COMPLETION REPORT

FOR

TRANSDUCER CALIBRATION PLATFORM (TCP) MOORING

NAVAL UNDERWATER SYSTEMS CENTER, SENECA LAKE DETACHMENT DRESDEN, NEW YORK

FPO-1-83 (33)

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The Ocean Engineering & Construction Project Office of the Chesapeake Division, Naval Facilities Engineering Command (CHESDIV) accepted tasking from the Naval Underwater Systems Center (NUSC), Newport, Rhode Island, to design and monitor the installation of a 4-point mooring for the Transducer (Con't)

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Calibration Platform at the Naval Underwater Systems Center Seneca Lake Detachment, Dresden, New York. CHESDIV also monitored the recovery of the existing temporary mooring and prepared a bill of materials of the recovered components.

The recovery and installation operations were performed under a firm fixed price contract awarded by Northern Division, Naval Facilities Engineering Command (NORTHDIV) to Dissen and John Corporation, of East Webster, New York. Operations commenced 20 June 1983 and were completed on 5 August 1983.

This report describes the procedures used to recover three existing moorings and to install and proof test a 4-point mooring in 535 feet of water.

ABSTRACT

The Ocean Engineering and Construction Project Office of the Chesapeake Division, Naval Facilities Engineering Command (CHESDIV) accepted tasking from the Naval Underwater System Center (NUSC), Newport, Rhode Island, to design and monitor the installation of a 4-point mooring for the Transducer Calibration Platform at the Naval Underwater Systems Center, Seneca Lake Detachment, Dresden, New York. CHESDIV also monitored the recovery of the existing temporary mooring and prepared a bill of materials of the recovered components.

The recovery and installation operations were performed under a firm fixed price contract awarded by Northern Division, Naval Facilities Engineering Command (NORTHDIV), to Diseen and John Corporation, of East Webster, New York. Operations commenced 20 June 1983 and were completed on 5 August 1983.

This report describes the procedures used to recover three existing moorings and to install and proof test a 4-point mooring in 535 feet of water.

Keywords: Mooring buoys, Wire rope.

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FOR

TRANSDUCER CALIBRATION PLATFORM (TCP) MOORING

NAVAL UNDERWATER SYSTEMS CENTER, SENECA LAKE DETACHMENT

DRESDEN, NEW YORK

1.0 INTRODUCTION

1.1 <u>Background</u>. The Ocean Engineering and Construction Project Office (FPO-1) of CHESDIV accepted tasking from NUSC Newport, Rhode Island, to design a 4-point mooring for the Transducer Calibration Platform (TCP) operated by NUSC in Seneca Lake near Dresden, New York. Tasking also included monitoring the recovery of the existing temporary TCP mooring and the installation of the new mooring. A map of the area and a chart of Seneca Lake are shown in Figures 1 and 2. A firm fixed price contract for the recovery and installation was awarded by NORTHDIV to Dissen and Juhn Coporation, East Webster, New York. Recovery operations began on 20 June 1983, and installation was completed on 5 August 1983.

This report describes the procedures used to recover and install a mooring in 535 feet of water. Recommendations and "lessons learned", based on experience gained during the field operations, are presented. A bill of materials listing all recovered mooring components is included as Appendix A. The "as-built" drawing of the new 4-point mooring is included in Appendix B.

1.2 <u>Design and Operational Procedures</u>. Design of the TCP 4-point mooring was completed by FPO-1. The Contractor, with CHESDIV approval, developed recovery, installation, and proof test procedures. The "as-built" drawing - NAVFAC Drawing No. 3026161, "NUSC Lake Seneca, NY, Transducer Calibration Platform (TCP) 4-Point

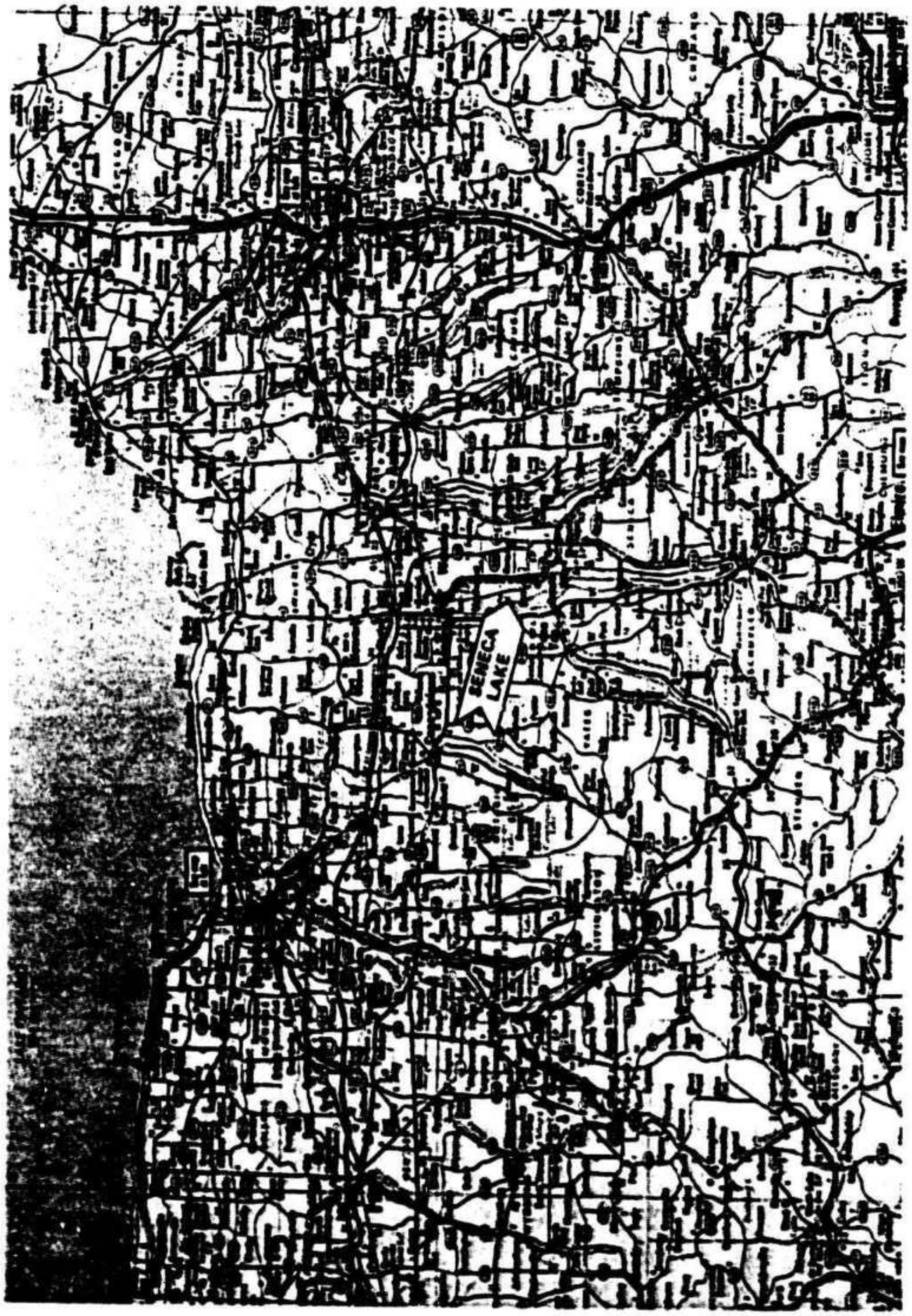
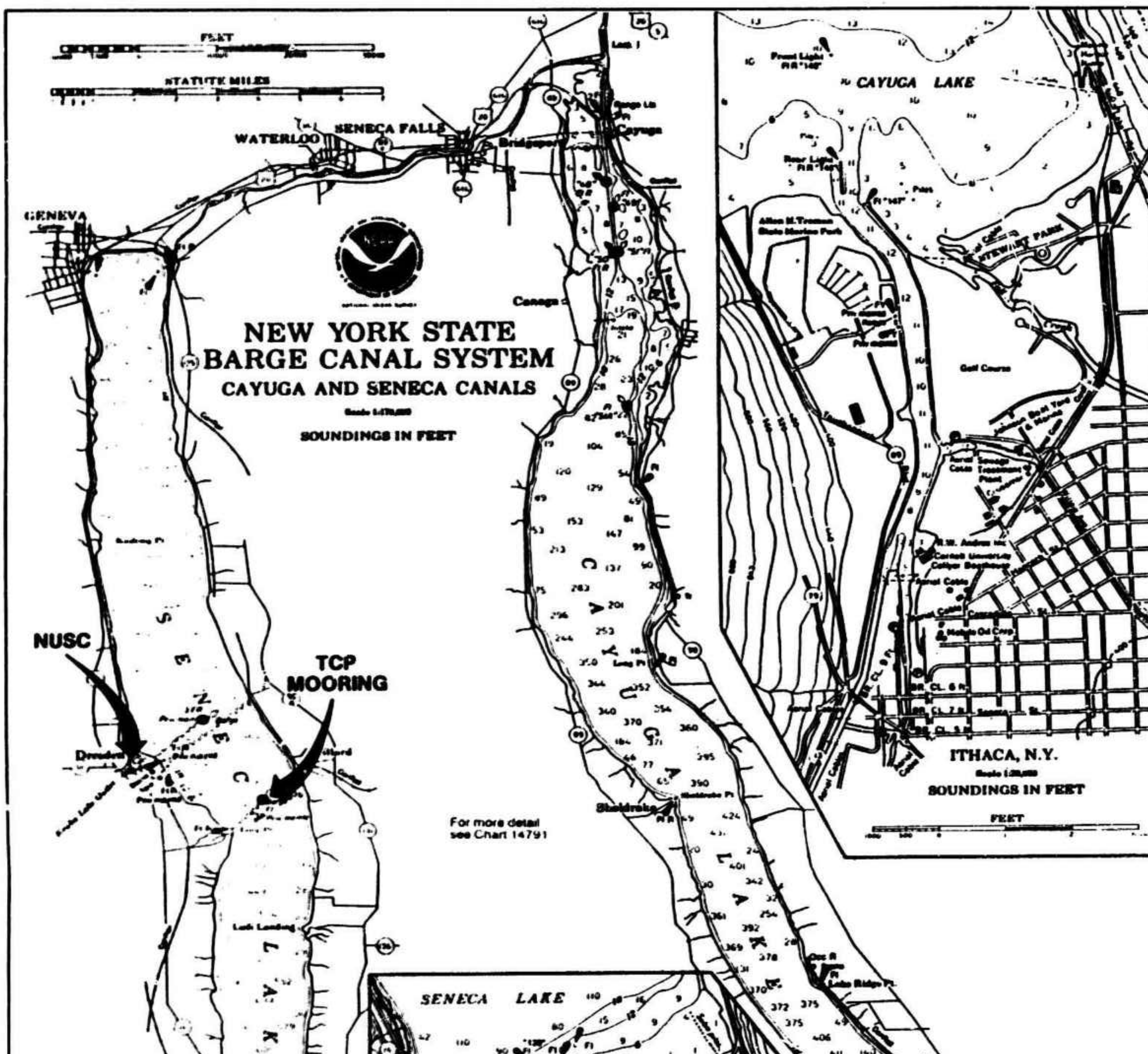


FIGURE 1
MAP OF AREA


FEET
STATUTE MILES
GENEVA
WATERLOO
SENECA FALLS
Bridgeport
Cayuga
Lock 1
Canoga
NEW YORK STATE
BARGE CANAL SYSTEM
CAYUGA AND SENECA CANALS
SOUNDINGS IN FEET
NUSC
Dresden
TCP
MOORING
For more detail
see Chart 14791
Sheldrake
Long Pt
Lodi Landing
C A Y U G A L A K E
S E N E C A L A K E
CAYUGA LAKE
Front Light
Rear Light
Allan H. Treman State Marine Park
STEWART PARK
Golf Course
ITHACA, N.Y.
SOUNDINGS IN FEET
FEET
SENECA LAKE

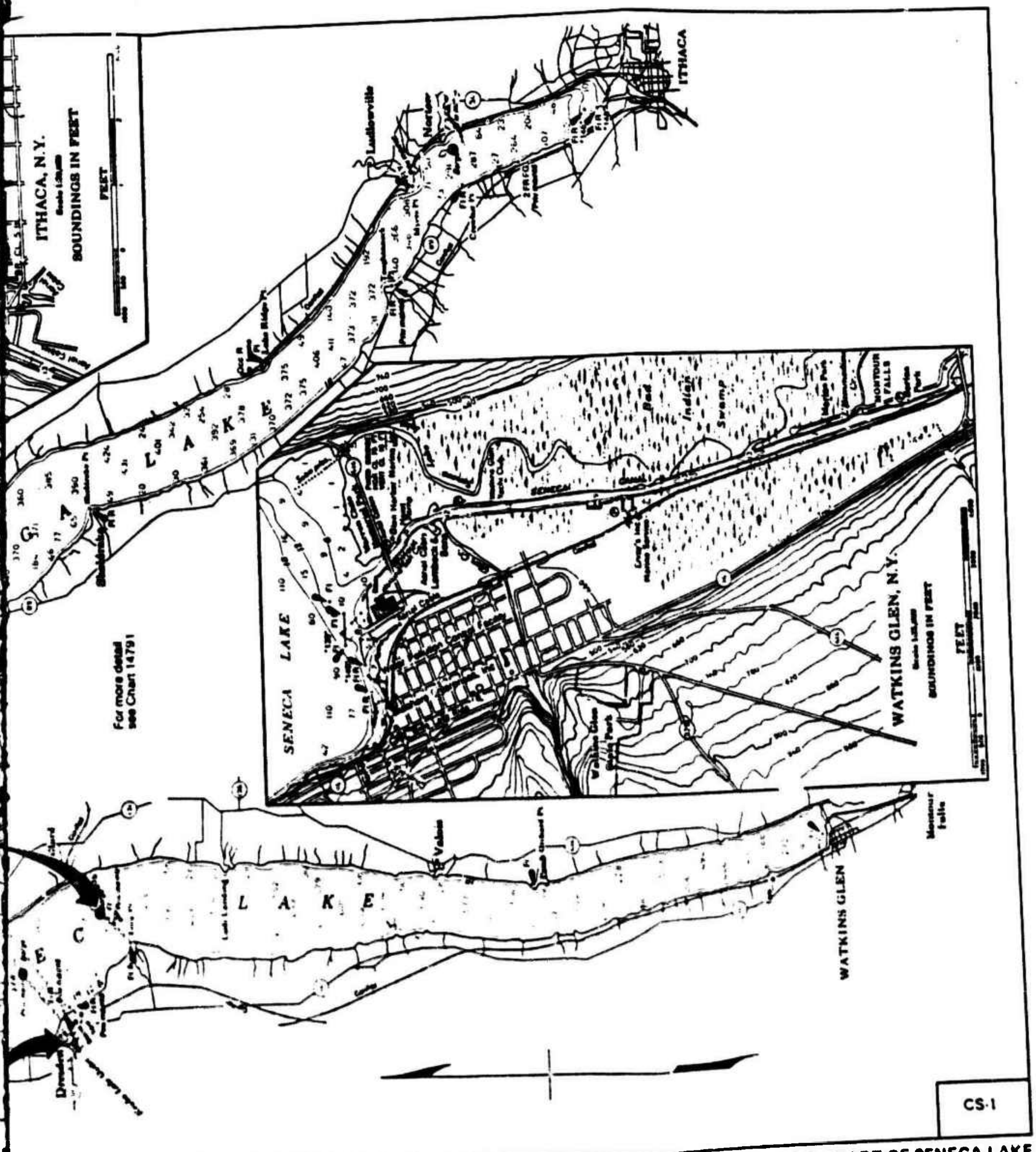


FIGURE 2 CHART OF SENECA LAKE

Mooring; Site, Plan, and Details", Revision B of 19 August 1983 - is included in Appendix B and will be referenced throughout this report.

1.3 Equipment and Materials.

1.3.1 Government Furnished Equipment and Materials. Equipment supplied by NUSC:

(a) Two carpenter's stoppers. (Note: During the mooring installation a wedge from one of the stoppers was lost overboard.)

(b) Three return blocks.

(c) One center marker buoy, installed.

(d) Four 2 1/2-inch bow safety shackles.

Materials Supplied by CHESDIV: The government provided material for an engineering change order which added mooring bridles for attachment of the TCP transformer float to the 4-point mooring (see paragraph 5.0).

1.3.2 Material and Equipment Furnished by Contractor. The Contractor supplied all mooring material and components (buoys, chain, fittings, wire rope, anchors, etc.), except as noted above.

The following equipment was provided by the Contractor for mooring recovery, installation, and testing:

(a) A 40-foot by 130-foot steel barge. The barge had two anchor winches, each fitted with three independent wire rope drums (see Figures 3 and 4).

(b) A 50-ton hydraulic mobile crane with telescopic boom. The boom was rigged with a three-part wire block.

(c) A 45-foot steel tug, used to maneuver the crane barge.

(d) An 18-foot runabout, for personnel transportation.

FIGURE 3

40 FOOT x 130 FOOT CRANE BARGE

FIGURE 4

CRANE BARGE, 45 FOOT STEEL TUG, AND
18 FOOT RUNABOUT

(e) A Dillon dynamometer, used to measure the applied load during pull testing.

1.4 Mobilization. The initial mobilization was at Dissen and Juhn's terminal at Weedsport, New York. Here, the four 9 1/2-shot lengths of chain, used in the mooring riser legs, were connected and arranged on the deck of the crane barge. Each connection between shots was painted with a unique marking used to identify the amount of chain in the water or on deck at any time during the installation. All other mooring components were also loaded at this time. The barge was moved through the Cayuga-Seneca Lake Canal to Seneca Lake and then down the lake to NUSC, a total distance of approximately 50 miles. At NUSC, the anchors, sinkers, and buoys were off-loaded in order to make available additional deck space for the recovered mooring components. The off-loaded components were stored on the lake bed in shallow water, since no dock space was available at NUSC (see Figures 5 and 6).

2.0 RECOVERY

2.1 Procedure. The existing temporary mooring consisted of three buoys, located in the northwest, northeast, and southeast quadrants of the TCP barge location. The three existing buoys, similar to those shown in Figures 7 and 8, were recovered, complete with all components. In addition, the fittings used to secure the TCP power transformer float between the northwest and northeast buoys were recovered. The transformer float, which was connected to a submerged live electrical cable from shore, was in the work area making it necessary to continually maneuver around the float to avoid a collision.

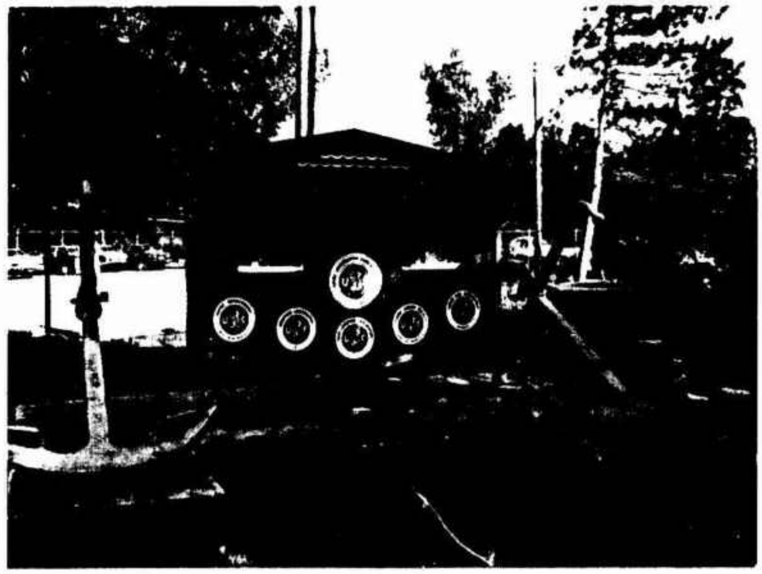


FIGURE 5

NAVAL UNDERWATER SYSTEM CENTER
SENECA LAKE

FIGURE 6

TEMPORARY STORAGE AREA FOR BUOYS,
SINKERS, AND ANCHORS

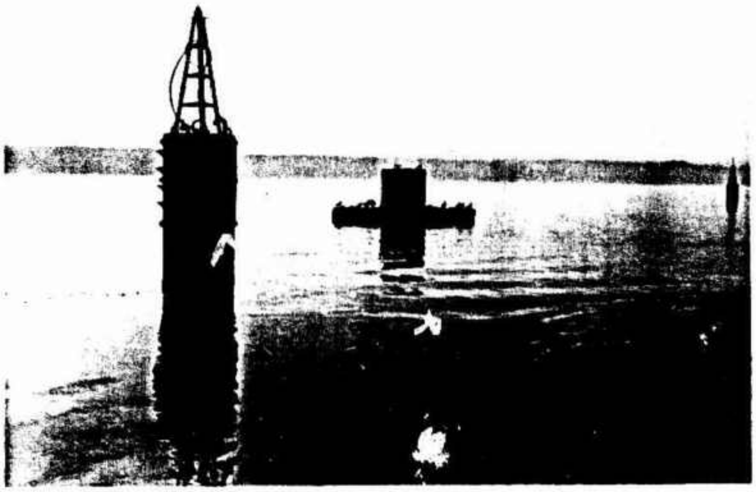


FIGURE 7

TEMPORARY NORTHEAST AND NORTHWEST BUOYS
WITH TRANSFORMER FLOAT

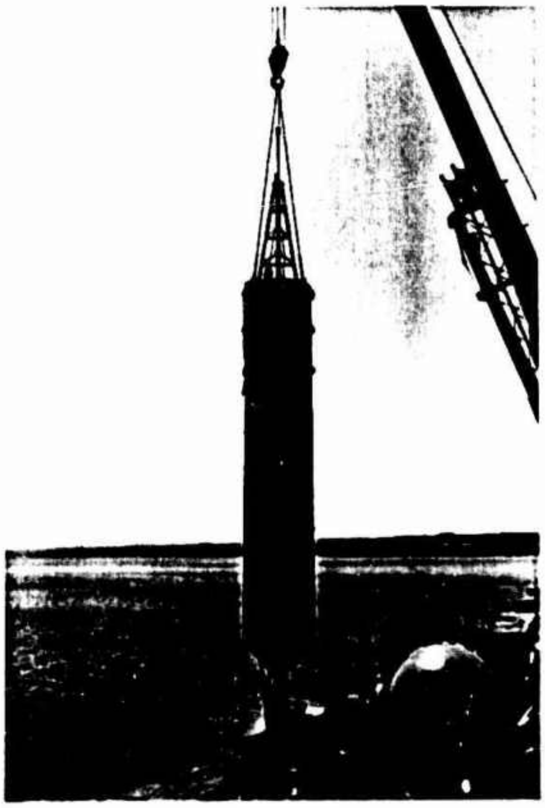


FIGURE 8

RECOVERING NORTHWEST MOORING

The northeast mooring was recovered first, after releasing the transformer float connection. The recovery was completed without incident, and the barge was moved to shore to off-load the recovered components.

Next, the transformer float was disconnected from the northwest mooring. (Note: The float remained moored by its 5-inch electrical power cable until it was attached to the new 4-point mooring, as described in paragraph 5.0.) When the float was released from the northwest buoy, it veered over the government's preinstalled center marker buoy, cutting the buoy's light mooring line. The marker buoy drifted off station, but was replaced by the government 2 days later. In the meantime, the Contractor used the transformer float as a navigational reference. When the center marker buoy was replaced, it was positioned approximately 60 feet too far to the west. However, its position was acceptable since NUSC preferred to have the barge position tolerance to the west because of the electrical cable connected to the transformer float. The buoy was referenced throughout the installation for bearings and distances.

During the recovery of the northwest mooring, the variation of the crane loads and the motion of the crane itself indicated that a bundle, or ball, of chain had been picked up from the bottom. The bundle suddenly untangled. The resulting rapid change in tension caused the crane to rock from side to side. This was the only potentially serious mishap on the project. It resulted in no damage or injury.

After disconnecting the buoy of the southeast mooring, the crane was connected to the 1 1/4-inch wire rope riser in an attempt to recover the remainder of the components, as had been accomplished for the other two moorings (see Figure 9). However, with the crane holding at approximately 40 tons of tension for 30 minu..., nothing moved. After shifting water ballast in the barge to

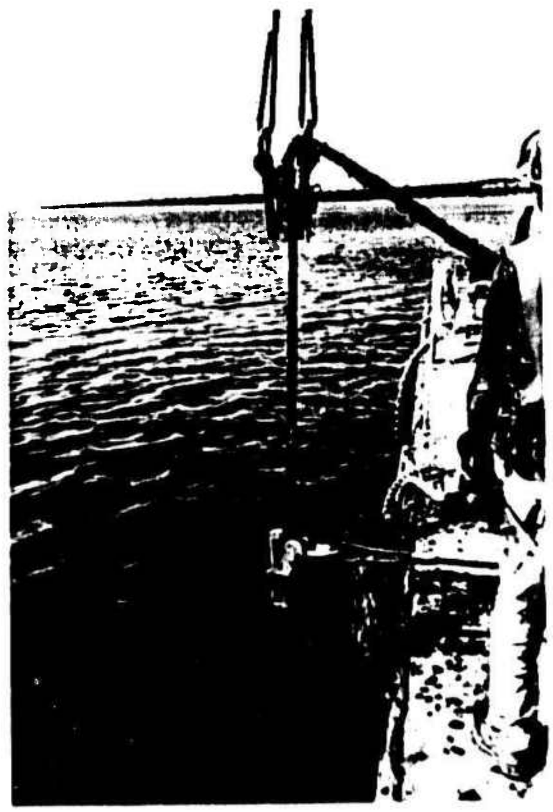


FIGURE 9

CARPENTERS STOPPERS USED TO
LIFT AND STOP-OFF WIRES

provide more lift, tension was again taken on the riser. Aftar waiting another 30 minutas for a possible suction break, thera was still no change in the attitude of the crane barge. The Contractor was than instructed to cut the risar, in the interest of safety for both the barge crew and the transformer float, which was downwind of and in close proximity to the barge. This action was reported to the ROICC and to personnel at NUSC. The foreman rigger at NUSC ststad thet "tha mooring had been down over 20 years", and that there was no chain in the riser - only wira rope securad to concrete mushroom anchors.

2.2 Bill of Materiels Recovarad. The bill of materials presented in Appendix A lists all materiel recovered from tha threa moorings and the transformer float attachments.

3.0 INSTALLATION

Following complation of all recovary operetions, tha crane barge was canterad over the repositionad center marker buoy on a north-south haading, with kedge anchors set out from aach quartar. Bearings wera than taken on prominent features eshora which coincidad with the dasign bearing of aach mooring lag. A premeasured end marked polypropylene line was used to detarmina distencas from the crena barge, end the tug moved in turn to aach of the four preastablished enchor locetions. Marker buoys - consisting of sealed eluminum bear kegs, painted red, and ettached to e small enchor by one-half inch nylon line - were positioned for reference during the placement of the anchors.

Tha generel procaduras described below were followed during the installation of each mooring leg. During lowering, the anchors were elung by a bridle in e horizontal position. A steel bar had previously been welded ecross the palms of the flukes to keep the flukes open et en engle of 50 degrees to the shank (see Figure 10). The anchors were lowered by the bridle at the port side, forward, with 5/8-inch diameter wire rope from the port side deck winch. The riser chain, which was connected to the anchor shank with an anchor shackle, was lowered simultaneously by the crane, located amidships along the port side (see Figures 11 and 12). The horizontal distance between the chain and bridle lowering locations alleviated any tendency of the anchor to twist while being lowered through the 535-foot water column (see Figure 13).

When the anchor reached the bottom, the lowering wire was cut from the winch and secured to a 4-foot diameter spherical buoy. This buoy served as an anchor crown marker, and also provided a means of recovering the anchor in the event the inboard end of the riser was lost for any reason during the remainder of the installation (see Figure 14).

After the anchor was on the bottom, the remainder of the chain was payed out while the crane barge was pulled toward the center of the mooring site by the two forward kedge anchors. Problems were encountered with the kedge anchors coming home, primarily because the 1,900 feet of wire on the winch drums did not allow for a long enough scope in over 500 feet of water. In addition, at 3,000 pounds, the kedge anchors were too light for the job. This problem was overcome, but required more than twice the normal number of kedge anchor sets during the installation of the northwest and northeast moorings. During the installation of the southeast and southwest moorings, this problem did not recur because the reciprocal mooring - northwest and northeast, respectively - was used to pull ahead, instead of kedge anchors. In these cases, only one kedge was set upwind to keep the barge online and the mooring leg taut and on the correct bearing.

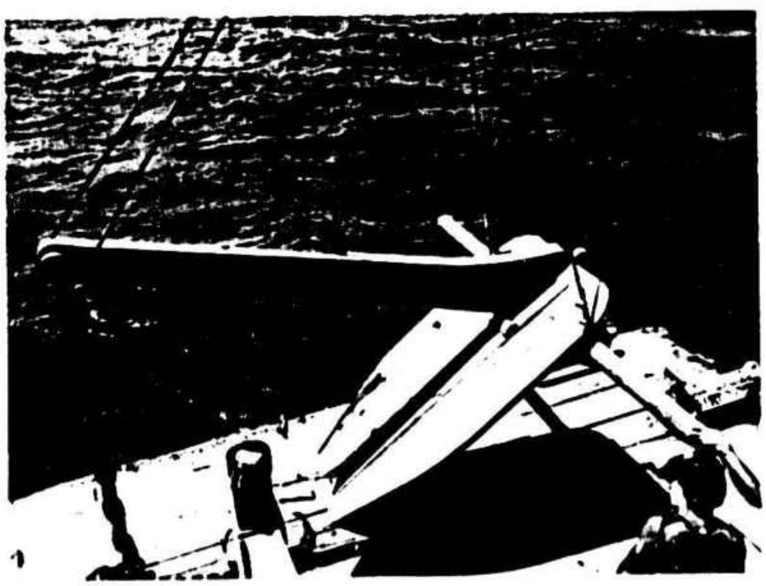


FIGURE 10

ANCHOR WITH FLUKES FIXED OPEN TO 50 DEGREES

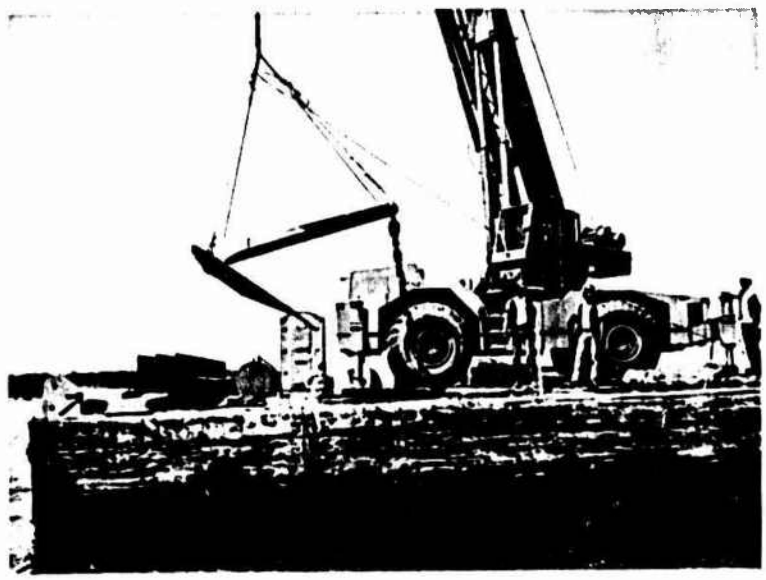


FIGURE 11

LOWERING ANCHOR OVER THE SIDE OF CRANE BARGE

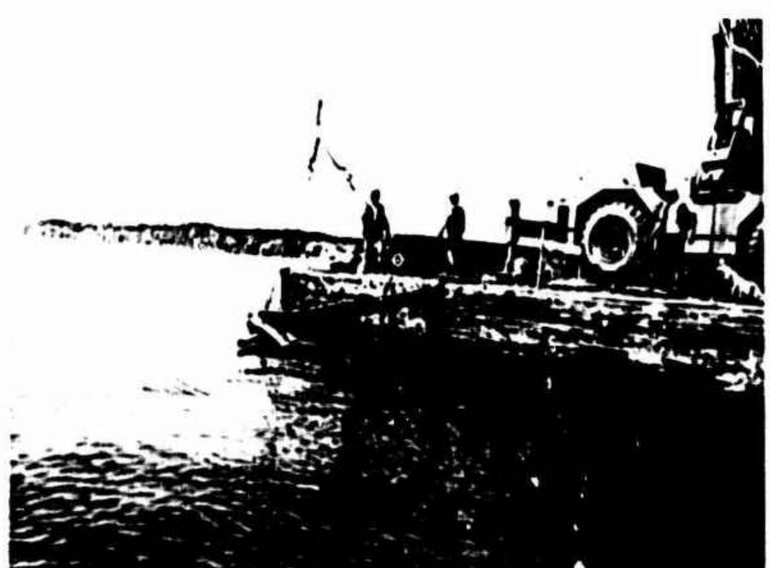


FIGURE 12

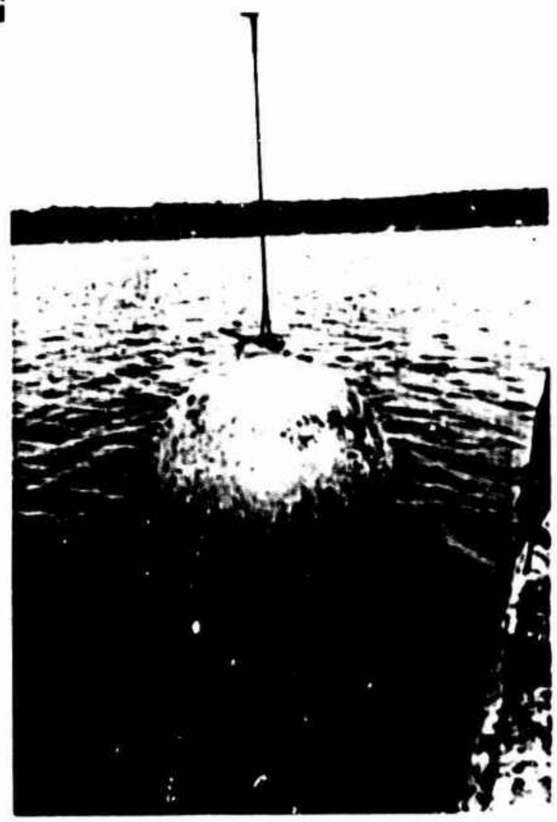
ANCHOR IN DIRECTION OF PULL AND READY FOR LOWERING

FIGURE 13

LOWERING CHAIN WITH PELICAN HOOK, NOTE SINKER SHACKLE USED AS STOPPER

FIGURE 14

ANCHOR CROWN BUOY



The sinker was connected on the last half-shot of chain in each mooring leg, one link in from the last full shot (see Figures 15 and 16). The connection was made with a 2 1/2-inch safety shackle back-to-back with a sinker shackle as shown in Detail A of the "as-built" drawing. The nut on the safety shackle was welded in place, and the locking pin on the sinker shackle was peened over. The sinker was lowered to the bottom, then raised 10 feet while a strain was taken on the kedge anchors or pulling lines to ensure that the chain was taut. The sinker was lowered again after all slack was taken out of the chain.

Next, the 1 3/4-inch riser wire, which had previously been connected to the end of the chain, was lowered by the crane over the side of the barge (see Figures 17 and 18). Wire rope clips and bow shackles were then secured to the riser wire, as shown in Figure 19 and Detail F of the "as-built" drawing. These fittings were later used to secure the temporary mooring pattern lines, as discussed in paragraph 6.0. Finally, the buoy was connected to the riser wire by an open swage fitting, shown in Figures 20, 21, & 22 and Details B, C and G of the "as-built" drawing.

The buoys were left with the mooring lines secured to the chafing rail, as shown in Figures 23 and 24.

4.0 TESTING

4.1 Test Procedures. The contract specifications called for a test consisting of a minimum of 30,000 pounds horizontal pull applied to diagonally opposed mooring legs for at least 15 minutes, with a maximum anchor drag of 50 feet being acceptable. If an anchor dragged more than 50 feet, it was to be reset and tested until a drag of less than 50 feet was attained. The test procedures

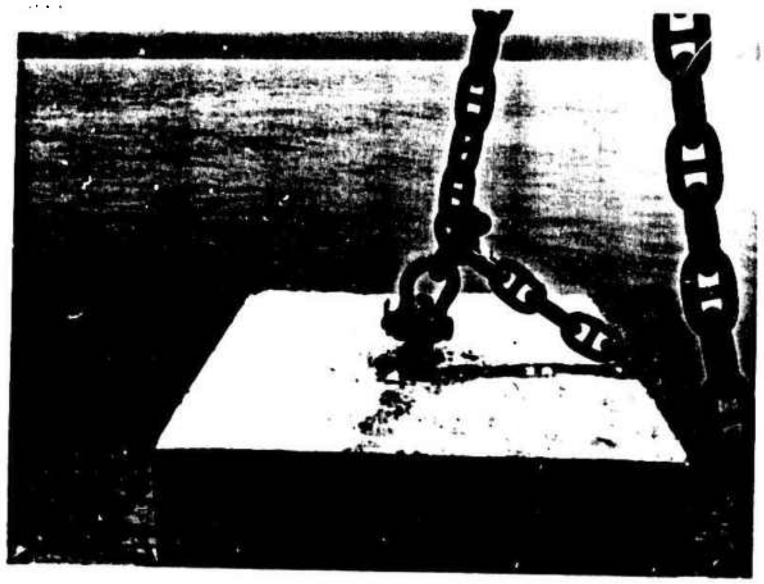


FIGURE 15

BACK-TO-BACK 2 1/2 INCH SAFETY SHACKLE
AND SINKER SHACKLE CONNECTION

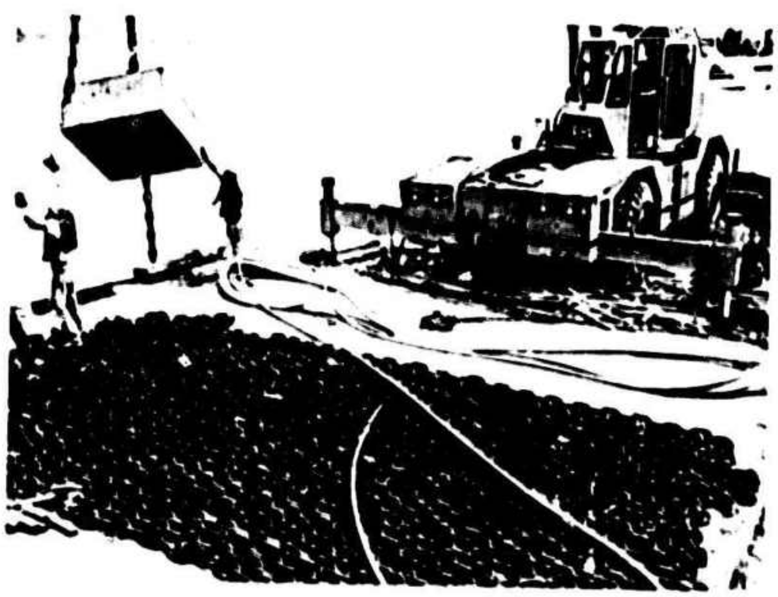


FIGURE 16

LOWERING CHAIN AND SINKER.
NOTE LAYOUT OF CHAIN AND WIRE

FIGURE 17

CARPENTERS STOPPER ATTACHLD TO 1-3/4 INCH RISER WIRE

FIGURE 18

CARPENTERS STOPPERS,TOP FOR LIFTING, BOTTOM USED OVER THE SIDE AS A STOPPER

FIGURE 19

WIRE ROPE CLIPS AND
BOW PIN SHACKLES USED FOR
CONNECTION OF
TEMPORARY LINES

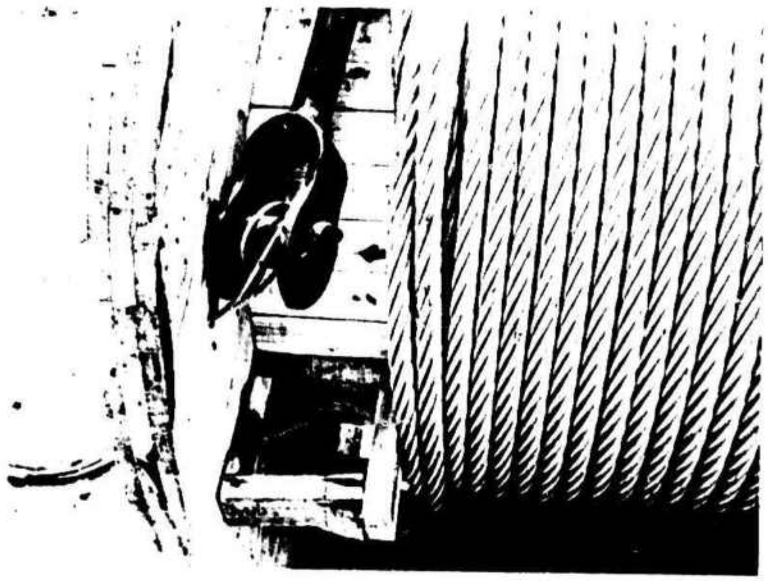


FIGURE 20

OPEN SWAGE WIRE ROPE FITTING

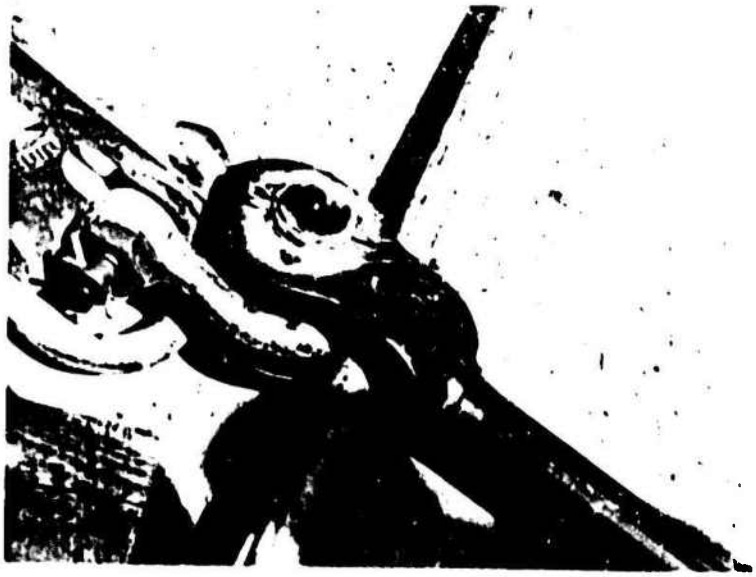


FIGURE 21

WELDED PIN ON OPEN SWAGE
WIRE ROPE FITTING

FIGURE 22

OPEN SWAGE CONNECTING THE
END OF THE CHAIN TO THE
1-3/4 INCH WIRE CABLE RISER

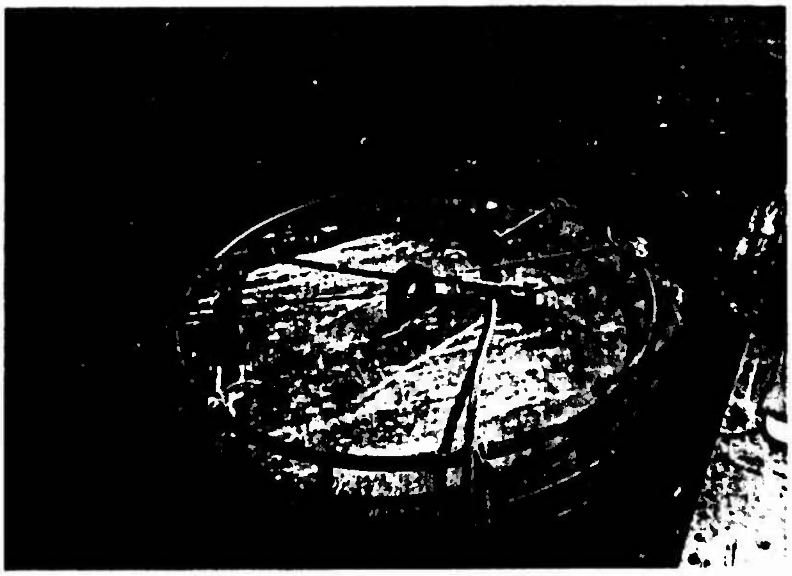


FIGURE 23

NORTH MOORING BUOY FOR
LEG NO. 1

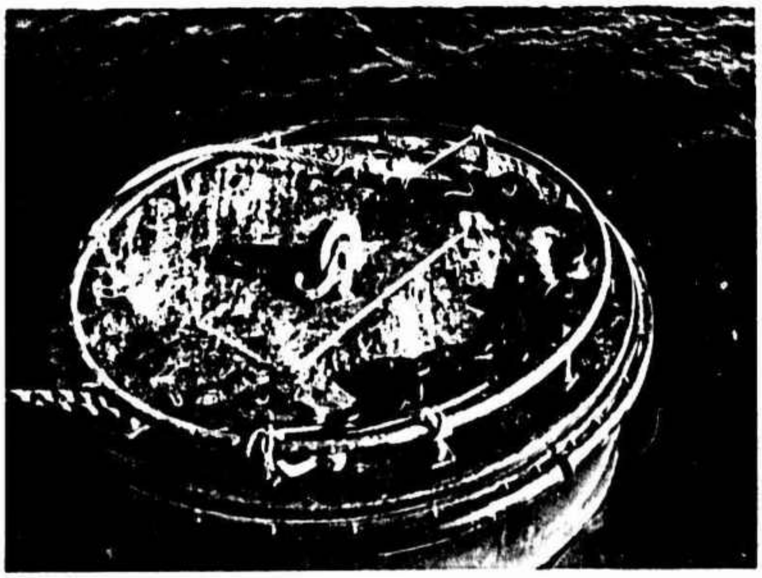


FIGURE 24

SOUTH MOORING BUOY FOR
LEG NO. 3

adopted in the field essentially followed the pre-established procedures, with some additional steps included.

Prior to testing, the crane barge was positioned in the center of the mooring pattern. Mooring lines from diagonally opposed buoys were then secured in turn on the barge deck, with the southern leg connected to the dynamometer and the northern leg attached to the four-fold purchase, as shown in Figures 25 through 30.

Before applying the full test load of 30,000 pounds, a tension of 6,000 pounds was applied to the buoys to determine the barge and buoy positions under load. While the mooring lines were in tension, fixes were taken on references ashore. During this phase of the testing, it was determined that the northeast buoy's mooring line was 85 feet short of the on-deck connection. This discrepancy was corrected as described in paragraph 4.2 below.

After determining the buoy locations, the Contractor applied the final acceptance proof test load of 30,000 pounds for 15 minutes. This was done for each set of diagonally opposed mooring legs.

4.2 <u>Test Results.</u>

The first pull test was conducted on 28 July 1983, on the northwest and southeast buoys. A steady pull of 30,000 pounds was sustained from 1830 to 1845. Testing of the northeast and southwest buoys was conducted on 2 August 1983, with 30,000 pounds of tension applied from 1524 to 1539.

The CHESDIV Project Manager witnessed and approved the tests. After the tests, bearings were taken on the anchor crown marker buoys, and the CHESDIV Project Manager determined that there had been no significant drag of the anchors.

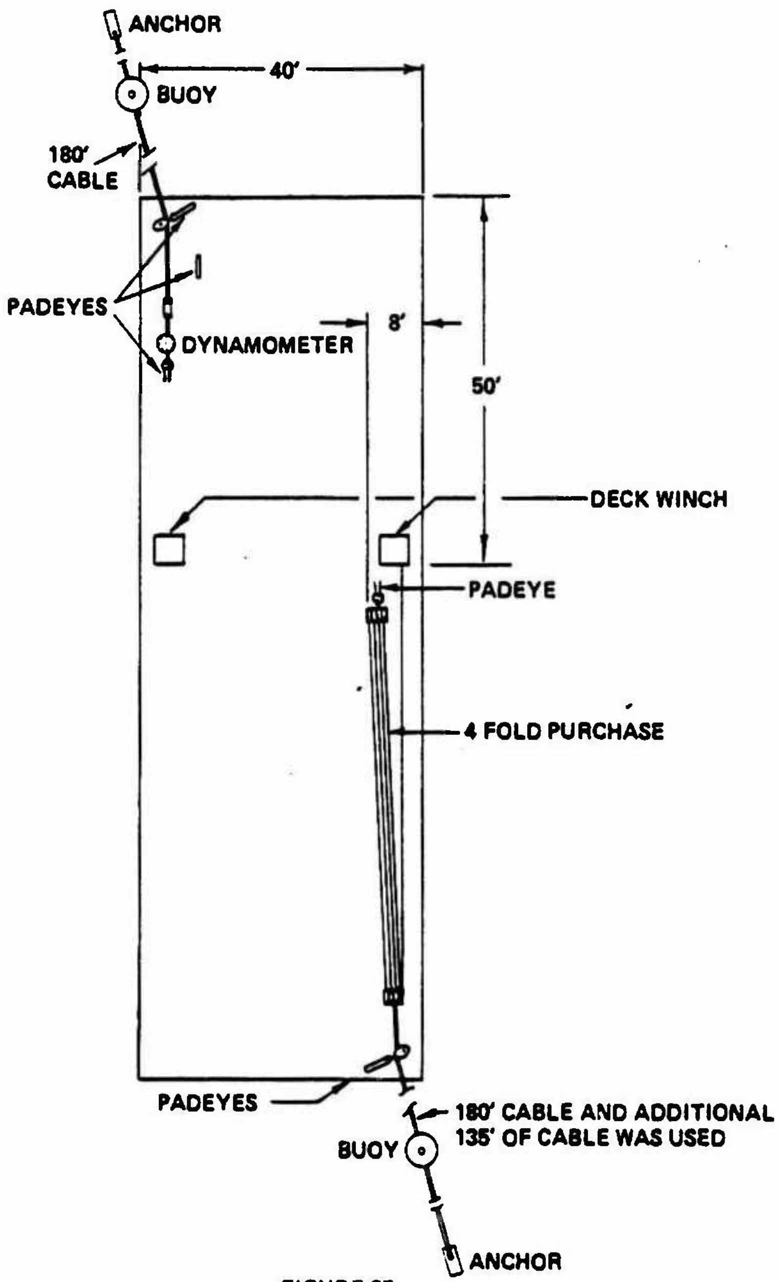


FIGURE 25

SKETCH OF BARGE
AS SET UP FOR PULL TEST

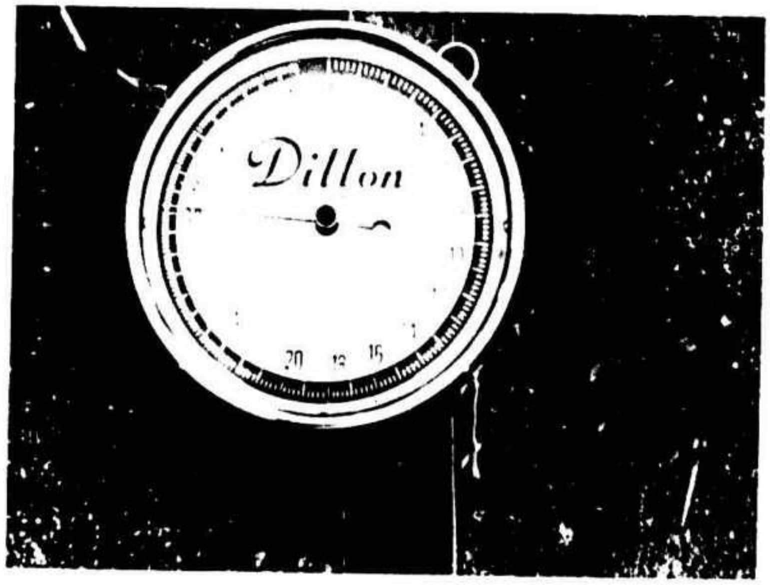


FIGURE 26

DILLON DYNAMOMETER USED FOR PULL TEST OF ANCHORS

FIGURE 27

H-BEAM WELDED TO DECK AND STIFFENED TO ACT AS DEAD-EYE

FIGURE 28

CONNECTING UP PURCHASE FOR DECK PULL OF ANCHORS

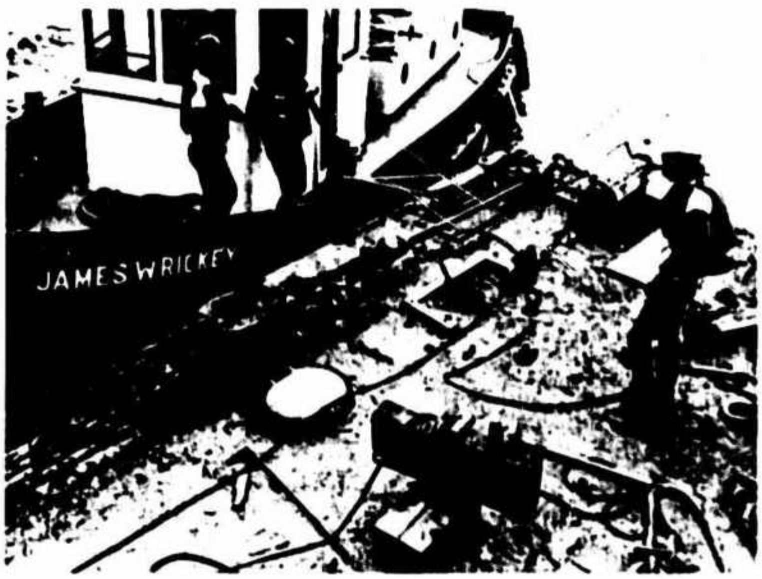


FIGURE 29

PURCHASE CONNECTED TO PULLING WIRE FROM BUOY

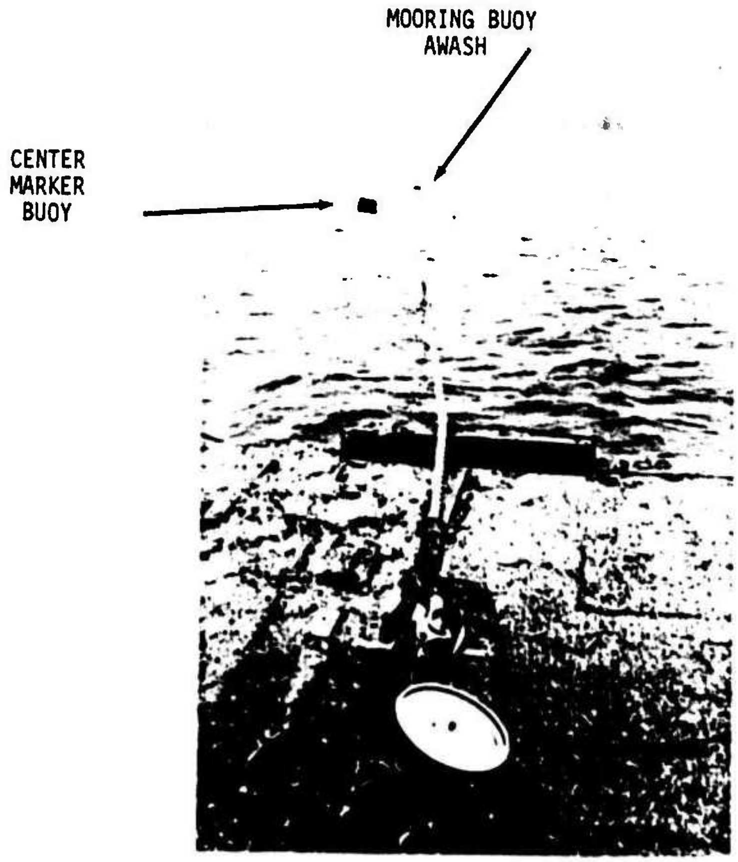


FIGURE 30

BUOY RESPONSE AT SPECIFIED LOAD OF 30,000 LBS

However, due to the northeast mooring being an estimated 85 feet short, the contractor was instructed to add one shot (90 feet) of 1 1/4-inch Baldt Di-Lok chain between the towing plate and the open swage fitting on the buoy and of the 1,100-foot length of riser wire (see Figure 31 and Detail G of the "as-built" drawing).

4.3 Calibration Verification. A Dillon and Company, Inc. dynamometer, Serial Number AN 54735, was used to measure proof test loads. The dynamometer was last calibrated on 15 February 1983, and scheduled for recalibration on 15 February 1984.

5.0 TRANSFORMER FLOAT CONNECTION

After the installation of the additional length of the chain to the northeast mooring, the crane barge was moved to the center of the mooring pattern. A winch wire from the barge was run through return blocks temporarily set up on each buoy, and a tension of approximately 6 kips was applied to moor the barge in the position which the TCP will occupy when moored. At this point the transformer float was located forward and slightly to the west of the crane barge.

To secure the transformer float between the northwest and northeast buoys, the CHESDIV Project Manager tructed the contractor to fit a bridle to the padeyes at the corners of each nd of the float (see Figures 32 and 33). The bridle, consisting of 1 1/4-inch Di k chain with associated fittings, was connected to each buoy's mooring line a shown in Detail H of the "as-built" drawing.

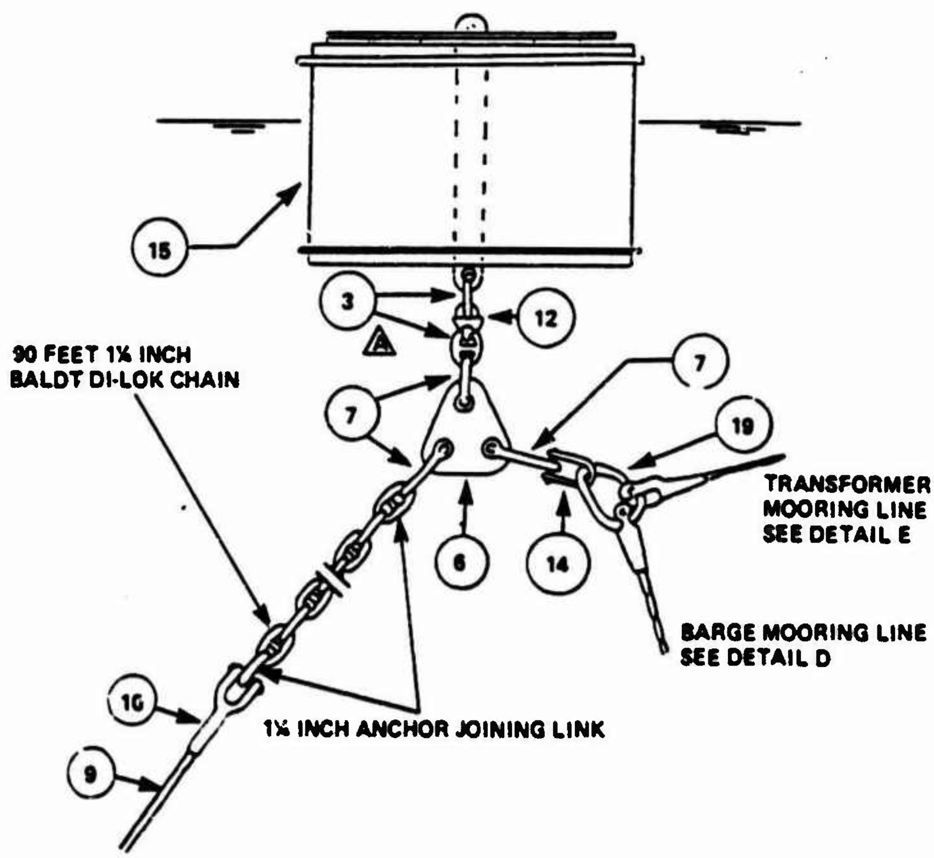


FIGURE 31

"AS BUILT" DETAIL SKETCH
OF MOORING BUOY LEG NO. 2

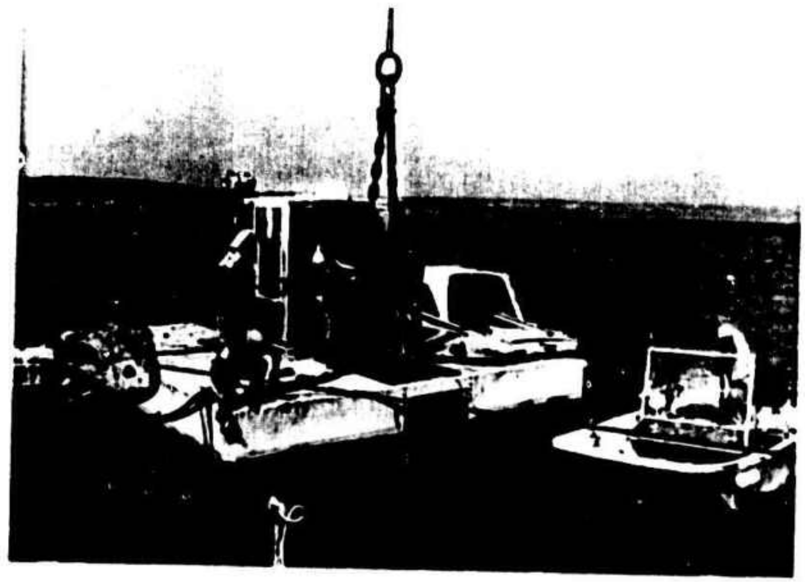


FIGURE 32

CONNECTING EAST 1 1/4 INCH BALDT
DI-LOK CHAIN BRIDLE ON THE
TRANSFORMER FLOAT

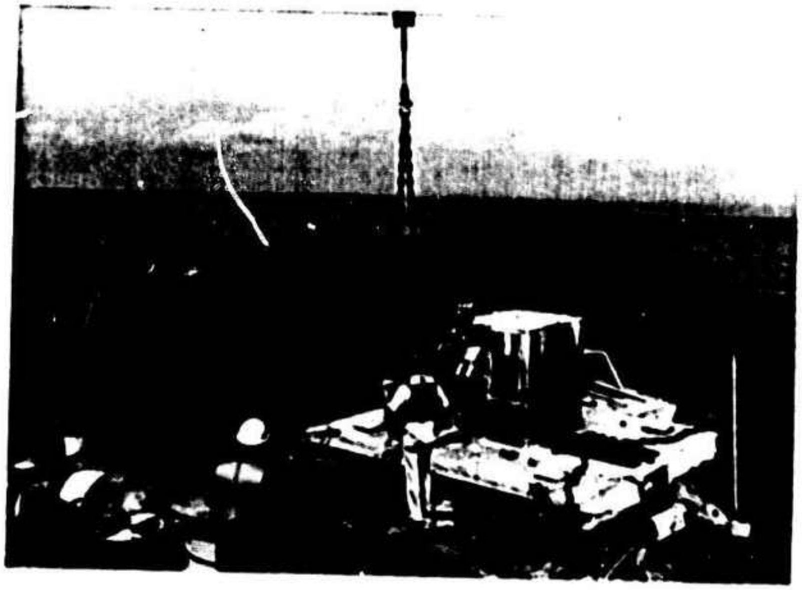


FIGURE 33

CONNECTING WEST 1 1/4 INCH BALDT
DI-LOK CHAIN BRIDLE ON THE
TRANSFORMER FLOAT

The material for this change order was supplied to the Contractor by CHESDIV and included:

(a) One shot (90 feet) of 1 1/4-inch Baldt Di-Lok chain.

(b) Four 1 1/4-inch joining links.

(c) Two 2 1/2-inch bow safety shackles.

(d) Four 1 3/8-inch screw pin shackles.

(e) Two 12 1/2-inch by 2 3/8-inch diameter ground rings.

The components for the bridle were taken from the material recovered from the temporary moorings. The final installed position of the transformer float is shown in the Plan View on the "as-built" drawing and in Figures 34 and 35.

6.0 CONNECTION OF TEMPORARY MOORING PATTERN LINES

When the transformer float was in place, and with a tension of 6 kips still being applied to all four mooring buoys, divers were employed to connect the temporary mooring pattern lines. The temporary pattern lines, which were secured to the four mooring lines 20 feet below the buoys, are used to keep the 4-point mooring in a rectangle of 420 by 300 feet to simplify mooring of the TCP. The connections of the temporary 1 1/2-inch diameter nylon line to the previously secured clips and bow shackles was inspected in place and found to be in compliance with specifications (see Detail F of "as-built" drawing).

After the temporary pattern lines were secured, the crane barge slowly eased out the entire pattern until all lines were slack. The temporary mooring pattern's final configuration was as designed and is indicated in the Plan View on the "as-built" drawing. The mooring lines and the 10-foot lengths of chafing chain were left tied with stoppers to the top of each buoy. The southeast buoy's mooring line is 26-feet short, as reflected in the "as-built" drawing and the

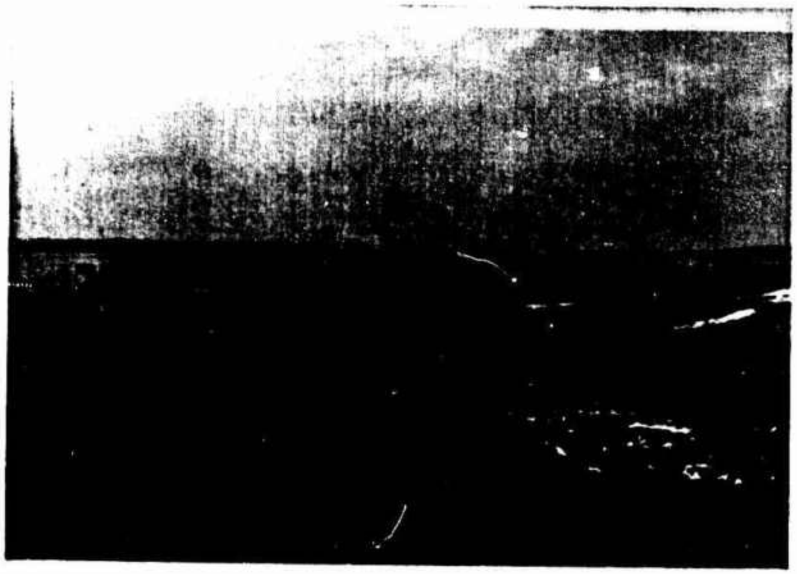


FIGURE 34

FINAL PATTERN OF
TRANSFORMER FLOAT

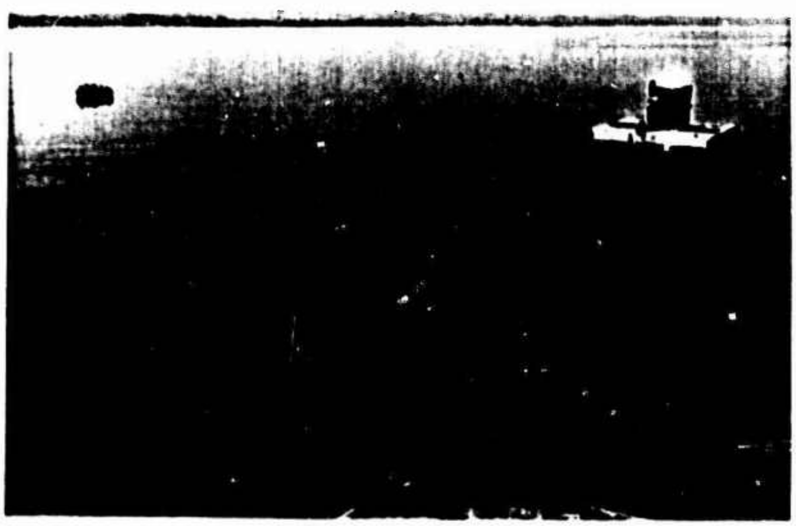


FIGURE 35

TRANSFORMER FLOAT AND
WEST MOORING BUOY

discrepancy list in Appendix B. However, since this mooring leg was placed at a depth 35 feet less than the design depth, the shorter mooring line was acceptable. A final heading of 328.5°T, versus the designed 330°T, was obtained and is shown on the "as-built" drawing.

7.0 ENVIRONMENTAL DATA

The Contractor had 4 down days due to weather. High winds were the primary problem, and appeared to result from the funnel effect caused by the high terrain on either side of the long, narrow lake. To some extent the limiting wind conditions varied depending on the phase of the project being worked on. In general, winds over 20 MPH, as reported by the marine weather station, were considered too strong to work in effectively. For example, when laying out chain in quartering winds and seas, it was not possible to keep on line and reset kedge anchors with one small tug.

8.0 PROJECT PERSONNEL

NAME	AGENCY	TITLE
Dr. Richard Beckwith	CHESDIV	Project Manager
Mr. William Seelig	CHESDIV	Design Engineer
Mr. Allan Hubler	CHESDIV	Assistant Engineer
Mr. Tim Lamoy	NORTHDIV	ROICC (Rome, N.Y.)
Mr. Paul McPhearson	NORTHDIV	Inspector (Rome, N.Y.)
Mr. Art Treisbank	NUSC	Assistant Manager (Dresden, N.Y.)
Mr. Gilbert Dissen Mr. Martin Juhn	Dissen & Juhn Corporation	Prime Contractor
Mr. Peter Williams	VSE Corporation	Technical Monitor for ROICC/ CHESDIV

9.0 LESSONS LEARNED

9.1 The Contractor, Dissen and Juhn Corporation, was found to be very responsive and cooperative during all phases of the operation. Change orders, field modifications, and other revisions were executed in a timely and professional manner. The Contractor demonstrated a high degree of accuracy in the installation of this deepwater mooring. The crane barge crew worked extremely well as a team. Dissen and Juhn is highly recommended as a contractor for future mooring projects or other marine work in the Eastern United States.

9.2 The successful completion of this project demonstrates that high-quality marine construction work can be performed by a relatively inexperienced contractor, given a sound yet flexible design, thorough but adaptable operational planning, and a full-time quality control and monitoring effort. These attributes contributed to the success of the project, despite the fact that the Contractor had not previously worked on a mooring recovery or installation.

9.3 Accurate navigation and precise locational data are of utmost importance on a deepwater mooring installation. The lack of prominent landmarks on which to take fixes should be anticipated in less developed regions or in areas for which detailed nautical charts are not available. Temporary range monuments should be set up on shore prior to the installation of center or anchor marker buoys.

The positioning of buoys and vessels may be facilitated by the use of some simple, readily available equipment. The CHESDIV Project Manager has recommended that the government representative have the following items as part of a standard package on future installations of this type:

(a) Chart of the area.

(b) Navigational tools: three-leg station pointer, dividers, compasses, and an azimuth circle fitted to a boat's compass or a hand-held bearing compass.

(c) Binoculars.

(d) Sounding chain or lead line.

(e) Distance line wound on a hand-held reel.

A Mini-Ranger would have been a valuable asset when setting marker buoys and anchors, and when verifying positions. A hand-held range finder would also be helpful when confirming distances between anchor and center marker buoys.

9.4 In order to reduce the hazard to personnel presented by slippery buoy topside decking, it is recommended that buoy decks be covered with lightweight fiberglass or steel gratings, coated with nonskid paint, or constructed of diamond-pattern nonskid plate.

APPENDIX A

BILL OF MATERIALS RECOVERED

BILL OF MATERIALS RECOVERED

FROM NORTHEAST MOORING

QUANTITY	DESCRIPTION	CONDITION
1	Buoy: 30 feet x 5 feet, cylindrical	In need of maintenance
	Buoy Jewelry: TOP: none	
1	BOTTOM: 3-inch pear link	GOOD
1	2-inch bold shackle	GOOD
	<u>Wire Rope</u>:	
1	Length - 660 feet Diameter - 1 3/8 inches Fitted with thimble eye on both ends, made up with Crosby wire clips.	GOOD
2	Length - 150 feet Diameter - 1 3/8 inches Fitted as above.	GOOD
1	Length - 100 feet Diameter - 1 3/8 inches Spliced thimble eye on each end.	POOR
	<u>Shackles</u>:	
*2	Bow Safety, 2 1/2-inch	GOOD
1	"D" shackle, 2-inch	GOOD
2	"D" shackle, 1 3/4-inch	GOOD
	<u>Detachable Links</u>:	
6	Connecting Link, Baldt, 1 1/4-inch	GOOD
1	Connecting Link, Baldt, 1 1/8-inch	GOOD
1	Connecting Link, Baldt, 1 3/8-inch	GOOD
2	Connecting Link, Baldt, 1 3/4-inch	GOOD
	<u>Chain</u>:	
4 1/2 shots	1 1/8-inch Baldt Di-Lok	GOOD - New condition, no measureable wear.

BILL OF MATERIALS RECOVERED

FROM NORTHEAST MOORING - Continued

QUANTITY	DESCRIPTION	CONDITION
7 shots	1 1/4-inch Baldt Di-Lok	GOOD - New condition, no measure-able wear
45 feet	1 1/2-inch Baldt Di-Lok	GOOD
25 feet	1 1/2-inch Baldt Di-Lok	GOOD
	Anchor:	
1	Danforth type, 3140 lbs., Serial No. 41179-JL, 1944, U.S. Navy	GOOD - New condition
2	Flashing Lanterns	WORKING

*The two bow safety shackles were later used in the transformer float bridle.

BILL OF MATERIALS RECOVERED

FROM NORTHWEST MOORING

QUANTITY	DESCRIPTION	CONDITION
1	Buoy: 30 feet x 5 feet, cylindrical	In need of maintenance
	Buoy Jewelry: TOP: none	
1	BOTTOM: 3-inch pear link	GOOD
1	2 1/2-inch safety bow shackle	GOOD
	Wire Rope:	
2	Length - 250 feet Diameter - 1 3/8 inches Fitted with thimble eye on one end, made up with Crosby wire clips. The other end was cut.	POOR
2	Length - 150 feet Diameter - 1 3/8 inches Fitted with spliced thimble eye each end.	POOR
	Shackles:	
*2	Bow Safety, 2 1/2-inch	GOOD
1	"D" Shackle, 1 1/2-inch	GOOD
	Detachable Links:	
*2	Anchor joining links, Baldt, 1 1/4-inch x 1 9/16 inch	GOOD
*8	Connecting Links, Baldt, 1 1/4-inch	GOOD
2	Connecting Links, Baldt, 1 3/8-inch	GOOD
	Chain:	
8 shots	1 1/4-inch Baldt Di-Lok	GOOD
2 shots	1 3/8-inch Baldt Di-Lok	GOOD
4 1/2 shots	1 1/8-inch Baldt Di-Lot	GOOD - New condition, no measureable wear.

BILL OF MATERIALS RECOVERED

FROM NORTHWEST MOORING - Continued

QUANTITY	DESCRIPTION	CONDITION
*7 shots	1 1/4-inch Baldt Di-Lok	GOOD - New condition, no measure-able wear
45 feet	1 1/2-inch Baldt Di-Lok	GOOD
25 feet	1 1/2-inch Baldt Di-Lok	GOOD
	Anchor:	
1	Danforth type, 3000 lbs., Serial No. 6858, Breda 1953, U.S. Navy	GOOD
1	Flashing Lantern From Buoy	WORKING

*Two bow safety shackles, two anchor joining links, four 1 1/4-inch connecting links, and one shot of 1 1/4-inch Di-Lok chein were later used in the transformer float bridle.

BILL OF MATERIALS RECOVERED

FROM TRANSFORMER FLOAT

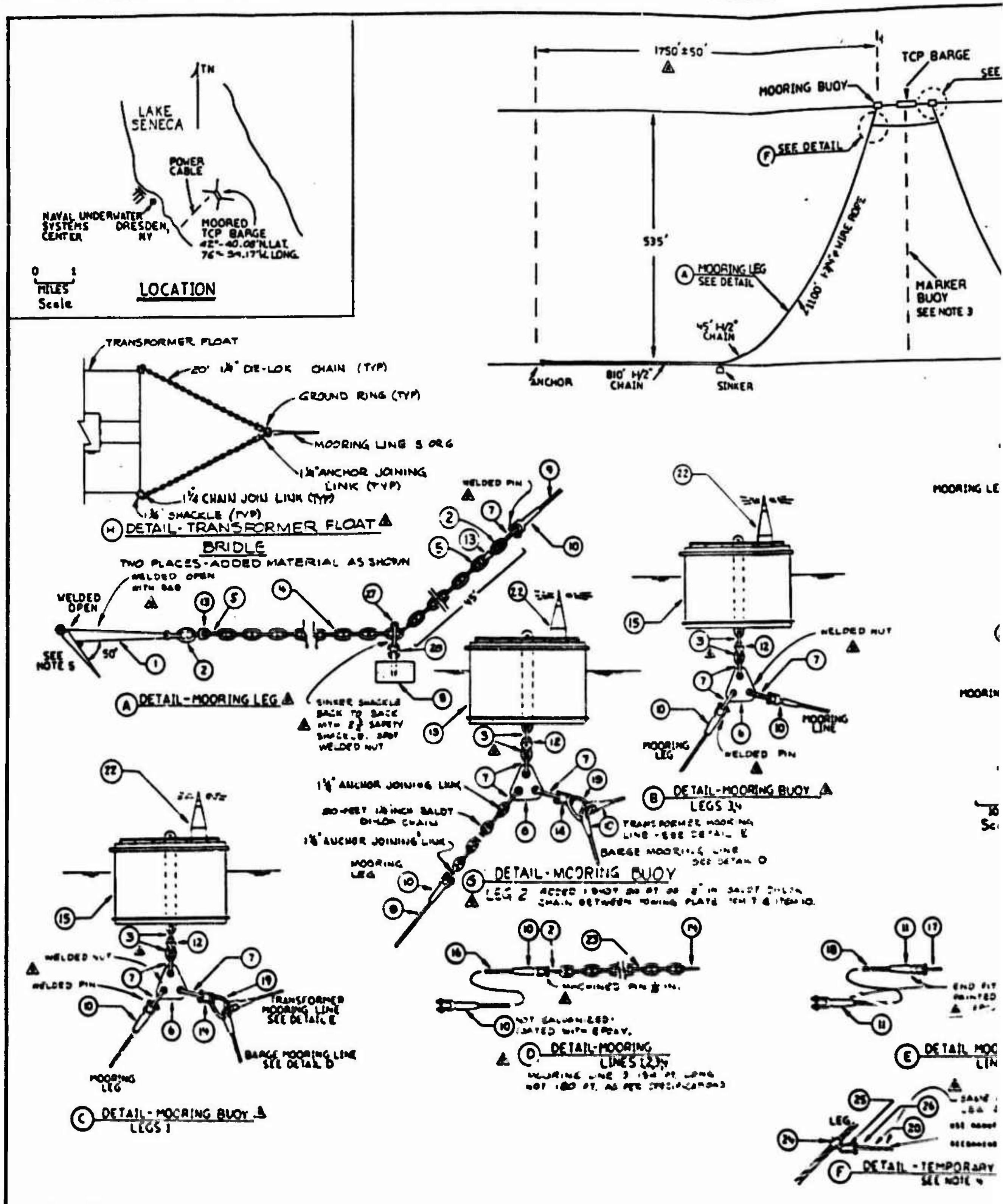
AND SOUTHEAST BUOY

QUANTITY	DESCRIPTION	CONDITION
1	Buoy: 30 feet x 5 feet, cylindrical	In need of maintenance
1	Buoy Jewelry: TOP: none BOTTOM: Fixed Ring 12-inch I.D. x 1 1/2-inch	POOR
	<u>Shackles and Joining Links</u>:	
3	"D" Shackles, 2-inch	GOOD
*5	"D" Shackles, 1 1/2-inch	GOOD
1	Bow Shackle, 2 3/4-inch	GOOD
1	Bow Shackle, 2 1/8-inch	
1	Connecting Link, Baldt, 1 1/2-inch	GOOD
	<u>Rings</u>:	
*2	12 1/2-inch I.D. x 2 3/8-inch	GOOD
	<u>Swivels</u>:	
1	2-inch	POOR
1	1 1/2-inch	POOR
	<u>Chain</u>:	
3	Short Lengths (under 10 feet), Various Sizes	GOOD
10	Various Lengths of 1 1/8-inch Wire Rope with Spelter Sockets	POOR

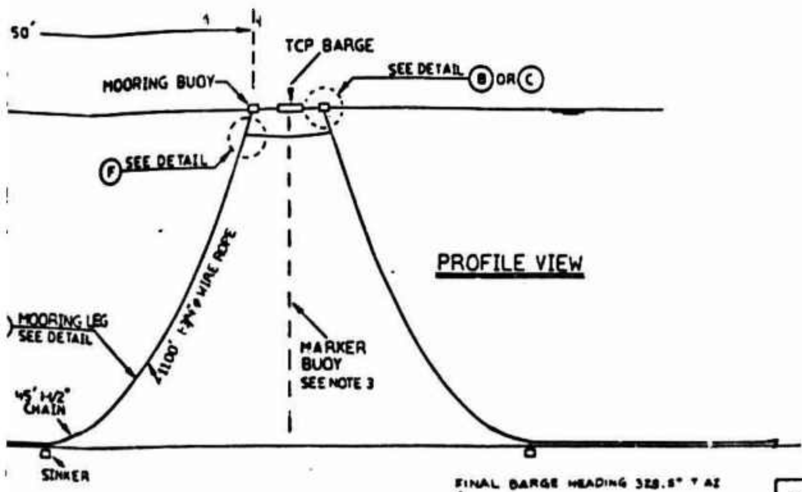
*The two ground rings and four of the 1 1/2-inch "D" shackles were later used in the transformer float bridle.

APPENDIX B

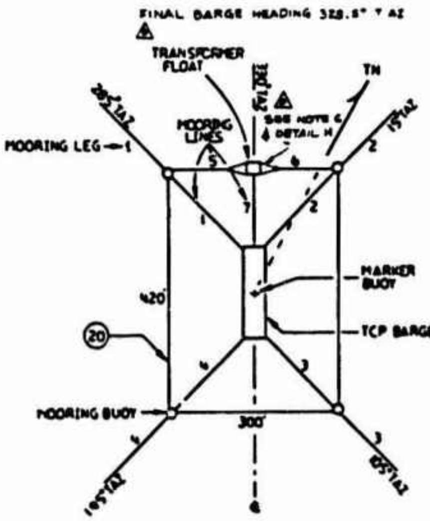
"AS-BUILT" DRAWING AND DISCREPANCY LIST


LAKE SENECA
TN
POWER CABLE
NAVAL UNDERWATER SYSTEMS CENTER
DRESDEN, NY
MOORED TCP BARGE
42°-40.08'N LAT.
76°-54.17'W LONG.
MILES
Scale
LOCATION
1750'±50'
TCP BARGE
MOORING BUOY
F SEE DETAIL
535'
A MOORING LEG SEE DETAIL
1100' 1¼" WIRE ROPE
MARKER BUOY SEE NOTE 3
45' 1/2" CHAIN
ANCHOR
810' 1/2" CHAIN
SINKER
TRANSFORMER FLOAT
20' 1¼" DI-LOK CHAIN (TYP)
GROUND RING (TYP)
MOORING LINE 5 ORG
1¼" ANCHOR JOINING LINK (TYP)
1¼ CHAIN JOIN LINK (TYP)
1¼" SHACKLE (TYP)
H DETAIL-TRANSFORMER FLOAT BRIDLE
TWO PLACES-ADDED MATERIAL AS SHOWN
WELDED OPEN
WELDED OPEN WITH BAR
SEE NOTE 5
50°
45°
WELDED PIN
A DETAIL-MOORING LEG
SINKER SHACKLE BACK TO BACK WITH SAFETY SHACKLE, SPOT WELDED NUT
WELDED NUT
MOORING LINE
MOORING LEG
WELDED PIN
B DETAIL-MOORING BUOY LEGS 3,4
1¼" ANCHOR JOINING LINK
1¼" ANCHOR JOINING LINK
TRANSFORMER MOORING LINE-SEE DETAIL E
BARGE MOORING LINE SEE DETAIL D
MOORING LEG
DETAIL-MOORING BUOY
LEG 2
TRANSFORMER MOORING LINE SEE DETAIL E
BARGE MOORING LINE SEE DETAIL D
MOORING LEG
C DETAIL-MOORING BUOY LEGS 1
MACHINED PIN
NOT GALVANIZED-COATED WITH EPOXY.
D DETAIL-MOORING LINES (2,3,4)
MOORING LE
MOORIN
E DETAIL MOO
LEG
F DETAIL-TEMPORARY
SEE NOTE 4

SYMBOL	DESCRIPTION	DATE	APPROVED
▲	PC 1 was 96 LNT, QTY CHGD – PC 2 was 20. PC 3 was deleted from Detail A, PC 3 was added to Details B & C, PC 5 was 40, PC 7 was 30, PC 20 was 2500; PC 19 was 1-3/8"; NEW PC 27; [illegible] PROFILE – was 1650'; revised Note 5.	5/[illegible]	[illegible]
▲	ADDED DETAIL G & H, ADDED BRIDLE CONNECTION TO TRANSFORMER FLOAT IN PLAN VIEW. LEG 2 REMOVED FROM DETAIL C. ADDED NOTES TO DETAIL A. ADDED NOTES TO DETAIL B. ADDED NOTES TO DETAIL C. ADDED NOTES TO DETAIL D. ADDED NOTE TO DETAIL E. ADDED NOTE TO DETAIL F. ADDED NOTE G. ADDED PIECE NO. 28	[illegible]	[illegible]

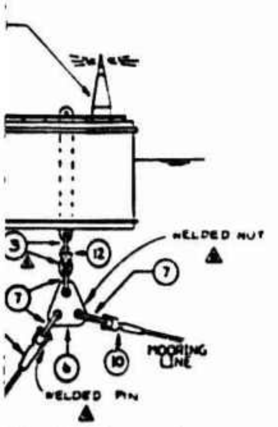


PROFILE VIEW

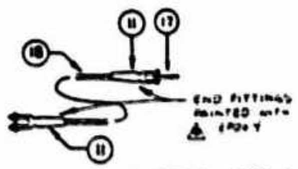


100' Scale

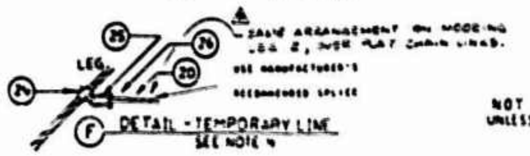
PLAN VIEW



DETAIL-MOORING BUOY ▲ LEGS 3,4



E DETAIL MOORING LINES 5,6,7



F DETAIL - TEMPORARY LINE SEE NOTE 4

NOT TO SCALE UNLESS INDICATED

PIECE NO.	PART OR IDENT. NO.	QTY. REQD.	DESCRIPTION	SPEC.	MATERIAL
1		4	[illegible]		STEEL
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28		4	SHACKLE 1¼" ALLOY		STEEL

NOTES

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. ▲ [illegible]
6. ▲ FIT BRIDLE TO PADEYES EACH END OF TRANSFORMER FLOAT

DEPARTMENT OF THE NAVY, NAVAL FACILITIES ENGINEERING COMMAND, CHESAPEAKE DIVISION

NUSC LAKE SENECA N.Y. TRANSDUCER CALIBRATION PLATFORM (TCP) 4 POINT MOORING SITE, PLAN & DETAILS

F | 80091 | 302[illegible]

2

DISCREPANCY LIST

See "As-Built" Drawing for Details and Description of Pieces.

Requirement	Discrepancy	Corrective Action
1. Piece Nos. 10 and 11 - swage fittings shall be galvanized according to ASTM standards A123 and A153 (per paragraph 2.5, page 02199-2 of Spec. No. 04-82-0378 to Contract No. N62472-82-C-0378)	Piece No. 10 - open swage wire rope fittings, 1 3/4-inch: all were epoxy coated vice galvanized. Piece No. 11 - open swage wire rope fittings, 1 1/4-inch: not galvanized or coated.	Piece No. 10 - Accept-as-is; well coated with epoxy. Piece No. 11 - Wire brushed and painted with SIKAGARA 62-603 epoxy resin, batch number 30006. Compliance with MILSPEC checked by ROICC.
2. Piece No. 16 - 6x37 IWRC wire rope, 1 3/4-inch, 180-foot lengths.	One mooring line on southeast mooring is only 154 feet long vice 180 feet.	Accept-as-is.
3. Piece no. 27, sinker shackle, to fit hairpin of Piece No. 8, concrete sinker.	Sinker shackle was not large enough to fit over the hairpin.	Baldt, Inc. supplied (at no cost) four 2 3/4-inch safety shackles which were connected back-to-back with the sinker shackle as shown in Detail A.
4. Pin of Piece No. 10, open swage, to fit piece No. 2, anchor joining link, as shown in Detail D.	Pin was slightly too large to fit the link.	ROICC issued a change order to have the pins turned down one-sixteenth of an inch.