were secured for the nite and instructed to pick up their regular shift schedule commencing at 0800 the following day.

At 2315 I returned onboard the work barge and remained overnite to be available to meet the heavy lift vessel on her arrival at the sea buoy.

Monday 19 August 1974

At first light the heavy lift craft "Teledyne Movible No. II was sighted making her approach to the Galveston ship channel entrance and at 0638 I boarded her from the launch C M WOOD.

For a brief period I met with the master of the lift craft to discuss the tentative mooring plan for bringing the vessel into position along the NW side of the remains of A. Mackenzie.

At about 0830 the attending Tugs commenced running mooring anchors and wire from the Derrick barge across the North ship channel.

0930 With the Movible II mooring virtually complete I radioed Tug Wolf II to up anchor and bring the Lima-400 work barge alongside the heavy lift derrick and to the South.

1013 All moorings complete with Lima-400 alongside Movible II and ready to commence diving operations

1025 BSI divers in the water connecting 3" lift slings to A Mackenzie hull section F-1.

1254 A Mackenzie hull section F-1 landed on the scrap barge.
Reported weight when clear of the water = 168 short tons

--

-- The OSI diving team relieved BSI personnel and the salvage operation continued.

1755 A. Mackenzie hull section F-2 landed on the scrap barge.
Reported weight when clear of the water = 320 short tons

Monday 19 August 1974 continued

2145 A. Mackenzie hull section E-1 landed on the scrap barge.
Reported weight when clear of the water = 100 short tons

Note: OSI divers continued operations thru midnite.

Tuesday 20 August 1974

0043 A. Mackenzie hull section E-2 landed on the scrap barge
Reported weight when clear of the water = 320 short tons

On completion of the above lift BSI divers relieved the OSI team and resumed diving operations.

As the scrap barges became loaded to capacity they were towed away from the wreck site by attending tugs and were replaced by empty barges on the return trip from Galveston.

0414 A. Mackenzie hull section D-1 landed on the scrap barge.
Reported weight when clear of the water = 85 short tons

0951 A. Mackenzie hull section D-2 landed on the scrap barge.
Reported weight when clear of the water = 234 short tons

1255 BSI divers completed connecting up lift slings to hull section C-2 and almost immediately thereafter the Lima-400 barge pulled away leaving the final lift operation to Movible NO. II.

At this point in the operation the heavy lift craft was partially moored to the sunken remains of A. Mackenzie with two 1 5/8" chains running up from the port side of section C-2 and with no anchor points running across the South channel which remained clear at all times during this final lift phase.
A 3000 SHP tug was employed to steady the heavy lift vessel as she accomplished the final lift with said tug pushing on her stbd. beam and from a Northerly direction.

1315 A. Mackenzie hull section C-2 landed on the scrap barge.
Reported weight when clear of the water = 310 short tons.

After seein the last remaining section of A. Mackenzie's hull landed safely on the scrap barge I brought my personal gear off the Lima-400 and departed the wreck site for the last time leaving the bottom clean up phase as a responsibility of Capt. U E Sweeting and the BSI diving team under the supervision of Andy Webb.

Wednesday 21 August 1974
With the bottom clean up phase proceeding on schedule under Capt. Sweeting I spent mosy of his day at the Murphy Pacific trailer office finalizing pertinent administrative matters relative to my departure from Galveston and the A Mackenzie salvage operation.
Thursday 22 August 1974
Again during the AM I visited the MYPAC office to ensure that all is in good order for my departure.
1345 I departed Galveston enroute to Houston Texas.
--- Remained in Houston overnight.

Friday 23 August 1974
Enroute from Houston Texas to Parkersburg West Virginia
Saturday 24 August 1974
At Parkersburg West Virginia visiting friends and relatives
Sunday 25 August 1974
At Parkersburg West Virginia
Monday 26 August 1974
Enroute from Parkersburg to Miami Florida
Tuesday 27 August 1974
At Miami engaged in recovery of lost baggage.
Wednesday 28 August 1974
Enroute from Miami to Kingston Jamaica
1645 Arrived at Norman Manley air port Kingston Jamaica and proceeded directly on board the Motor Vessel Rescue.

In closing this report and in behalf of the entire A. Mackenzie salvage crew I wish to express our sincere appreciation for the excellent support provided by the US Navy Supervisor of Salvage and the US Army Corp of Engineers especially pertaining to logistics and public relations.

Fini A. Mackenzie salvage operations as related to services rendered by the undersigned.

Cyrus E. Alleman
Cyrus Earl Alleman
Salvage Master

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A. MACKENZIE SIT. REP.
Wednesday August 21, 1974

1000 Derrick barge in 4 point moor at wrêck site. Rigging diver reference positions for bottom clean up.

Note: LCDR Bartholomew, (U.S.N.) on board this AM. - Advised me that clean-up operation of bay bottom would end 25th and all gear in area, including barge and overboard gear would have to depart scene on Sunday and go to docks to enable buoy tender to shift channel buoys.

My expressed opinion was that 3½ days would not be enough to even do an adequate job. Divers efficiency limited by current and poor visibility. Previously understood time frame was two weeks. Have asked for extension of time.

Diving time this day 2 hrs. 25 min.

U. E. Sweeting

U. E. Sweeting
Salvage Master

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A. MACKENZIE SIT. REP.
Thursday August 22, 1974

Continued removing debris from bottom at position where the sunken stern area rested. Divers are diving during periods of slack and near slack current. Due to total exposure to current, unable to dive when current exceeds 1.5 knots. Visibility at most times poor.

After talk with Corps of Engineers Supervisor Mr. Bissell, verbal agreement that clean-up operation would continue beyond 25th.

Total diving time for 5 divers this day 6 hrs. 50 min.

U. E. Sweeting

U. E. Sweeting
Salvage Master

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A.MACKENZIE SIT. REP.
Friday August 23, 1974

Continued removing surface debris from bottom. Presently working in stern area. Removal being carried out in accordance with no specified date of termination for clean-up phase.

Able to dive only in AM Slack.

Magnet would have helped during non-diving periods but Capt. Alleman exhausted all possibilities of acquiring one without success.

Sending lift chains and salvage gear ashore while not diving.

Total diving time 3 divers 5 hrs. 52 min.

LCDR Bartholomew asked if we would be finished by Sunday. Our answer was that it would be impossible. No further mention of job terminating on August 25.

U. E. Sweeting

U. E. Sweeting
Salvage Master

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A. MACKENZIE SIT. REP.
Saturday August 24, 1974

Continued removing surface debris from bottom. Presently working in stern area. Removal still being carried out in accordance with no specified date of termination.

LCDR. Bartholomew boarded barge. In our discussion it was agreed that on Monday 26, he would let me know the thoroughness of clean-up operation desired by Colonel McCoy and if there would be a termination date set.

PM easterly swell 4 to 5 ft.

Total diving time (5 divers) 7 hrs. 40 min.

UE Sweeting
U. E. Sweeting
Salvage Master

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A. MACKENZIE SIT. REP.
Sunday August 25, 1974

Continued removing surface debris from bottom.

PM received report of tropical wave at Lat. 26° 00'N Long. 92° 30' W. moving W.N.W. at 18 miles an hour toward Texas coast.

Secured materials on derrick barge.

Total diving time (4 divers) 6 hrs. 58 min.

U.E. Sweeting
U. E. Sweeting
Salvage Master

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A. MACKENZIE SIT. REP.
Monday August 26, 1974

Removing of debris progressing satisfactorily according to plan.

Current running strong this day due to high tides caused by tropical depression.

Plan on meeting with Dredge captain tomorrow.

Total diving time (3 Divers) 4 hrs. 19 min.

U. E. Sweeting

U. E. Sweeting
Salvage Master

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A. MACKENZIE SIT. REP.
Tuesday August 27, 1974

Continued removing debris from bottom surface.

Capt. Greenwood, Dredge captain of the MCFARLAND, boarded the derrick barge to observe the debris we had brought to the surface. U.S. Navy and Corps of Engineers representatives were present. The opinion was that the quantity and size of the removed pieces would be more than adequate for the safety of the dredge in future dredging operations in this area.

Total diving time (5 Divers) 9 hrs. 40 min.

U.E. Sweeting
U. E. Sweeting
Salvage Master

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A. MACKENZIE SIT. REP.
Wednesday August 28, 1974

Continued removing debris from bottom surface. Presently working in area where the after end of the forward engine room was resting on bottom. Heavy accumulation of debris in this area.

Total diving time (5 Divers) 7 hrs. 39 min.

U. E. Sweeting

U. E. Sweeting
Salvage Master

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A. MACKENZIE SIT. REP.
Thursday August 29, 1974

Continued removing debris from bottom surface.

Able to progress with more speed after removing heavy accumulation at after end of forward engine room.

Possible to complete removal of surface debris from entire pre-determined clean-up area during tomorrow's diving period. Derrick barge will then be towed to dock for scrap and equipment removal.

Total diving time (5 Divers) 7 hrs. 13 min.

U. E. Sweeting
U. E. Sweeting
Salvage Master

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A. MACKENZIE SIT. REP.
Friday August 30, 1974

Completed removal of surface debris from entire pre-determined clean-up area. (Sketch to be provided). Diving foreman advises that any further diving would not be necessary. Corps of Engineers and U. S. Navy representatives agreed that the clean-up was in accordance with our original agreement.

Dredge MCFARLAND working in area 30 minutes after we had departed area.

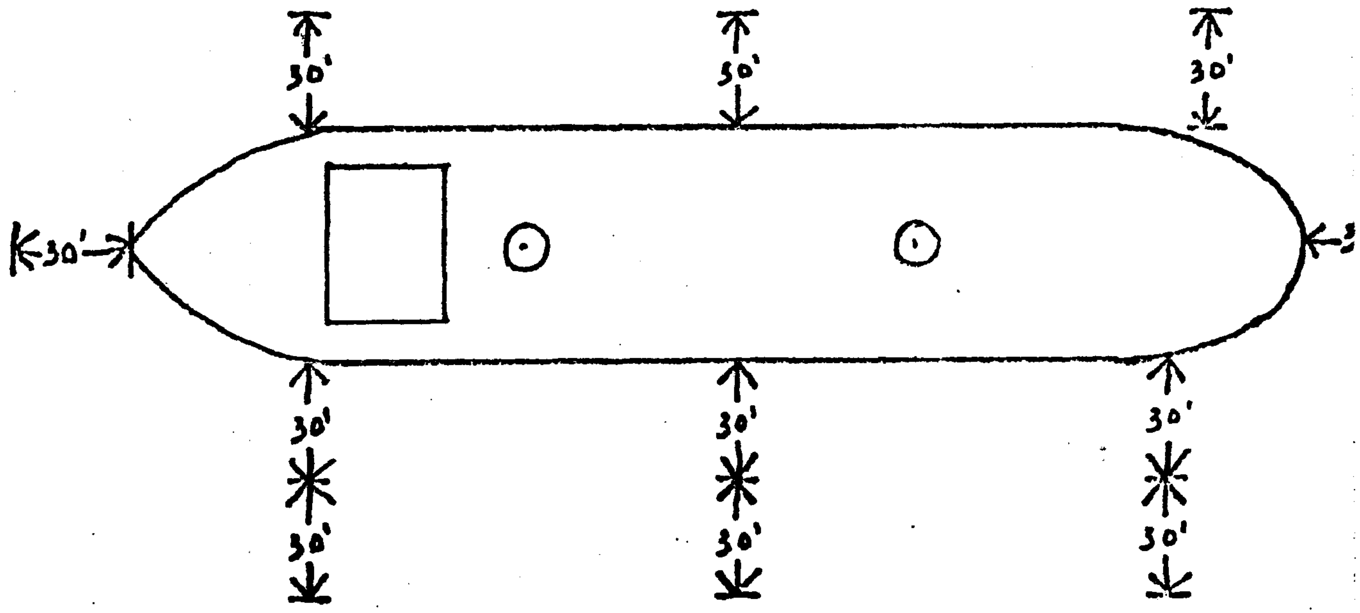
1125 Completed diving operation. Started recovering diver's reference stations and derrick barge's moorings.

1525 Derrick barge's moorings recovered. Proceeding to Corps of Engineers dock.

1700 Derrick Barge alongside dock. Started to discharge equipment.

U. E. Sweeting

U. E. Sweeting
Salvage Master



A. MACKENZIE

NOTES:

1- AREA CLEANED TO MUD LEVEL.

2- AREA OF SEARCH EXTENDED ADDITIONAL 30' ON PORT SIDE DUE TO LOADING IN THIS AREA.

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A. MacKENZIE SIT REPORT
SATURDAY AUGUST 31, 1974

DISCHARGING EQUIPMENT AND SCRAP METAL FROM DERRICK BARGE

1325 Tug Wolf 11 towed the derrick barge to Freeport, Texas.
All equipment and scrap metal removed.

B S I Divers using this day for travel time.

U. E. Sweeting
U. E. Sweeting
Salvage Master

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A. MacKENZIE SIT. REP.
SUNDAY Sept. 1, 1974

Reviewed and completed signing B S I Divers Reports.

Signed and brought up to date all bills received.

U. E. Sweeting

U. E. Sweeting
Salvage Master

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A. MacKENZIE SIT. REP.
Monday Sept. 2, 1974

Labor Day Holiday observed.

Shore help being retained through Wednesday, Sept. 4th.

U. E. Sweeting
U. E. Sweeting
Salvage Master

MURPHY PACIFIC MARINE SALVAGE COMPANY
MERRITT DIVISION

A. MACKENZIE SIT. REP.
Tuesday Sep. 3, 1974

Mr. Bissell, U. S. Corps of Engineers, spoke with Colonel McCoy. Understood that today would be the last day on the job for Mr. Walker, U. S. Navy, and for Murphy Pacific.

Bills outstanding $106,100. - not received.

Mr. Matthews of the U.S. Navy Salvage Finance Office will be here on Friday, Sep. 6th, to check over financial statements. On a previous visit he advised that a Murphy representative should sign all bills before he signed them.

Mr. Day will be the only Murphy Pacific representative on scene.

LCDR Bartholomew will be here on Monday, Sep 9th.

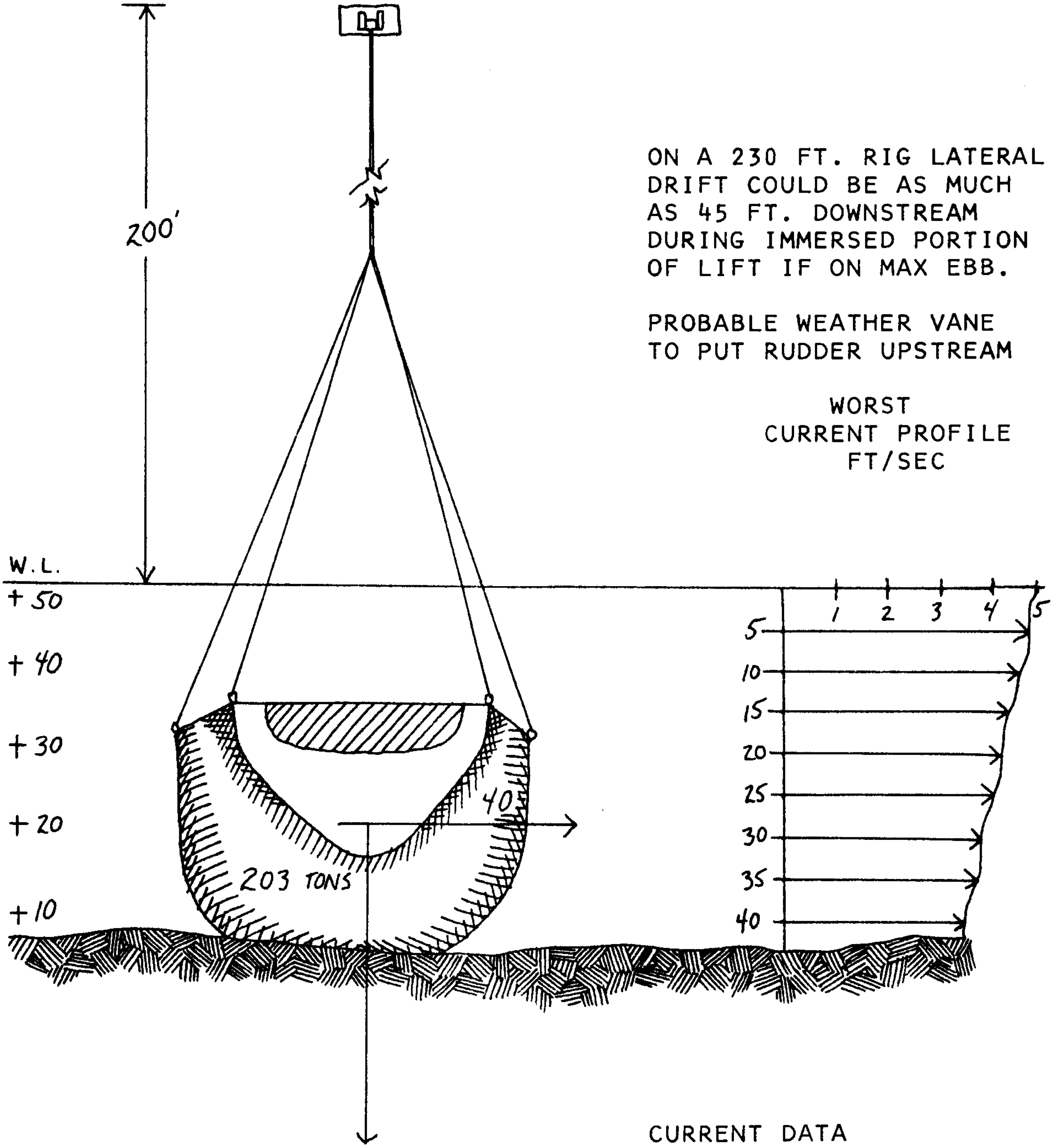
U. E. Sweeting

U. E. Sweeting
Salvage Master

5.5 Lateral Drag Effects

ON A 230 FT. RIG LATERAL DRIFT COULD BE AS MUCH AS 45 FT. DOWNSTREAM DURING IMMERSED PORTION OF LIFT IF ON MAX EBB.

PROBABLE WEATHER VANE TO PUT RUDDER UPSTREAM



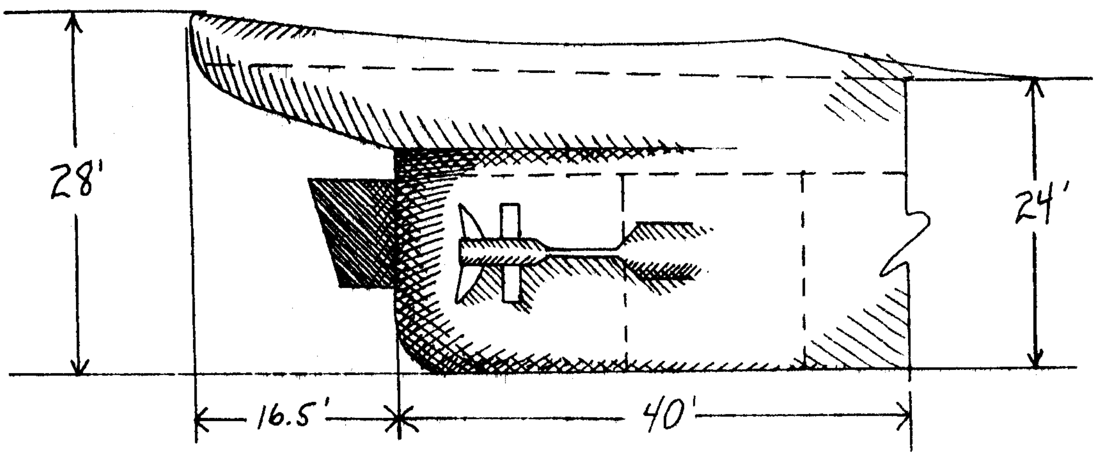
CURRENT DATA
REF: GALVESTON DISTRICT
SURVEY PROVIDED 6/20
FOR BUOY 9

5.6 Horizontal Drag Force on Stern Section

$$D = C_D \, \rho \, \frac{V^2}{2} \, (AREA)$$

USE $C_D = 1.8$ (TWO SHARP EDGES)

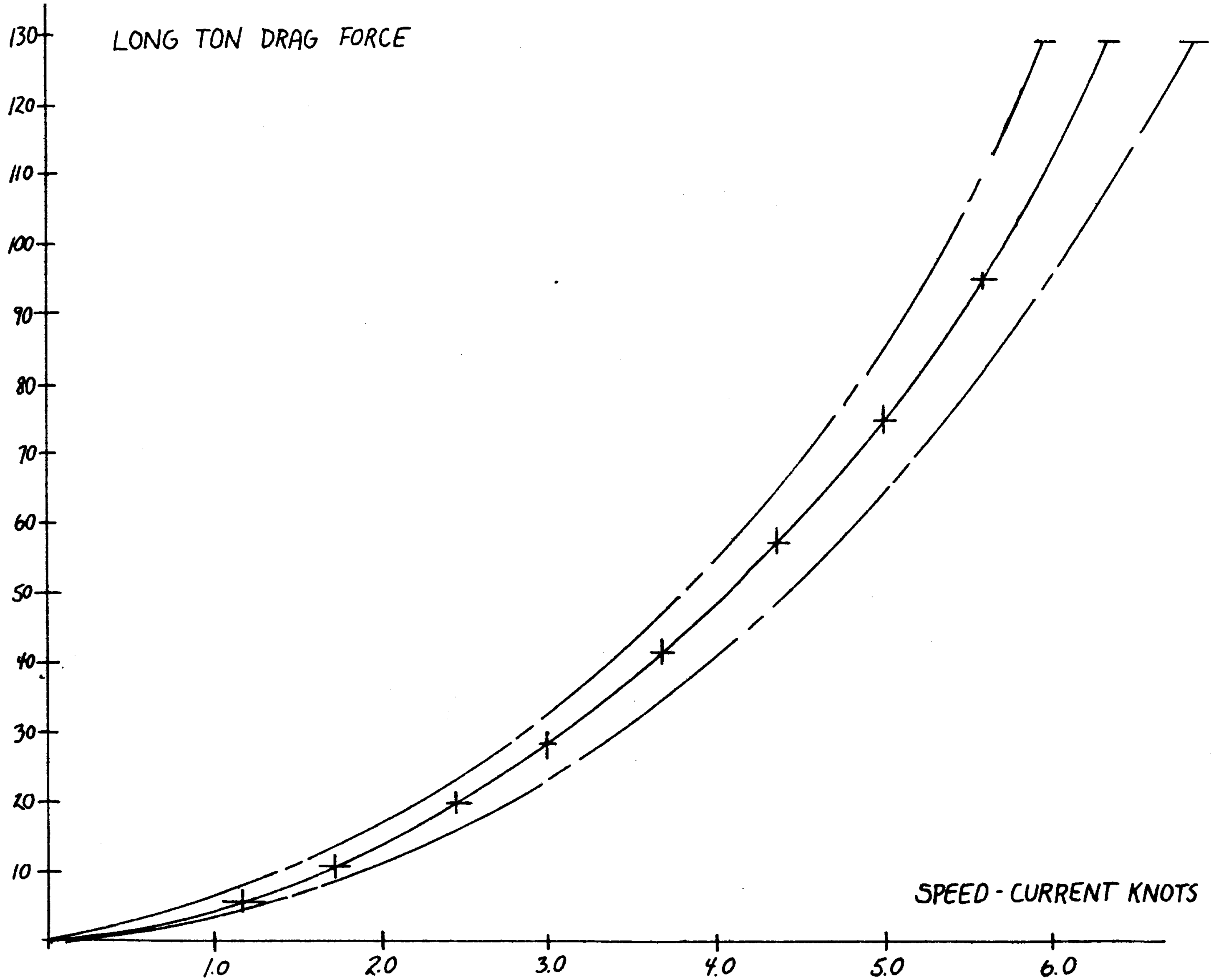
$$\frac{64.4}{32} = 2$$



$$AREA = (26)(56.5) = 1469$$

$$V = V^2 C_D \frac{\rho}{2} \qquad \frac{1.8V^2(1469)}{\frac{2644.2}{2270}} = 1.18 \text{ TONS}$$

Ft/per	DRAG =	
1.0	1.18 TONS	.60
2.0	4.72	1.20
3.0	10.62	1.80
4.0	18.66	2.40
5.0	29.5	3.01
6.0	42.40	3.61
7.0	57.82	4.22
8.0	75.52	4.82
9.0	95.58	5.42
10.0	118	6.02


LONG TON DRAG FORCE
130
120
110
100
90
80
70
60
50
40
30
20
10
SPEED - CURRENT KNOTS
1.0
2.0
3.0
4.0
5.0
6.0

5.7 Silt Weight - Volumetric Data

SILT WEIGHT -- VOLUMETRIC DATA

Two samples provided from Section G, one from recreation area main deck, one from bilges in machinery space.

Test results 7/1/74:

Sample A Very wet	Vol = 930 cc Wt = 1249 grams

apparent specific gravity = 1.34
wt/ft^3 = 83.61 lbs

Sample B Very wet	Vol = 950 cc Wt = 1216 grams

apparent specific gravity = 1.28
wt/ft^3 = 79.87 lbs

Sample B 5 min clearing & settling	container wt = 270 gr

clearest vol = 270 cc

$$\text{est. S.G.} = \frac{1541 - 270 - 293}{950 - 270} = \frac{978}{680} = 1.44$$

wt/ft^3 = 89.74 lbs

7/2/74

Sample B 19 hr settling & clearing	Vol = 630 cc) after decanting Wt = 1194) clear fluid

apparent S.G. = 1.45

wt/ft^3 = 90.7 lbs

5.8 Calculations for Residual Strength

Residual Strength Maintenance during MACKENZIE Cutting Operations

Ref: Sun Shipbuilding to Dwg. 58-710-2
"Transverse Frames Nos. 21 to 47 Incl."

Sun Shipbuilding to Dwg. 58-715-2-3
"Main Deck Plating Aft"

Assume a cut to include all but the main deck and the longitudinal stringers that run above the inner bottom, the residual strength of the hulk will prevent her from breaking further, provided the tidal currents are not in excess of 3 kts.

ASSUMPTIONS

Ref: Sun Ship Dwg. 58-710-2
"Transverse Frs. 21-47 Incl"

Sun Ship Dwg. 58-715-2-3 "MN DK PLTG AFT"

a) Assume only Intact Longds. above inner bottom

b) Assume Intact Main Deck

1) Calc the intact section modulus above the horizontal axis

ITEM	① AREA IN.² (FOR ½ BREADTH)	② DIS FT.	① × ② ③	③ × ② in.² ft.²
MAIN DECK	37.9 (5)(12) (25.5/40.4) 41.8 (11)(12) (12.5/41)	18.0	1435	25830
UPPER STRINGER	(21)(15.3/40.4)	10.0	80	795
LOWER STRINGER	(21)(15.3/40.4)	5.0	40	199
Σ	95.7	Σ	1555	26625 in² ft²

$Y = \frac{1555}{95.7}$ $18.0 - 16.25 = 1.75$ ft. Below M.D.

$AY^2 = (95.7)(16.25)^2$

26625
25266
1358 in² ft²

$C = 16.25 - 5 = 11.25$ ft.

$\frac{1}{2} Z = 1358/11.25 = 121$

2) Calc the intact section modulus about the vertical axis (C.L.)

ITEM	IN²	DIS FT.	① × ② ③	③ × ② IN² Ft²	ft³/12 in.² ft.²
MAIN DECK ①	37.9	20.75	786	16318	$(25.5/40.4)(60/12)(5^2) = 79$
②	41.8		543	7064	$(12.5/40.4)(132/12)(11^2) = 421$
					500
UPPER STRINGER	8.0	13.0 22.0	176	3872	
LOWER STRINGER	8.0	22.0	176	3872	
	95.7			31126 500 (31627 in² Ft²)	

(31627)(2)

3) Bending about the vertical axis (C.L. Plane)

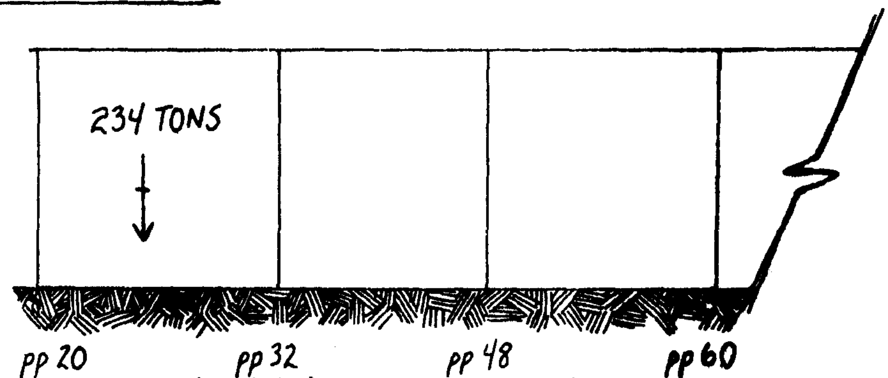
Assume a 50 ton horizontal thrust on the section with tidal current/drag

$$M = (50)(12) \text{ ft. TONS} \qquad Z = 3048 \text{ in.}^2 \text{ ft.}$$

$$\text{TENS OR COMP. BENDING} = \frac{(50)(12)}{3048} = 2 \text{ TONS/IN.}^2$$

The horizontal tearing forces with a tidal current should not be enough to break off the Fr 20 to 32 segment (Section B) if the main deck is left intact.

Horizontal Bending



$$\frac{M}{Z} = \frac{(234)(12)}{(121)(2)} = \frac{23.2}{\cancel{2}} \rightarrow 11.6 \ \frac{\cancel{\text{FT.}}\ \text{TONS}}{\text{IN.}^2\ \cancel{\text{FT.}}} \quad \text{COMP,}$$

If the whole thing were to cantelever, the lower stringer would buckle, but since it is resting on the bottom this is no real concern.

$$\text{TENSILE BENDING} = \frac{M}{Z\ \text{TONS}} = \frac{(234)(12)}{\left(\frac{1358}{1.75}\right)(2)} = \frac{\cancel{3.6}}{\cancel{2}} \rightarrow 1.8 \ \text{TONS}/\text{IN.}^2$$

The tensile residual strength appears quite adequate, if we retain the main deck.

HORIZONTAL SHEAR

$$\text{SHEAR} \ \frac{234}{(2)(95.7)} = \frac{\cancel{2.45}}{\cancel{(2)}} \rightarrow 1.2 \ \text{TONS}/\text{IN.}^2 \quad \text{SHEAR}$$

The Shear residual with the main deck intact looks quite adequate.

5.9 Section B, Lift Analysis

B SECTION

COMPARISON OF SINGLE LIFT TO TWO LIFTS

Single Lift:

Initial Dead Wt. =	247 tons
Wt. on	69
Wt. off	70
Gross lift (moderate silt)	246 tons
Net lift after washing off	-60
	186 tons optimum

Schedule 10 working days

Double Lift:

	Upper "B"	Lower "B"
Initial Dead Wt.	130 tons	117 tons
Wt. on	+17	+57
Wt. off	-18	-51
Gross Lift (moderate silt)	129	123
Net left after washing	-8	-46
	121 optimum	77 optimum
Schedule	7 working days	5 working days

Total schedule about 12 working days

Recommendations:

Stay with single lift and unless silt exceeds 1 foot depth in bilges, skip wash operation on big lift.

5.10 Phase III Lift Estimates

PHASE III WEIGHT ESTIMATES
USING RETURNED WEIGHT CORRECTIONS FROM PHASE I AND II

Weight Predictions for Phase III Lifts

Using the U.S. Army Engineers Philadelphia District base line of departure and using the Teledyne hook data as a guide, the following predictions were made on Phase III lifts:

Lower C	258 short tons
Upper D	164
Lower D	332
Upper E	176
Lower E	388
Upper F	115
Lower F	358

The calculations deriving the predictions are summarized in the table below:

TABULAR SUMMARY OF COMPARISONS SHORT TONS/FT
OF BASE LINE DATA AND TELEDYNE HOOK DATA

	BASIC HULL US ARMY PHILA.	BREAK OUT	% BASIC	INTERFACE JUMP	TOTAL LANDED
BOW	3.95	4.4	1.11	2.63	7.03
STERN	3.95	4.2	1.06	2.52	6.72
B	5.40	6.7	1.24	6.60	13.3
UPPER C	5.4	2.34	.43	1.52	3.28
UPPER G	5.4	4.00	.74	1.25	5.25
LOWER G (BALLAST)	5.4	6.00	.65	3.0	9.0

RATIONALE: Take the returned weight results and compare them to the initial Philadelphia estimates. Use the wt/ft data base. Develop section characteristics on a wt/ft basis.

BASIC MACHINERY SPACE DATA B SECTION:

a) Original estimate base

main hull steel - 4.8 LT/ft

machinery wts. - $\frac{3.2 + 7.3}{2}$ = 8.9 LT/ft) 14.7 LT/f or 16.46 ST/

wood & gear - 1.0 LT/ft

$\frac{(2240)}{(2000)}(14.7)\ (24)$ = 395 short tons from the initial length wt. distributions

b) U.S. Army Engineers Phila. Data - used for official best estimate total for section with machinery removed = 247 tons or 10.3 ST/ft

c) Actual

break out 160 tons or 6.7 tons/ft

interface 320 tons or 13.3 tons/ft

silt area (24) (45) = 1080 ft^2

if 2' deep $\frac{(1080)\ (2)\ (90)}{2000}$ = 97 tons) or av. 121 tons) or 5.1 tons/ft

if 3' deep " = 145 tons)

BASIC SECTION WEIGHT COMPARISONS:

a) Bow 3.5 LT/ft or 3.92 SH/ft in hull

Break out was 4.40 ST/ft actual

Landing weight was 7.03 of which 120/45.5 = 2.63 tons/ft interface jump possibly was water & silt

b) Stern 3.5 LT/ft or 3.92 ST/ft in hull

Break out was 4.20 ST/ft actual

Landing weight was 6.72 ST/ft of which perhaps 80 tons = 1.45 tons/ft would have been water & silt

interface jump 2.52 tons/ft

c) Upper C

Break out was 75/32 = 2.34 tons/ft or $\frac{2.34}{5.4}$ = .43 basic hull

Landing weight was 105/32 = 3.28 tons/ft

interface jump 1.52 tons/ft

d) Upper G

Break out was $\frac{80}{20}$ = 4.0 tons/ft or $\frac{4.0}{5.4}$ = .74 basic hull

Landing weight was $\frac{105}{20}$ = 5.25 tons/ft

interface jump 1.25 tons/ft

e) Lower G

Break out was $\frac{120}{20}$ = 6.0 tons/ft

Ballast estimated 2.5 tons/ft

$\frac{3.5}{5.4}$ = .65 basic hull

Landing weight was $\frac{180}{20}$ = 9.0 tons/ft

Interface jump 3.0 tons/ft

estimated silt = $\frac{(20)\ (45)\ (90)\ (2)}{2000}$ = 81 tons or 4.05 tons/ft

PREDICTIONS FOR UPPER F:

RATIONALE: Use constants developed for Upper C.

```
(3.3 tons/ft)(16)(2) = 105 tons now
                      + 10 tons Bldg. 92
                       115 tons
```

PREDICTIONS FOR LOWER F:

RATIONALE: Use contants developed for Lower G, but
modify by a) adding machinery + 15 tons
b) adjusting ballast to 3.9 tons/ft
in _____ 2.5 tons/ft

```
                                1.4
                                9.0
                               10.4 tons/ft factor

(10.4 tons/ft)(32) =383
                   - 15
                    348 tons
                   + 10 Bldg 92
                    358          could trap another 40 tons silt
```

PREDICTIONS FOR LOWER C:

RATIONALE: Use constants developed for Lower G, but
modify by a) adding machinery + 50 tons
b) deleting ballast

```
                                9.0
                              - 2.5
                                6.5 tons/ft factor

(6.5 tons/ft)(32) = 258 tons

                            could trap another 40 tons silt
```

PREDICTIONS FOR HOPPER SPACES WITH NO DREDGE SPOILS:

```
Basic Hull upper     = 2.5 ST/ft
Hopper stuff upper   = 1.5 ST/ft
                       4.0 ST/ft
```

UPPER D

```
(4.0)(28) = 112
             10 Bldg 48
            122

Interface jump = (1.5)(28) = 42
                            164 ST
```

UPPER E

```
(5.5)(32) = 176
             20 Bldg 62,78
            196 ST
```

LOWER D

```
Basic Hull Lower   = 3.0 ST/ft

Hopper stuff lower= 4.0 ST/ft
                    7.0 ST/ft
(similar stern)
Spares & stuff     = 2.5

Interface jump     = 2.0
                   (11.5)(28)

                    322
                     10 Bldg 48
                    332
```

LOWER E

```
(11.5)(32) = 368
              20 Bldg 62,78
             388 ST/ft
```

5.11 Project Engineer Cost and Time Estimate for 21 May 1974 Decision on Salvage Plan

FOAM BUOYANCY/CUT IN PLACE COMBINED

APPROACH

- REMOVE TOP HAMPER
- CUT SHIP AT FRAMES 48 AND 78
- CUT HOPPER'S IN PLACE AND REMOVE WITH 250 TON CRANE
- MOOR REMAINING BOW AND STERN SECTIONS ON BOTTOM
- INSTALL POLYURETHANE FOAM IN STERN SECTION
- BLOW AFT FUEL TANKS TO MAKE STERN POSITIVELY BUOYANT
- SLIP MOORS AND RAISE STERN
- TOW TO SEA AND SINK WITH EXPLOSIVE CHARGES
- FLOAT AND DISPOSE OF BOW IN SIMILAR MANNER

ESTIMATED TIME TO CLEAR CHANNEL

- 100 DAYS

ESTIMATED TOTAL COST

- $3,150,000

RISK

- SUSEPTABLE TO STORM DAMAGE
- MINIMAL VOLUME AVAILABLE FOR RESERVE BUOYANCY OR TO ALLOW FOR POOR QUALITY FOAM
- FOAMED SECTIONS WILL BE AWKWARD TO TOW DUE TO DEEP DRAFT (ESTIMATED 32 FT)

ENVIRONMENTAL ACCEPTABILITY

- SINKING AT SEA IS ONLY FEASIBLE MEANS TO DISPOSE OF FOAM SECTIONS
- SOME EXPLOSIVES WILL BE EMPLOYED
- FOAM CAN CREATE MINOR POLLUTION PROBLEM

ESTIMATED RETURN ON SCRAP

- $ 20,000

PRINCIPAL ADVANTAGES

- 30 DAYS LESS ESTIMATED TIME TO CLEAR CHANNEL
- $250,000 LESS ESTIMATED COST

PRINCIPAL DISADVANTAGES

- ELEMENT OF RISK
- POTENTIAL ENVIRONMENTAL PROBLEMS

FOAM BUOYANCY/CUT IN PLACE COMBINED

COST SUMMARY BASED ON 100 DAYS TO CLEAR CHANNEL

SALVAGE

CORPS OF ENGINEERS

Costs to Date	$36,743		
Costs to Complete		$ 67,410	
Total			$ 104,153

NAVY SUPERVISOR OF SALVAGE

Costs to Date	$10,115		
Costs to Complete		$ 40,150	
Total			$ 50,265

MURPHY PACIFIC

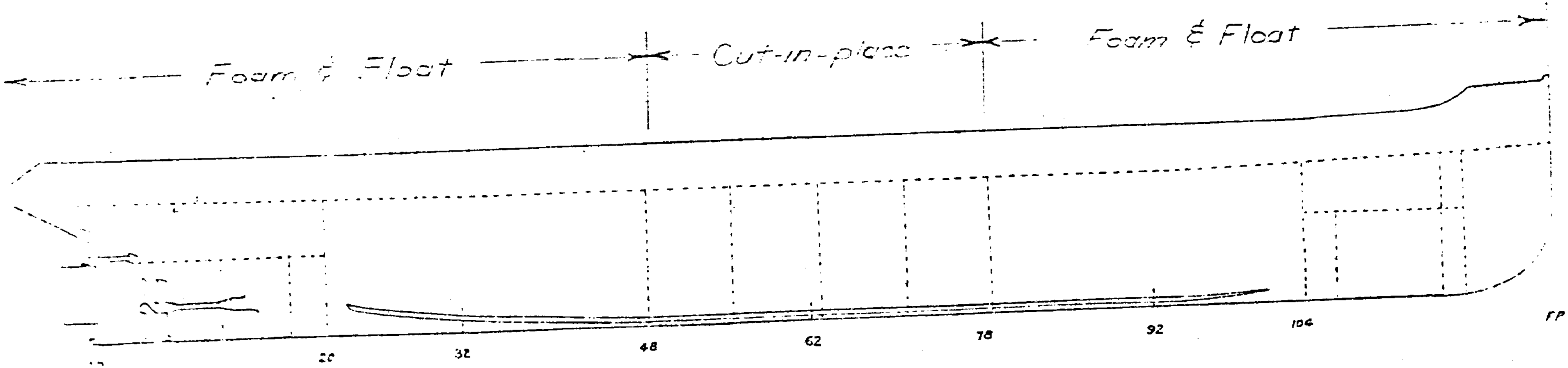
Costs to Date	$52,000		
Costs to Complete		$1,769,514	
Total			$1,821,514

50, 250, AND 500 TON CRANE SUPPORT

Costs to Date	$ --		
Costs to Complete		$ 388,000	
Total			$ 388,000

TOTAL COSTS TO DATE	$98,910		
TOTAL COSTS TO COMPLETE		$2,265,074	
TOTAL (SALVAGE)			$2,363,932

ALTERNATE NO. 1



CUT IN PLACE

APPROACH

- REMOVE TOP HAMPER
- CUT SECTIONS OF DREDGE AND RIG FOR 100-200 TON LIFTS
- MOBILIZE 250 TON CRANE AND MAKE LIFTS
- DEMOBILIZE 250 TON CRANE
- CUT LOWER SECTIONS OF DREDGE AND RIG FOR 250-400 TON LIFTS
- MOBILIZE 500 TON CRANE AND MAKE LIFTS
- DEMOBILIZE 500 TON CRANE
- DISPOSE OF 3300 TONS OF SCRAP ON CONTINUING BASIS

ESTIMATED TIME TO CLEAR CHANNEL

- 130 DAYS

ESTIMATED TOTAL COST

- $3,400,000

RISK

- NO RISK THAT JOB WILL BE ULTIMATELY SUCCESSFUL. HOWEVER, TIME REQUIRED TO COMPLETE COULD INCREASE.

ENVIRONMENTAL ACCEPTABILITY

- EXPLOSIVES WILL BE EMPLOYED

ESTIMATED RETURN ON SCRAP

- $60,000

PRINCIPAL ADVANTAGES

- MINIMAL RISK
- POSITIVE AND FINAL REMOVAL OF DREDGE
- SIGNIFICANTLY MORE SALEABLE SCRAP

PRINCIPAL DISADVANTAGES

- 30 DAYS ADDITIONAL TIME TO CLEAR CHANNEL
- ADDITIONAL COSTS

CUT IN PLACE

COST SUMMARY BASED ON 130 DAYS TO CLEAR CHANNEL

SALVAGE

CORPS OF ENGINEERS

Estimated Costs to Date	$36,743		
Estimated Costs to Complete		$ 96,300	
Total			$ 133,043

U. S. NAVY SUPERVISOR OF SALVAGE

Estimated Costs to Date	$10,115		
Estimated Costs to Complete		$ 50,800	
Total			$ 60,915

MURPHY PACIFIC

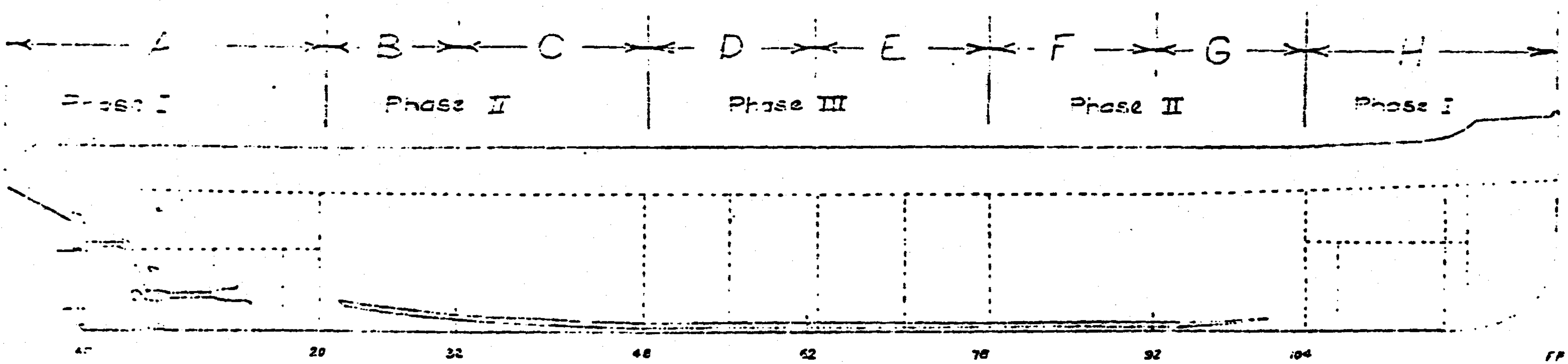
Estimated Costs to Date	$52,000		
Estimated Costs to Complete		$1,394,681	
Total			$1,446,681

50, 250 & 500 TON CRANE SUPPORT

Estimated Costs to Date	$ --		
Estimated Costs to Complete		$ 895,500	
Total			$ 895,500

TOTAL ESTIMATED COSTS TO DATE	$98,858		
TOTAL ESTIMATED COSTS TO COMPLETE		$2,437,281	
TOTAL SALVAGE COSTS			$2,536,139

ALTERNATE NO. 2



CUT IN PLACE

COST SUMMARY BASED ON 130 DAYS TO CLEAR CHANNEL

POLLUTION ABATEMENT

CORPS OF ENGINEERS

Estimated Costs to Date	$ 1,348		
Estimated Costs to Complete		$ 1,500	
Total			$ 2,848

U. S. NAVY, SUPERVISOR OF SALVAGE

Estimated Costs to Date	$ 8,600		
Estimated Costs to Complete		$13,300	
Total			$ 21,900

MURPHY PACIFIC

Estimated Costs to Date	$ 6,500		
Estimated Costs to Complete		$31,500	
Total			$ 38,000

TOTAL ESTIMATED COSTS TO DATE	$16,448		
TOTAL ESTIMATED COSTS TO COMPLETE		$46,300	
TOTAL POLLUTION ABATEMENT COSTS			$ 62,748
SUBTOTAL			$2,598,887
CONTINGENCY @ 30%			$ 779,666
GRAND TOTAL ESTIMATED COSTS			
MACKENZIE SALVOPS (Cut in Place)			$3,378,553

5.12 U.S. Army Corps of Engineers
Philadelphia District

"Dredge A. MACKENZIE
Effect of Collision Penetration
on Hull Girder Strength".

Dredge A. MACKENZIE

EFFECT OF COLLISION PENETRATION

on

HULL GIRDER STRENGTH

US Army Engineer Dist.
Phila., Pa.

Marine Design Div.
May 1974

CONTENTS

INTRODUCTION

During dredging operations in Galveston Harbor on 24 April 1974, the hopper dredge A. MACKENZIE was struck by a tanker which penetrated the hull on the starboard side between FRS 35 and 42. This report assesses the effect of the damage on the hull girder strength as it would relate to proposed lifting or wrenching operations needed to clear the navigation channel.

CHKD. BY ______ DATE ________ Hull Sect. Mod: JOB NO. ________

PRINCIPAL DIMENSIONS

LOA 268'-5 FR SP 24"

LBP 254'-0

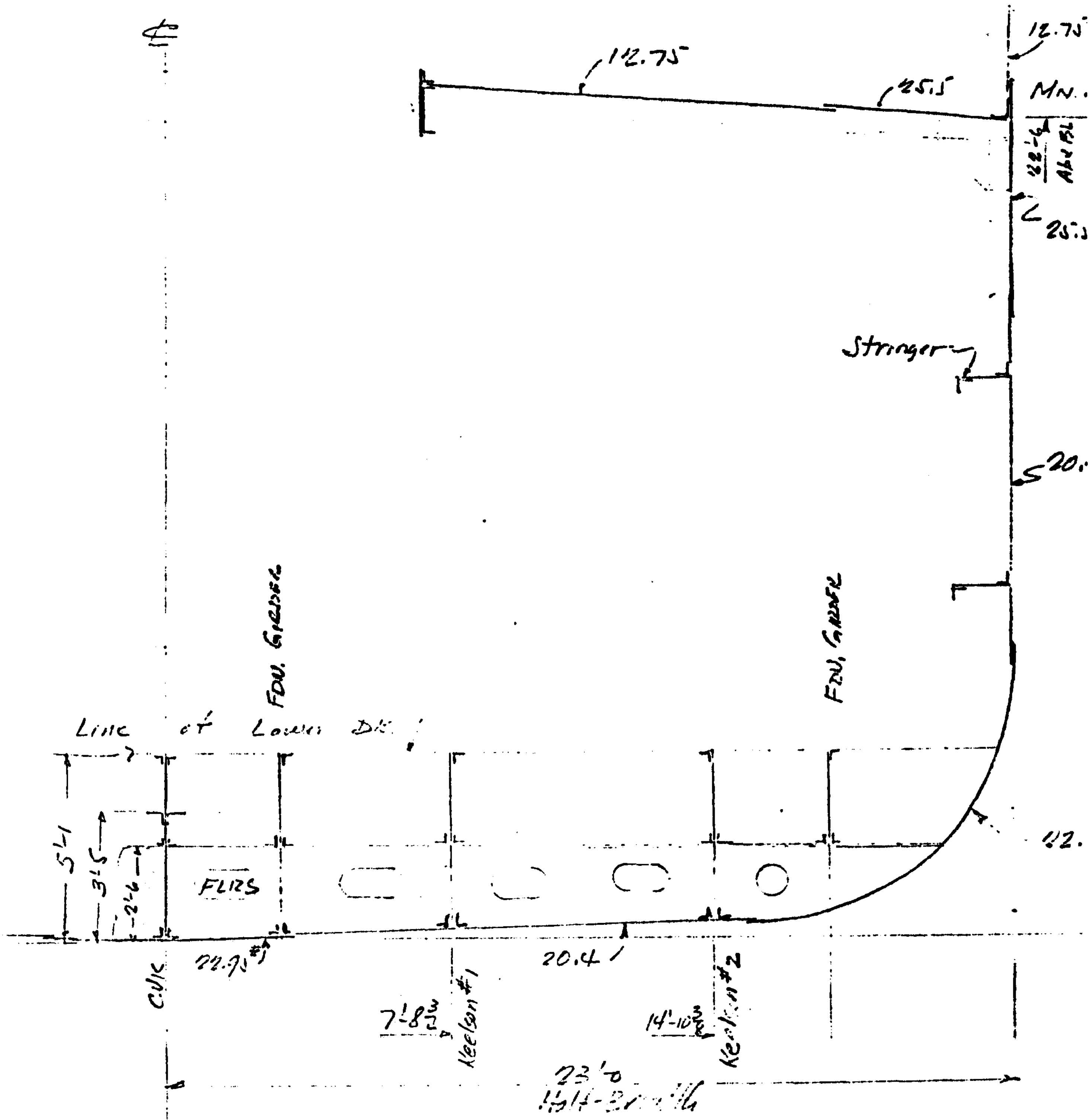
Breadth 46'-0

Depth 22'-6

BASIC SCANTLINGS

Main DK. Stringer Plating	25.5 #
" " Inbd. PL	12.75
Shell Sheerstrake (Main DK. Level)	25.5
Gunwale Bar (At Mn. DK.)	L 6x6x½
Shell Side PL	20.4
Side PL above Mn. DK	12.75
Bilge Strake	22.95
Shell B.H. PL	20.4
Flat PL Keel	22.95
CVK	20.4
Side Keelsons	20.4

CHKD. BY........ DATE.......... JOB NO..................



SECT. AT FR 36

Scale: 1/2" = 1'-0

CHKD. BY........ DATE.......... JOB NO.................

INTACT MOMENT OF INERTIA (FR 36)

Item	Scantling	Area (in.²) A	Lever (ft) y (Abv. BL)	Moment (in.²-ft) Ay	Inertia (in.²-ft²) Ay^2	I_o in²-ft $Ah^2 \div 12$ ft.
Flat ℘ Keel & Garboard Strake	42 x .56	23.5□"	.05	1.2	0.1	
CVK (Web)	$\frac{42 \times \frac{1}{2}}{2}$	10.5	1.75	18.4	32	11
" (Top Angles)	$\frac{2\text{-}Ls\ 5 \times 3\frac{1}{2} \times \frac{1}{2}}{2}$	4.0	3.41	13.6	46	
" (Bott. ")	$\frac{2\text{-}Ls\ 3\frac{1}{2} \times 3\frac{1}{2} \times \frac{3}{8}}{2}$	2.5	0.08	0.2	–	
Side Keelsons #1 & #2	4-Ls $3\frac{1}{2} \times 3\frac{1}{2} \times \frac{3}{8}$ (Top Angles)	10.0	2.41	24.1	58	
Bott. Shell	162 x .50	81.0	0.30	24.3	7.3	
Bilge Strake	132 x .56	73.9	3.50	258.7	906	370
Side Shell	120 x .50	60.0	12.30	738.0	9077	500
Sheerstrake	78 x .625	48.6	20.10	976.9	19636	171
Shell Stringer #1	$18 \times 3\frac{1}{2} \times \frac{3}{8}$	8.5	9.67	82.2	795	
" " #2	"	8.5	15.25	129.6	1976	
Mn. DK Gunwale Bar	∠ $6 \times 6 \times \frac{1}{2}$	5.8	22.67	131.5	2981	
Mn. DK Margin ℘	60 x .625	37.5	22.92	859.5	19700	
Mn. DK Inb'd. ℘	136 x .31	42.2	23.33	984.5	22968	
Hatch Coaming	℘ 21 x .375	7.9	23.0	181.7	4179	2
"	10 ⊏ 21.9	6.4	22.8	145.9	3327	
"	∠ $3\frac{1}{2} \times 3\frac{1}{2} \times \frac{3}{8}$	2.5	23.7	59.3	1405	
TOTALS, ONE SIDE →		433.3		4629.6	87093	1054
		433.3		4629.6	87093	1054
TOTALS, BOTH SIDES →		ΣA = 866.6		ΣAy = 9259.2	174186 (ΣAy^2)	2108 (ΣI_o)

INTACT "I" & "SM" (Con't.)

From preceding sheet:

Area of sect., A = 866.6 in.^{2}

ΣAy = 9259 in.^{2}-ft

ΣAy^2 = 174186 in^2-ft.^{2}

ΣI_o = 2108 in.^{2}-ft.^{2}

Neutral axis, $\bar{y} = \frac{\Sigma Ay}{A} = \frac{9259}{867} = 10.67$ ft. abv. BL

$y_{Deck} = 22.50 - 10.67 = 11.83$ (at side)

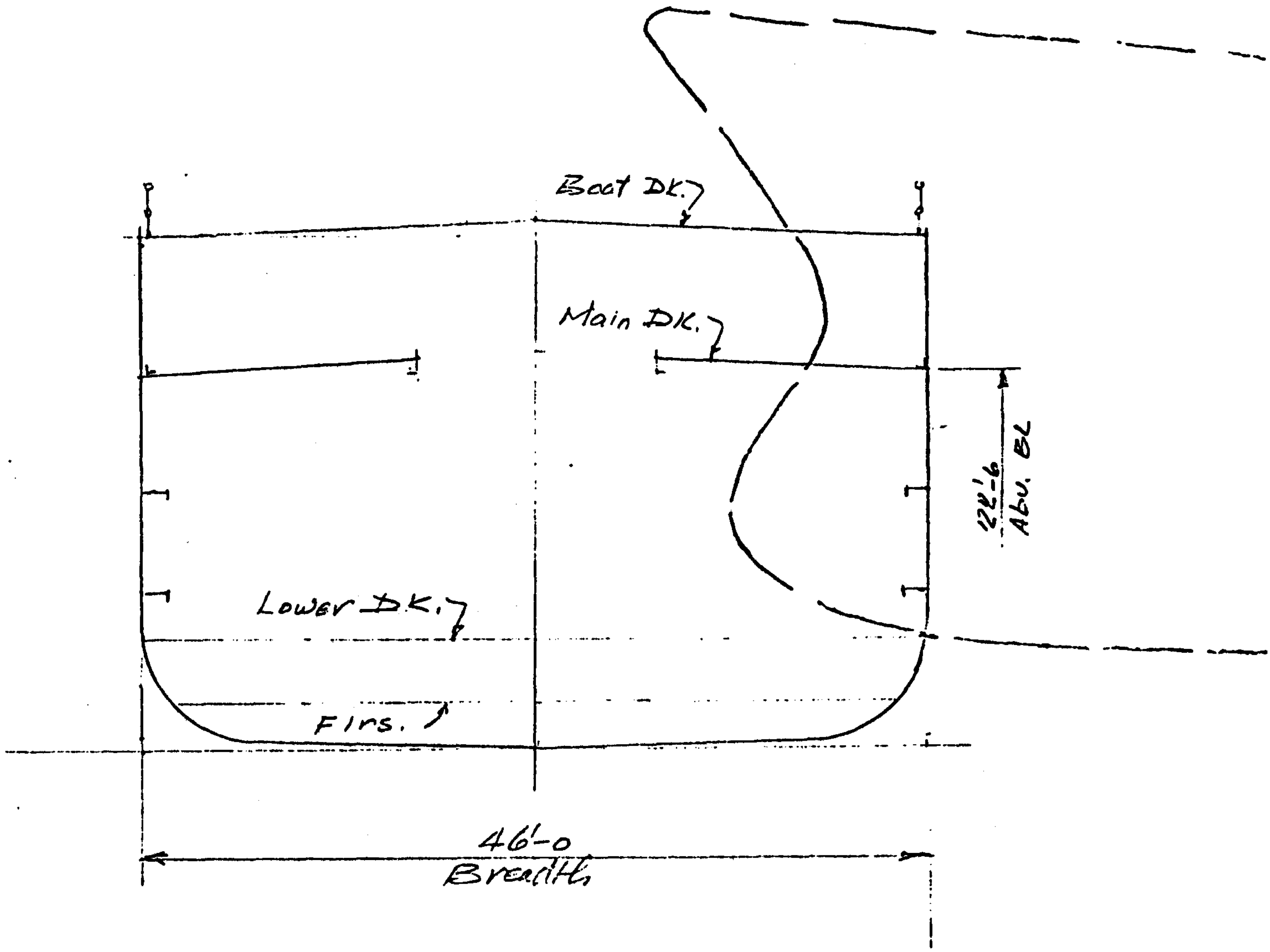
$I = \Sigma I_o + \Sigma Ay^2 - \bar{y}\Sigma Ay = 2108 + 174186 - 10.67(9259)$

$I = 176294 - 98{,}793 = \underline{77501}$ in.^{2}-ft

$SM_{Keel} = \frac{I}{\bar{y}} = \frac{77501}{10.67} = \underline{7263}$ in^2-ft

$SM_{Deck} = \frac{I}{y_{D.K}} = \frac{77501}{11.83} = \underline{6551}$ in.^{2}-ft

DAMAGED MOMENT OF INERTIA



SKETCH OF HULL PENETRATION

Dr'g. A. MACKENZIE

DAMAGED MOMENT OF INERTIA

(Effect of Collision Penetration)

Calc. based on loss of following long'l. strength members:

a. Mn. deck margin Pl & gunwale angle

b. Side shell Pl abv. upper turn of bilge

c. Shell stringers

Item	Scantling	Area (A) (in.²)	Lever (y) (ft.) (Abv BL)	Mom. (Ay) (in²-ft.)	I (Ay²) (in.²-ft.²)	I_o (in²-f.
INTACT TOTALS → (One Side)		433.3		4630	87,093	1052
DEDUCTIONS:						
Mn. DK. Margin Pl	60"x.625	37.5	22.92	860	19,700	-
Gunwale Bar	L 6x6x½	5.8	22.67	132	2981	
Side Shell Pl	120"x.50	60.0	12.30	738	9077	500
Stringers	18x3½x⅜	8.5	9.67	82	795	
	"	8.5	15.25	130	1976	
TOTAL DEDUCTIONS		-120.3		-1942	-34529	-500
NET TOTALS (One Side)		313.0		2688	52564	552
(Other Side)		313.0		2688	52564	552
TOTALS (Both Sides)		ΣA= 626.0		ΣAy = 5376	105128	1101
					ΣAy^2	ΣI_o

Cont., next sheet

CHKD. BY........ DATE.......... JOB NO..................

DAMAGED CONDITION (Cont.)

From preceding sheet:

Net Area of penetrated section, $A =$	626 in.^{2}
ΣAy	5376 in.^{2}-ft
ΣAy^2	105128 in.^{2}-ft.^{2}
ΣI_o	1108 in.^{2}-ft.^{2}

Neutral axis, $\bar{y} = \frac{\Sigma Ay}{A} = \frac{5376}{626} = 8.59$ ft.

$y_{Deck} = 22.50 - 8.59 = 13.91$ ft. (At side)

$I = \Sigma I_o + \Sigma Ay^2 - \bar{y}\Sigma Ay = 1108 + 105128 - 8.59\,(5376)$

$I = 106{,}236 - 46{,}180 = \underline{60{,}056}$ in.^{2}-ft.^{2}

$SM_{Keel} = \frac{I}{\bar{y}} = \frac{60{,}056}{8.59} = \underline{6991}$ in.^{2}-ft.

$SM_{DK} = \frac{I}{y_{DK}} = \frac{60{,}056}{13.91} = \underline{4317}$ in.^{2}-ft.

Percentage of intact strength:

SM At Deck, $\frac{4317}{6551} = 65\%$

SM At Keel $\frac{6991}{7263} = 96\%$

Mom. of Inertia $\frac{60056}{77501} = 77\%$

CHKD. BY ______ DATE ________ JOB NO. __________

HULL GIRDER STRENGTH

COMPARISON W/ ABS SM REQT.

$SM = mB \times (d + .11L)$

$B = 46'0$

$L = 254'0$

$d = 20'0$

	L	m
From TABLE,	250	2.13
	260	2.26
Interp. →	254	2.18

$SM_{REQD} = 2.18 \times 46 \times (20 + .11 \times 254)$

$= 2.18 \times 46 \times 48$

$= 4813$ in.^{2} - ft , at deck

$1.03 \times 4813 = 4957$, at keel

Compare w/ actual SM:

Intact : 6551 (at dk.)

Damaged : 4317 (at dk.)

BY .... DATE .... SUBJECT .... SHEET NO. ....
CHKD. BY .... DATE .... JOB NO. ....

SUMMARY OF RESULTS

	CONDITION		
	Intact	Damaged	%
Moment of Inertia (in^2-ft^2)	77501	60,056	77
Position of N.A. abv. BL (ft.)	10.67	8.59	-
Section Modulus ($in.^2$-ft.)			
Keel	7263	6991	96
Deck	6551	4317	65

DISCUSSION OF RESULTS

The analysis discloses that the maximum theoretical loss in section modulus of the hull is about 35 percent, with respect to the deck, as shown in the summary of results. Of greater significance, however, is that the damage has created an unbalanced girder section that would be subject to torsional buckling if lifting or lateral towing loads are imposed in the channel clearing operation. Also, damaged plating notch effects could cause propagation of cracks and further structural failures which would defeat the objectives of the salvage effort.

RECOMMENDATIONS

It is recommended that the damaged main deck and at least the upper portion of the penetrated side be repaired with structurally effective patches prior to lifting or lateral swinging of the hull. The patches could take the form of longitudinal tee-stiffened plating assemblies to span the openings and secured to the adjacent intact structure using throughbolts, to reduce underwater welding to a minimum. In the event of a decision to restore some buoyancy to the hull, the side shell repair could extend the full depth of the damage.

5.13 <u>U.S. Army Corps of Engineers</u>
<u>Philadelphia District</u>
<u>Marine Design Division</u>

<u>MACKENZIE Weight Estimates</u>
<u>Base Line Data</u>

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPMD

3 June 1974

SUBJECT: Dredge MACKENZIE Salvage: SALVOPS

District Engineer
U. S. Army Engineer District, Galveston
ATTN: Mr. Jim Bissel
Fort Point
Galveston, Texas 77550

1. Returned herewith for your information and use is your marked up sketch which was prepared by Mr. Alex Ryneki and submitted with your letter dated 24 May 1974.

2. As requested, we have inclosed a summary of weights of the proposed cut sections. The numbers correspond to the numbers on the sketch. The weights are estimated in short tons. Inclosed also are the individual machinery weights which were requested by note (1) on the sketch.

3. Please note that no allowance has been made for any weights which have been removed from the top hamper.

FOR THE DISTRICT ENGINEER:

George A. Johnson
GEORGE A. JOHNSON
Chief, Marine Design Division

3 Incl
1. Marked up sketch
2. List of wts of sections (dupe)
3. List of wts of mach. items (dupe)

Cy Furn: (w/cy incl and ref. ltr.)
DAEN-CWO-S

WEIGHTS OF [illegible]

[illegible]TION	WEIGHT SHORT TONS	REMARKS
1	141	
2	115	
3 *	130	* Motor & Reduction Gear Removed.
4 *	117	* Motor & Reduction Gear Removed.
5 *	255	* Diesel Generator & Aux. Power Generator Removed
6 *	227	* Diesel Generator & Aux. Power Generator Removed.
7	274	
8	204	
9	366	
10	228	
11 *	277	* Diesel Generator & Pump and Motor Removed
12 * Ⓐ	321	* Diesel Generator & Pump and Motor Removed.
13	192	
14 Ⓐ	312	
15	97	
16	89	

Ⓐ [illegible]

Note: [illegible] Removal [illegible]

[illegible] QUOTED AS (X)

ITEM	DESCRIPTION	WT LBS	WT SHORT TON
X_1	DIESEL GENERATOR	50,000	25.00
	PUMP MOTOR	15,200	7.60
X_2	DREDGE PUMP	53,700	26.85
X_3	DIESEL GENERATOR	50,000	25.00
X_4	DIESEL GENERATOR	50,000	25.00
X_5	DIESEL GENERATOR	50,000	25.00
X_6	AUX. POWER GENERATOR SET	33,000	16.50
		15,000	7.50
X_7	MOTOR & REDUCTION GEAR	20,000	10.00
		15,000	7.50
X_8	MOTOR & REDUCTION GEAR	20,000	10.00
X_9	AUX. POWER GENERATOR SET	33,000	16.50

X_n CORRESPONDS TO ITEMS AS SHOWN ON DRAWING "SECTION REMOVAL PLAN" WHICH WAS SUBMITTED WITH REQUEST FOR WEIGHT LISTING.

[illegible]

5.14 Work Sheets, Section B

Section B Fr 20-32	No. & Descriptive Size Ft/Ft²/Ft³	Weight Short Tons	Time Factors Rate/MHR	Sheet 1 Diver Hours Estimate
Clear Top Hamper Wood Boat Deck Machy [illegible] Structure Misc	[illegible] ft²/330 ft³ DAVITS 1 SET ER GRATING STATEROOM DAMAGE	@ 65 0ft² = 11.0 3.0 2.0 2.0 18.0	1 ft²/MIN. 2HRS/DAVIT	17 hrs 4 hrs
Remove cut line Interference Machy Longls Ballast	FR 32 4 STRINGERS@2' ea 7 4	8 35 40 } 83 ft BURNING	1/20 ft/MIN. (83)(20)/60 =	28 hrs.
Severing Burning cuts Trans Longl	64 46 32 } 142/42	142 ft. CUTTING TOTAL	1/20 ft./MIN. (142)(20)/60 =	14 hrs.
Severing Explosive cuts Trans Longl	100 @ 30 CHARGES	100 ft. OF EXPLOSIVE CUTTING	3 ft./hr.	34 hrs.
Remove machy	2 RED GEAR 2 PROP MOTORS 15.5 DIESEL	20 15 16.5 } 51.5 TONS OFF	8 hrs./PIECE	40 hrs.
Drain & Limber	24 x 1 ft²	NONE	2 hrs./HOLE	48 hrs.
Air Lift	22×36 ~800 ft²	@ 20 lbs./ft² ON 8 TONS	10 ft.²/hr.	80 hrs.
Jet Wash	22×46 ~1100 ft²	@ 90 lbs./ft.² ON 46 TONS	100 ft.²/hr. (DURING LIFT)	11 hrs.
Rig for lift Bolsters Chain End fitting	DOUBLE PART 4 CORNERS NONE 4 SHOTS 8 BOLT PLANS	9 TONS	4 hrs./CORNER	16 hrs.
Last Checks				10 hrs.
Lift Operation Pick Points	4		1½ hr./	6 hrs.
Net Weight	INITIAL DEAD WEIGHT = 247 TONS WT ON 69 WT OFF 70 GROSS LIFT 246 TONS (MODERATE SILT) NO WATER NET LIFT AFTER WASHING 60 186 TONS	— OPTIMUM	Total DIVER HRS. AVAIL./SHIFT SHIFTS EFFECTIVE RATIO 1) TIME ESTIMATE ABOUT	308 hrs 32 10 .50 hr. SCHEDULE 10 WORKING DAYS 11 HOURS

Section Upper B Fr 20-32	No. & Descriptive Size FT/FT^2/FT^3	Weight Short Tons	Time Factors Rate/MHR	Sheet 2 Diver Hour Estimates
Clear Top Hamper Wood Boat Deck Machy 2ndary Structure Misc	990 ft^2, 330 ft^3 DAVITS 1 SET 2' GRATING STATEROOM DUNNGE	11.0 3.0 2.0 2.0 OFF 18.0	1 ft.^{2}/MIN .2hrs /DAVIT	17 hrs 4 hrs
Remove cut line Interference Machy Longls Ballast	FR 32 4 STRINGERS @ 2' ea 40' LONGL BHDS NONE	48 ft.	1/20 ft /MIN. (48)(20)/60	16 hrs
Severing Burning cuts Trans Longl	44 46 } 134 TOTAL 44	88 ft. BURN	(88)(20)/60	30 hrs
Severing Explosive cuts Trans Longl		46 ft.	3 ft./hr.	16 hrs.
Remove machy	NONE			
Drain & Limber	12	NONE	2 hrs/HOLE	24 hrs.
Air Lift	22 × 36 ~ 800 ft.^{2}	@ 20 lbs. / ft.^{2} ON 8 TONS	10 ft.^{2}/hr.	.80 hrs.
Jet Wash	NONE	CUT ON		
Rig for lift Bolsters Chain End fitting	DOUBLE PART 4 CORNERS NONE 4 SHOTS 8 BOLT PLANS	9 TONS CUT ON	4 hrs./CORNER	16 hrs.
Last Checks				10 hrs.
Lift Operation Pick Points	4		1½ hr/PICK	6 hrs.
Net Weight	INITIAL DEAD WEIGHT : 130 TONS WT ON 17 WT OFF 18 GROSS 129 TONS — NO WATER LIFT NET LIFT AFTER WASH 8 121 TONS OPTIMUM		Total DIVER HRS. AVAIL./SHIFT SHIFTS EFFECTIVE RATIO :) TIME ESTIMATE ABOUT	219 hrs. 32 7 50 hr schedule 7 WORKING DAYS

Section B Fr 20-32 Lower B	No. & Descriptive Size $FT/FT^2/FT^3$	Weight Short Tons	Time Factors Rate/MHR	Sheet 3 Diver Hours Estimate
Clear Top Hamper wood Boat Deck Machy 2ndary Structure Misc	N A			
Remove cut line Interference Machy Longls Ballast	2 STRINGERS @ 2' ea 1 @ 5' ea	4 35 39 ft BURNING	1/20 ft/MIN. $\frac{(39)(20)}{60}$	13 hrs
Severing Burning cuts Trans Longl	46 24 70 TOTAL } 30 ft.		$\frac{(30)(20)}{60}$	10 hrs.
Severing Explosive cuts Trans Longl	40 ft.		3 ft/hr.	13 hrs.
Remove machy	2 RED GEAR 2 PROP MOTORS 1 SS DIESEL	20 15 16.5 } 51 TONS OFF	8 hrs./PIECE	40 hrs.
Drain & Limber	12 × 1 ft.²	NONE	2 hrs/HOLE	24 hrs.
Air Lift	NONE			
Jet Wash	22 × 46 ~ 1100 ft.²	90 lbs./ft.² ON 46 TONS	100 ft.²/hr. (DURING LIFT)	11 hrs.
Rig for lift Bolsters Chain End fitting	DOUBLE PART 8 4 SHOTS 8 BOLT PLANS	2 TONS 9 TONS 11 TONS	8 hrs./PICK	32 hrs.
Last Checks				10 hrs
Lift Operation Pick Points	4		1½ hrs./PICK	6 hrs.
Net Weight	INITIAL DEAD WEIGHT = 117 TONS WT ON 57 WT OFF 51 GROSS LIFT 123 TONS (MODERATE SILT) NET LIFT AFTER WASH -46 77 TONS	← NO WATER ← OPTIMUM	Total DIVERS HRS. AVAIL/SHIFT SHIFTS EFFECTIVE RATIO 1) TIME ESTIMATE ABOUT	159 hrs. 32 5 50 hr. schedule 5 DAYS

5.15 Cost Accounting Agreements of 15 May 1974

MEMORANDUM TO FILES 15 May 1974

Meeting was held at 9AM with personnel listed on attached roster in attendance.

LCDR Alex Paszly explained the functions of the Navy in removing the sunken Dredge MacKenzie. The Navy has a contract with Murphy Pacific Salvage Company to provide immediate performance of ship salvage when and where required. This contract includes a Schedule A which lists the rates for personnel and equipment which MYPAC has at its command. The contract also provides for reimbursement for approved other costs plus a negotiated percentage for G&A.

Three kinds of costs will be incurred in the removal of the Dredge MacKenzie - Contract (MYPAC), Navy in house expenses, and C of E expenses. The Galveston District will be furnished copies of all documents to support costs incurred by the Contractor or the Navy.

The Galveston District has issued an MIPR to the Navy for $1,300.000. Of this amount the Navy has earmarked $1,000,000 for Murphy Pacific, $200,000 for in house Navy expenses, and $100,000 for oil pollution control. The oil pollution control will be done by MYPAC.

MYPAC will incur three kinds of costs - Schedule A, G&A and costs incurred at the job site. Mr. Chester Matthews, USN SUPSALV, Washington, will come to Galveston weekly to review and approve these charges.

MYPAC has asked for an advance of $675,000 of which $350,000 will be advanced immediately. This money will be placed in a special bank account separate from any other funds of MYPAC. Each week MYPAC will submit a cash cost report. This cash cost report will be supported by copies of invoices for purchases made by MYPAC and for Schedule A and G&A costs of MYPAC. MYPAC is considered a vendor on this report. After the report has been approved by the Navy, MYPAC will draw checks on the special bank account payable to the vendors approved by the Navy. The Navy will countersign the checks.

Progress payments will be submitted periodically and after approval by the Navy, a check will be issued to MYPAC. This check will be deposited in the special bank account to replenish the account and to repay the advance. When the progress payments plus the remaining balance in the advance account plus the accrued interest equals 90 per cent of the total contract cost, no further payments will be made until the contract is complete and all costs agreed to.

MYPAC will pay interest at the rate of 7 7/8%.

The percentage of G&A was discussed and LCDR Paszly said he would negotiate a rate with MYPAC. The negotiated rate will be used on payments from the special account and on progress payments. DCAA will determine an actual rate when the contract is complete and before final payment is made.

Mr. Gamel asked about control of ordering equipment and supplies. LCDR Paszly assured Mr. Gamel that the Corps would make the decision as to who would provide the equipment (MYPAC, Navy or Corps) and the Area Engineer for the Corps would monitor ordering supplies.

We will be charged with transportation and cost of rehabilitation of equipment furnished by the Navy for use on the job. We will be charged for loss of such items. (This is part of Navy in house costs).

Oneida Woolfolk

ONEIDA WOOLFORD
Resident Auditor

15 May 1974

CORPS OF ENG / U S NAVY (SUPSAL)

Chester Matthews	USN SUPSALV
Jim Walker	USN SALSALV
LCDR Alex Pazsly	USN SUPSALV
B. E. Frost	Potomac Research
Mabel E. Breen	Galv. Dist (Ch, Pro. & Supply Div)
John A. Brigance	U S Army Corps of Engrs, SWD
John K. Bember	U S Army Corps of Engrs, Galv Dist
H. L. Richter	U S Army Corps of Engrs, Galv Dist
Fred R. Smith	U S Army Corps of Engrs, Detroit Dist
W. M. Gamel	U S Army Corps of Engrs, Galv Dist
Robert E. Cole	U S Army Corps of Engrs, SWD Dallas Tex
Oneida Woolford	U S Army Corps of Engrs, SWD Galveston
J. D. Bissell	U S Army Corps of Engrs, Galv Dist

MEMORANDUM TO FILES 15 May 1974

Meeting was held at 10:30 AM with personnel on attached roster in attendance.

Mr. Barracca explained the function of MYPAC and its relation with the Navy.

The details of the advance account were reviewed. It was again stated that payments to MYPAC would stop when the total of the progress payments, the remaining balance in the advance account, and the accrued interest equaled 90 per cent of the total contract amount. Final payment would be made when the contract was complete and the total costs agreed to.

Mr. Barracca stated his company would have its accountant, Mrs. Carol Hillis, in Galveston for a week to establish procedures to maintain the necessary records and to furnish the Corps with copies of all cost documents. MYPAC will have administrative personnel at the job site for the duration of the work.

LCDR Paszly asked about the G&A percentage. Mr. Barracca proposed a rate of 15 per cent. The rate for 1973 had been 35 per cent and a rate of 10 per cent will be used for the Suez Canal work. This rate of 15 per cent seemed fair to all present as it was felt this rate would not create a large over or under payment when the actual rate was determined.

Oneida Woolford
ONEIDA WOOLFORD
Resident Auditor

15 May 1974

CORPS OF ENG/U S NAVY (SUPSALV)/ MYPAC

Jim Walker	SUPSALV Project Manager
LCDR Alex Paszly	SUPSALV Logistics
Chet Matthews	SUPSALV Fiscal
Peter S. Barracca	MYPAC Executive V. P.
Matthew F. Cinquegrana	MYPAC Controller
John E. Ciak	MYPAC Mgr - Govt. Claims
Alex Rynecki	MYPAC Engineer
Fred R. Smith	USAED Detroit
J. D. Bissell	USAED Galveston
Oneida Woolford	USAED Galveston
Robert E. Cole	USAED - SWD Dallas

5.16 Cost Accounting Budget Items for the MACKENZIE Incident

The following critera is being rendered for each ADP Workcode and the overhead applications to be applied.

DR MACKENZIE SINKING AND GALVESTON CHANNEL BY-PASS

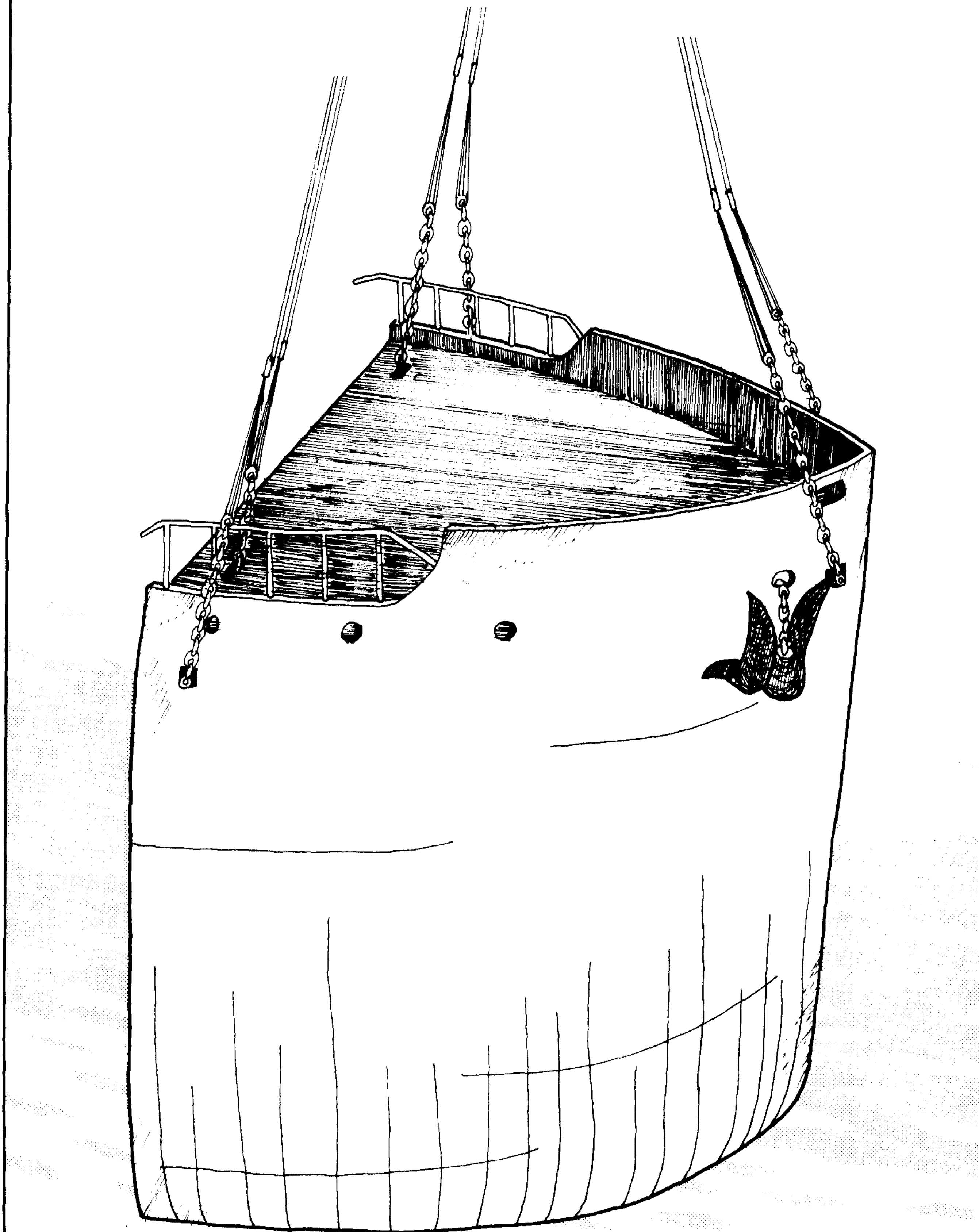
ADP WORKCODE	DESCRIPTION
	Cost created by the sinking of the Dr. Mackenzie.
VW8351001000000	Preliminary investigation including surveys. This account includes all hired labor cost relating to the initial investigation and surveys for the purpose of determining the apparent cause, the immediate action to be taken and recommendations to be made. Overhead: O&M Rate - 25.9% - Eff. 6/1/74
VW8351002000000	Dredge Mackenzie operating cost. This account includes all phase-out cost that would normally be charged to the operating account prior to the sinking of the dredge. Included in this account would be such cost as Administrative Leave for dredge personnel; PCS expenses of dredge personnel while on Rif Status; Subsistence and Quarters for the period awaiting transfers and other cost that would be applicable to the operating account. Overhead: O&M Rate - 25.9% - Eff. 6/1/74
VW8351003000000	Environmental Protection Cost. This account includes all cost associated with the protection of the environment. It has been requested that these cost be maintained separately for possible submission to state agencies. These cost would include hired labor and contract cost relating to the removal of diesel fuel, grease, lube and other items that would be hazardous to the environment. Overhead: O&M Rate - 25.9% - Eff. 6/1/74
VW8351004000000	Cost relating to the removal of Dr. Mackenzie including S&I. This account includes all hired labor cost not directly associated with the above ADP Workcodes. Overhead: O&M Rate - 25.9%% - Eff. 6/1/74
VW8351004100000	Cost relating to the removal of Dr. Mackenzie by Other Districts and Agencies. This account will include all hired labor cost, including overhead, for borrowed assistance from others. Overhead: None
VW8351005000000	Dr. Mackenzie inventory on hand at Warehouse. This account will include the book cost of the inventory on hand in the Stock Account and for all items received subsequent to the sinking of the dredge. Any inventory items charged to the Dr. Mackenzie that can be used on the Dr. McFarland or any other place will be transferred and this account will be credited. Furthermore, Warehouse Burden will be applied to this account. Overhead: None

ADP WORKCODE	DESCRIPTION
	Cost in connection with dredging Galveston Channel By-Pass. PHASE III
VW83553112ECOOO	Dredge McFarland Distribution. This account will be charged with the rental of the Dredge McFarland, less provision for depreciation and plant replacement. Overhead: FPAO Rate - 5.06% plus O&M Rate - 25.9% - Eff. 6/1/74
VW83554162ACOOO	Engineering & Design - Fort Point Area Office. This account will be charged with Engineering and Design cost incurred by the Fort Point Area Office. Overhead: FPAO Rate - 5.06% plus E&D Rate - 25.9% - Eff. 6/1/74
VW83554162BOOOO	Engineering & Design - District Office. This account will be charged with Engineering and Design cost incurred by the Galveston District. Overhead: E&D Rate - 25.9% - Eff. 6/1/74
VW8355582250000	Area Office Inspection - Hopper Dredge. This account will be charged with Fort Point Area Office Inspection cost relating to Dredge McFarland. Overhead: FPAO Rate - 5.06% plus O&M Rate - 25.9% - Eff. 6/1/74
VW8355583250000	Area Office Surveys - Hopper Dredge. This account will be charged with Fort Point Area Office survey cost relating to Dredge McFarland. Overhead: FPAO Rate - 5.06% plus O&M Rate - 25.9% - Eff. 6/1/74
VW8355584250000	District office Inspection - Hopper Dredge. This account will be charged with District Office Inspection cost relating to Dredge McFarland. Overhead: O&M Rate - 25.9% - Eff. 6/1/74
VW8355585250000	District Office Surveys - Hopper Dredge. This account will be charged with District Office survey cost relating to Dredge McFarland. Overhead: O&M Rate - 25.9% - Eff. 6/1/74

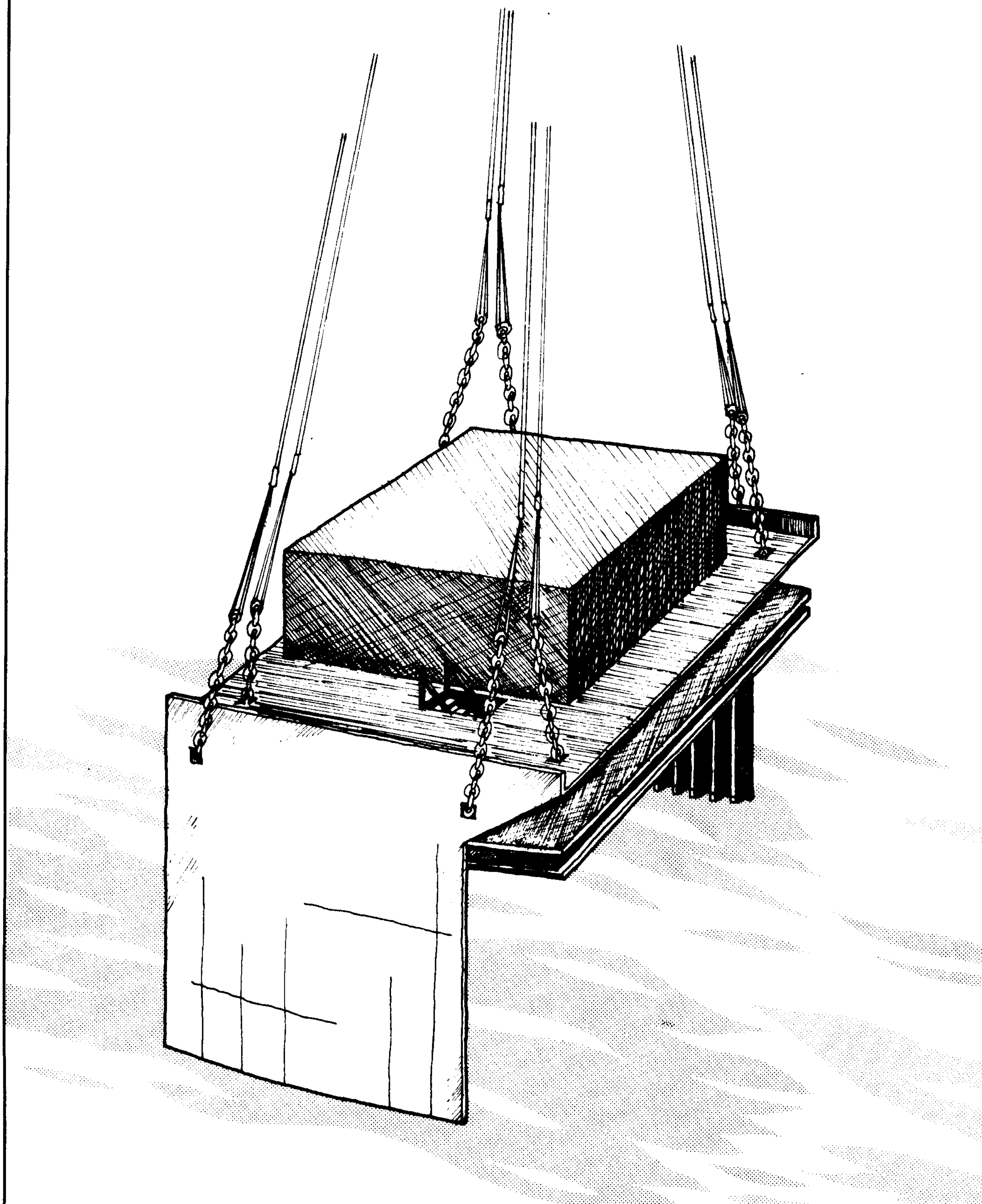
ADP WORKCODE	DESCRIPTION
	Cost directly related to the insurance account.
VW8352001000000	Asset value of Dredge Mackenzie. This account will be charged with the net asset value remaining in the retirement work order. The sale of scrap should be credited to the retirement work order prior to the transfer to this account. Overhead: None
VW8352002000000	Cost of removal. This account will contain Contractor's Earnings only. Overhead: None
VW8352003000000	Claims made by Dredge Mackenzie personnel. This account will be charged with all personal losses sustained by the sinking of the dredge. Overhead: O&M Rate - 25.9% - Eff. 6/1/74
VW8352004000000	Transfer of Dredge Mackenzie operating account balance. This account will be charged with the remaining balance in the operating account of the Dredge Mackenzie. Overhead: None
	Cost in connection with dredging Galveston Channel By-Pass. PHASE I
VW835331114DC000	Dredge Gerig Distribution. This account will be charged with the rental of the Dredge Gerig, Port Watch expense and related overhead cost which will be billed by the Jacksonville District. Overhead: None
VW835341162A0000	Engineering & Design - Fort Point Area Office. This account will be charged with Engineering and Design cost incurred by the Fort Point Area Office. Overhead: FPAO Rate - 5.06% plus E&D Rate - 25.9% - Eff. 6/1/74
VW835341162D0000	Engineering & Design - District Office. This account will be charged with Engineering and Design cost incurred by the Galveston District. Overhead: E&D Rate - 25.9% - Eff. 6/1/74
VW835358224000O	Area Office Inspection - Hopper Dredge. This account will be charged with Fort Point Area Office Inspection cost relating to Dredge Gerig. Overhead: FPAO Rate - 5.06% plus O&M Rate - 25.9% - Eff. 6/1/74
VW8353583240000	Area Office Surveys - Hopper Dredge. This account will be charged with Fort Point Area Office survey cost relating to Dredge Gerig. Overhead: FPAO Rate - 5.06% plus O&M Rate - 25.9% - Eff. 6/1/74
VW8353584240000	District Office Inspection - Hopper Dredge. This account will be charged with District Office Inspection cost relating to Dredge Gerig. Overhead: O&M Rate - 25.9% - Eff. 6/1/74
VW8353585240000	District Office Surveys - Hopper Dredge. This account will be charged with District Office survey cost relating to Dredge Gerig. Overhead: O&M Rate - 25.9% - Eff. 6/1/74

ADP WORKCODE	DESCRIPTION
	Cost in connection with dredging Galveston Channel By-Pass by Commercial Contract. PHASE II
VW8354312A00000	Contractors Earnings. This account will be charged with the contractors earnings relating to the Galveston Channel By-Pass. Overhead: None
VW8354416200000	Engineering & Design - District Office. This account will be charged with Engineering and Design cost incurred by the Galveston District. Overhead: E&D Rate - 25.9% - Eff. 6/1/74
VW8354416220000	Engineering & Design - Fort Point Area Office. This account will be charged with Engineering and Design cost incurred by the Fort Point Area Office. Overhead: FPAO Rate - 5.06% plus E&D Rate - 25.9% - Eff. 6/1/74
VW8354522A00000	Supervision & Inspection - District Office. This account will be charged with Supervision and Inspection cost incurred by the District Office. Overhead: O&M Rate - 25.9% - Eff. 6/1/74
VW8354522A20000	Supervision & Inspection - Fort Point Area Office. This account will be charged with Supervision and Inspection cost incurred by the Fort Point Area Office. Overhead: FPAO Rate - 5.06% plus O&M Rate - 25.9% - Eff. 6/1/74
VW8354532A00000	Supervision & Administration - District Office. This account will be charged with Supervision and Administration cost incurred by the District Office. Overhead: O&M Rate - 25.9% - Eff. 6/1/74

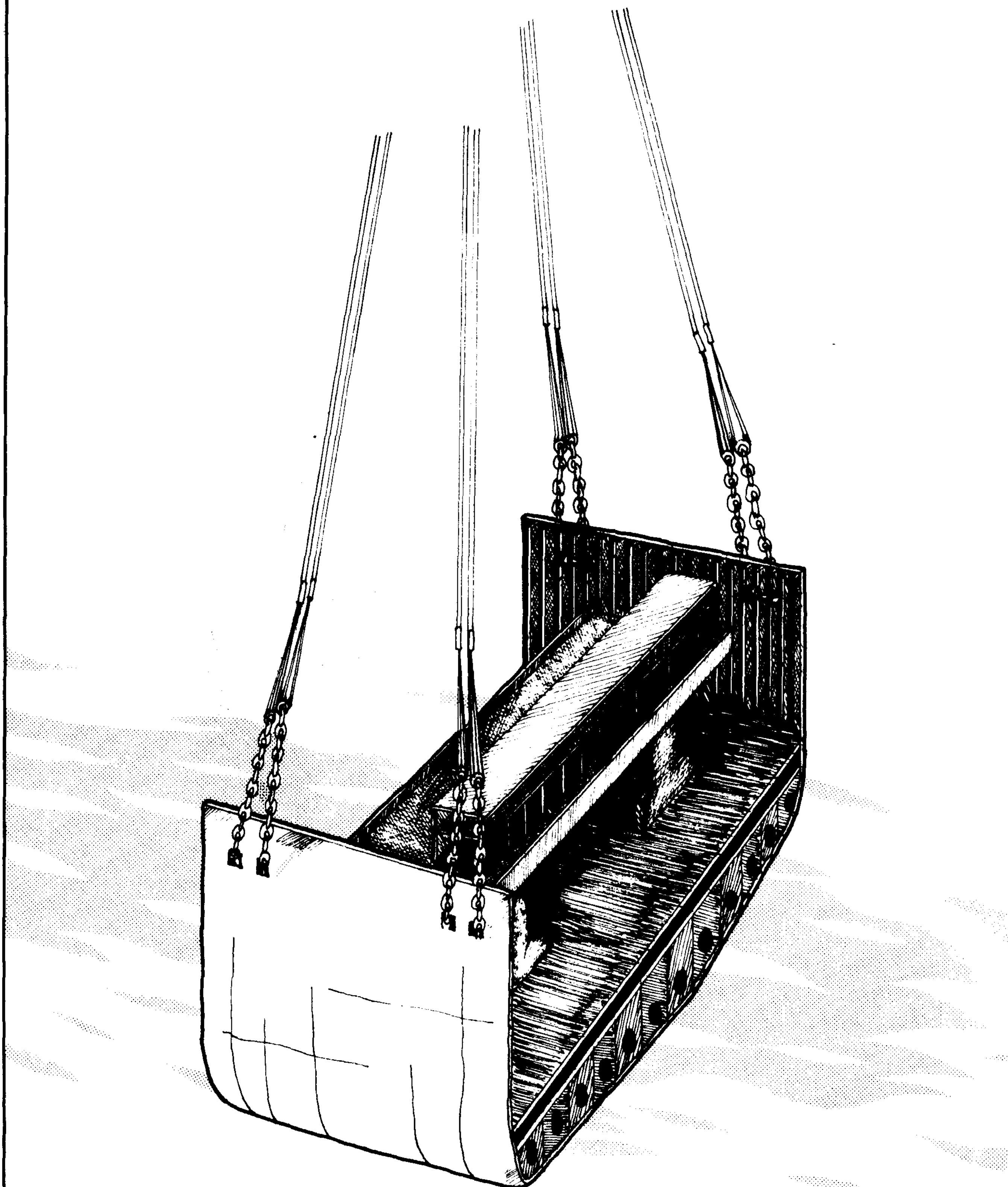
5.17 A. MACKENZIE Sections. Rigging Concept Sketches Showing Actual Hook Final Weights.



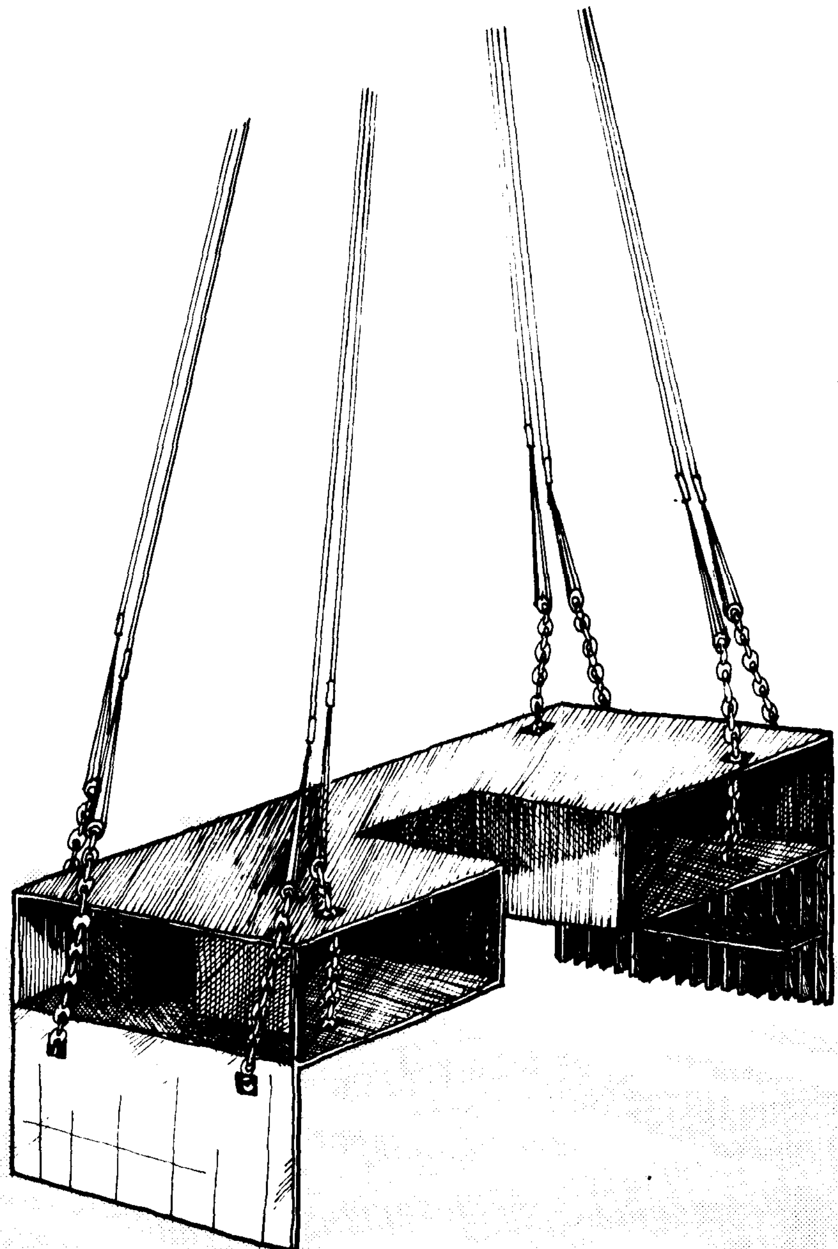
WEIGHT = 319 SHORT TONS



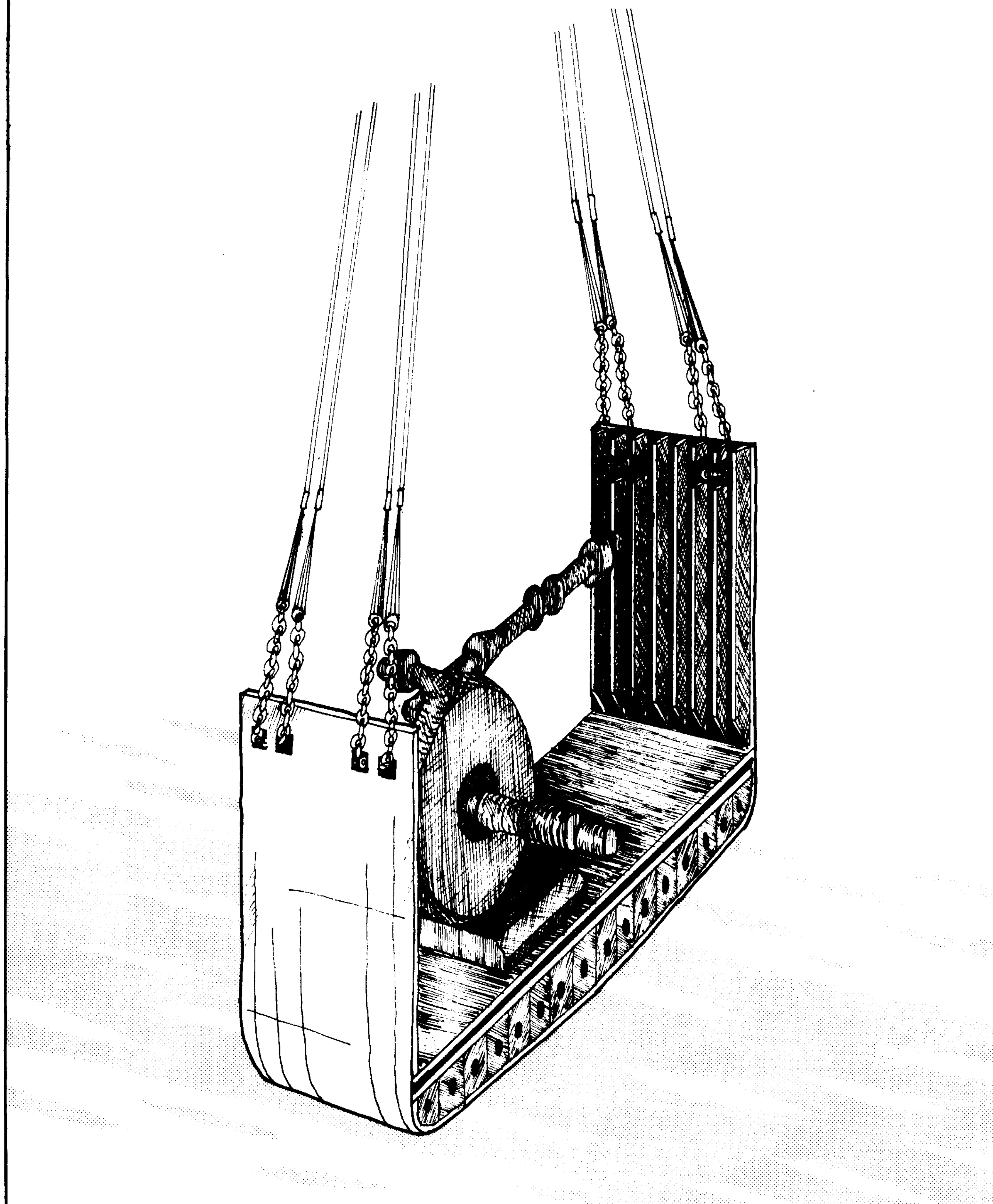
WEIGHT = 105 SHORT TONS



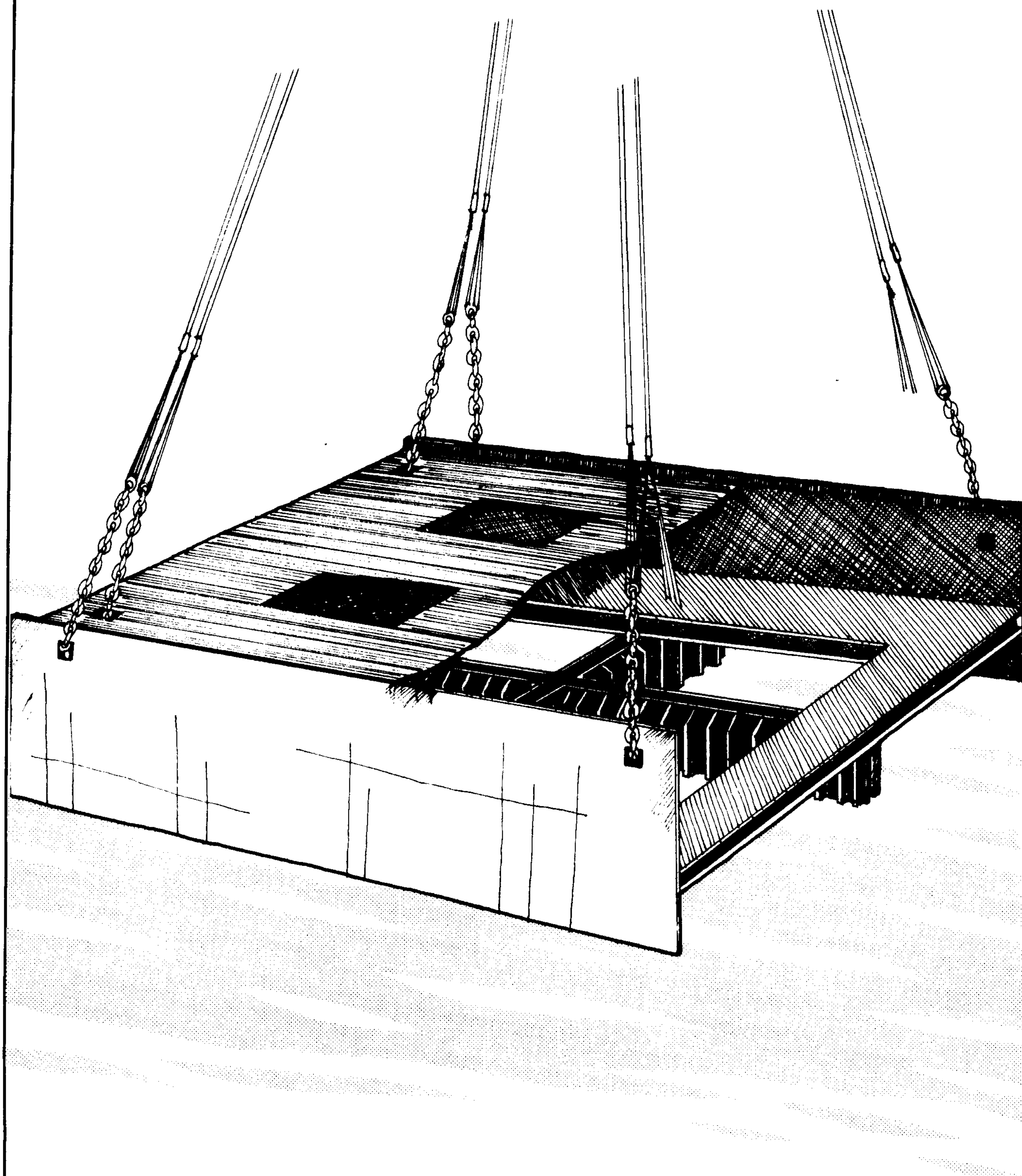
WEIGHT = 180 SHORT TONS



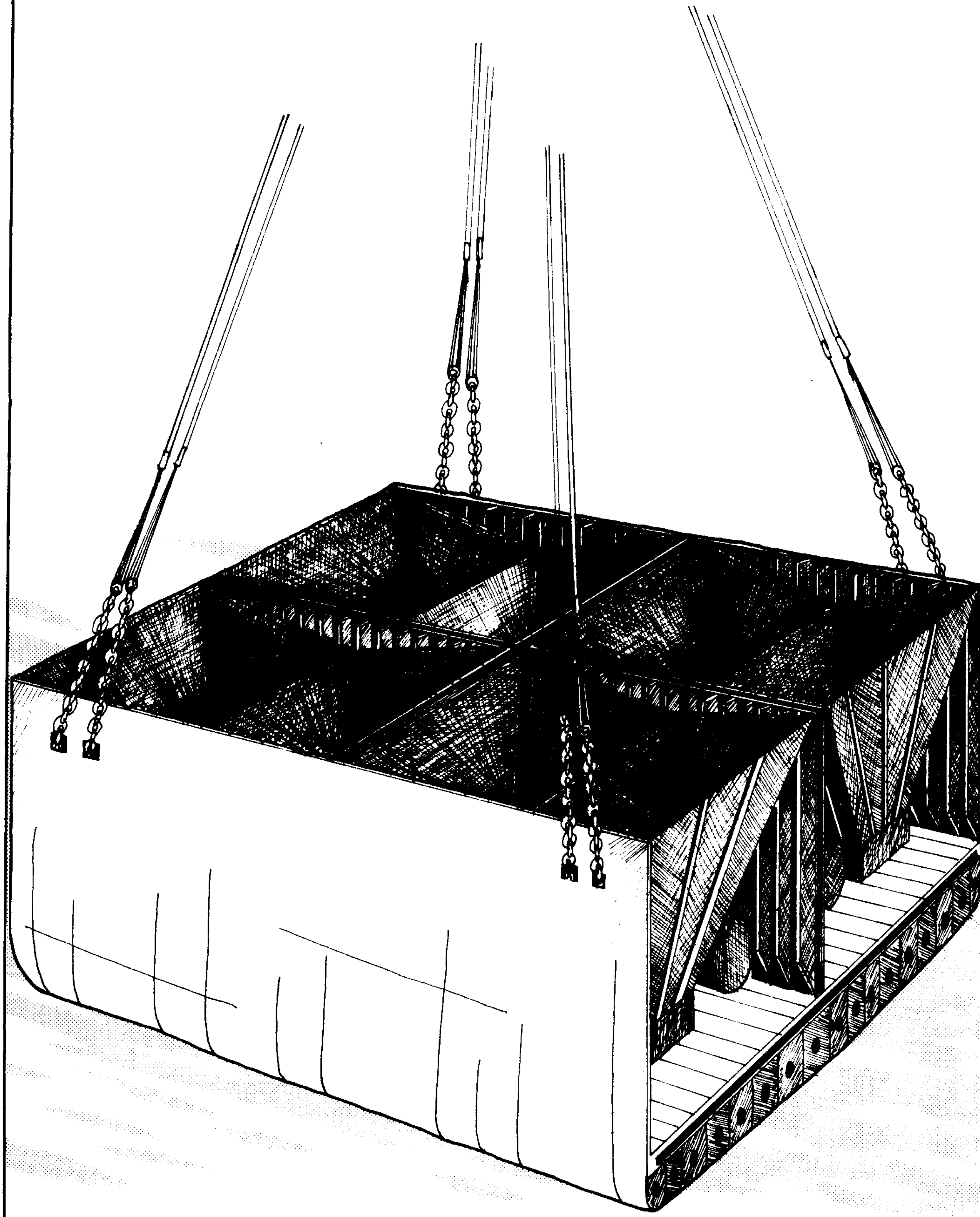
WEIGHT = 188 SHORT TONS



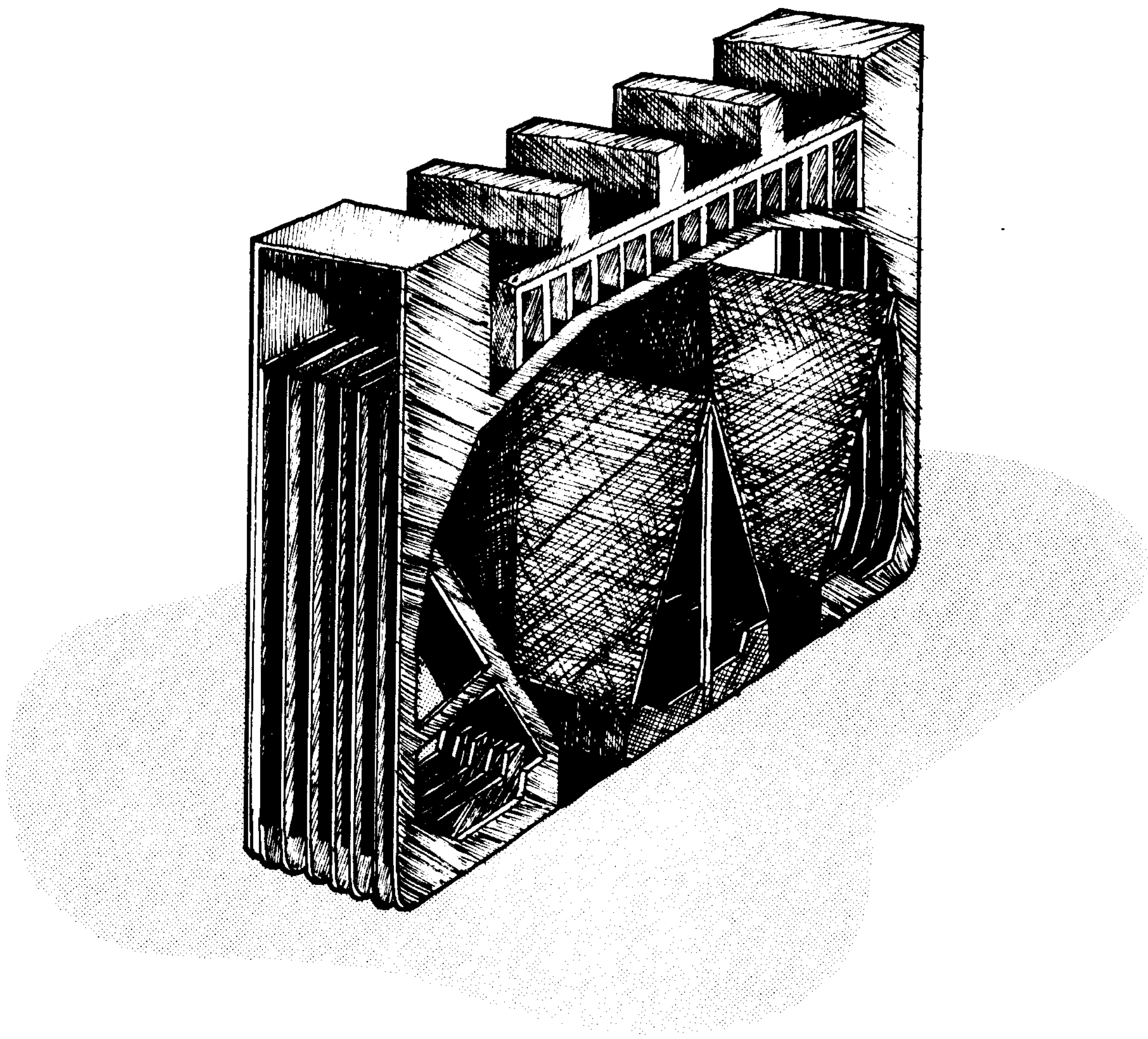
WEIGHT = 312 SHORT TONS

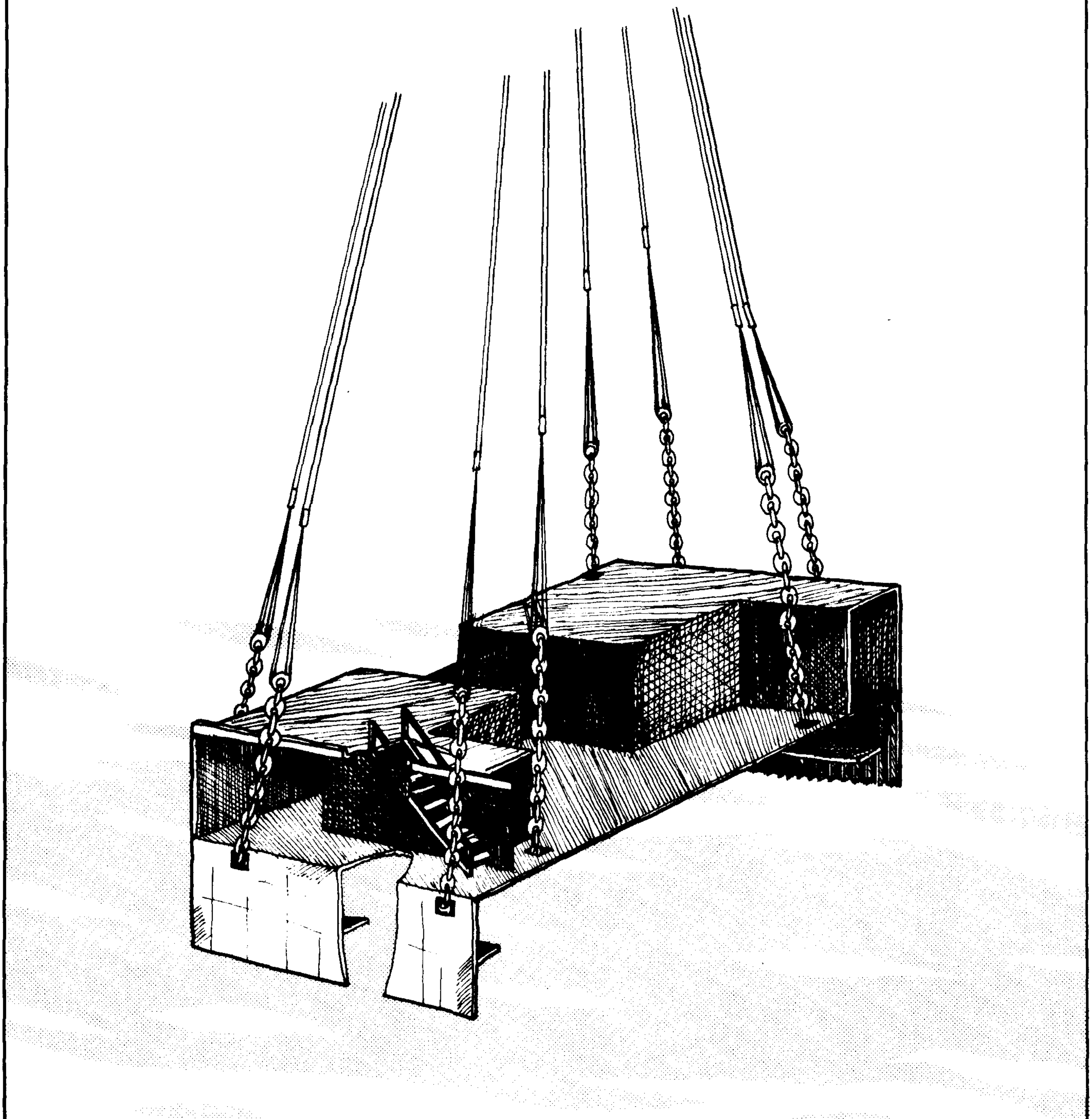


WEIGHT = 120 SHORT TONS

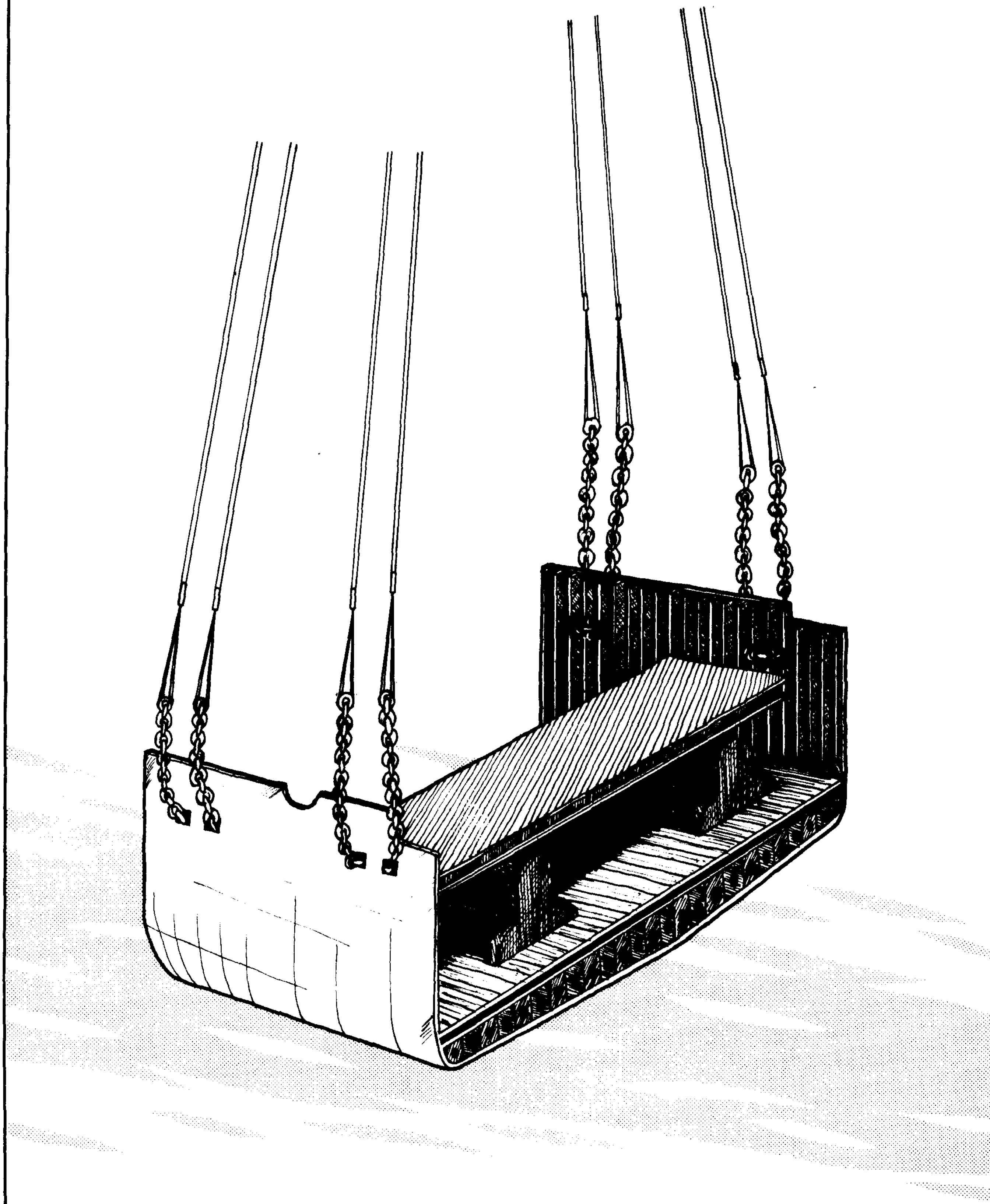


WEIGHT = 375 SHORT TONS

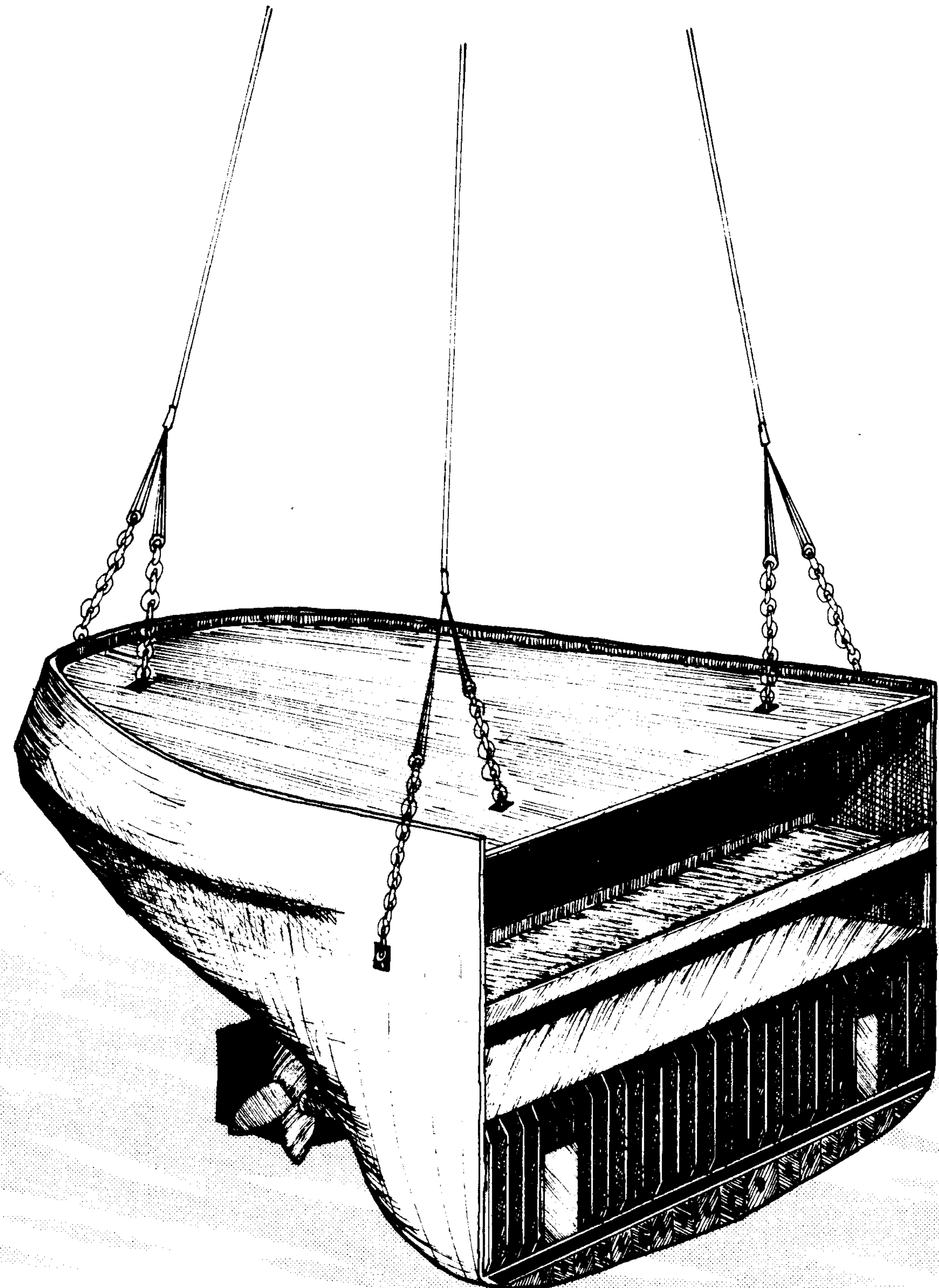




WEIGHT = 105 SHORT TONS



WEIGHT = 310 SHORT TONS



WEIGHT = 319 SHORT TONS