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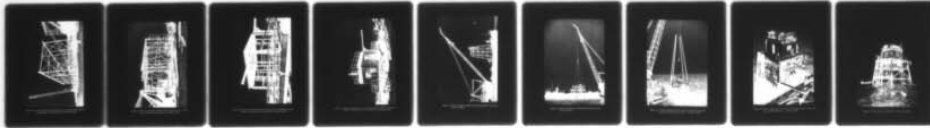
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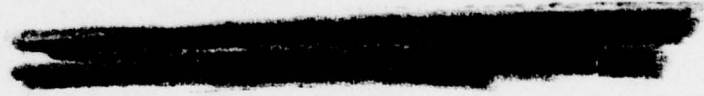
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THE NEL OCEANOGRAPHIC TOWER

E. C. LaFond

This memorandum has been prepared because the information herein is believed to be useful in this form to others in NEL and to a few persons or activities outside NEL. The opinions stated in it are those of the author and not necessarily those of the U. S. Navy Electronics Laboratory. This memorandum should not be construed as a report, as its only function is to present, for the information of others, the progress on the construction of a Laboratory facility.

Acknowledgments

Many people throughout the Laboratory contributed to the design of the tower and the construction of equipments. Mr. R. F. Kimball and Mr. W. H. Grimley of the NEL Public Work Division were responsible for planning and negotiating with 11th Naval District. Mr. L. C. Thompson of the NEL Field Engineering Branch coordinated the installation of equipment and facilities.

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THE NEL OCEANOGRAPHIC TOWER

E. C. LaFond

INTRODUCTION

^{N AN}
~~A few~~ oceanographic research tower was installed on 11 June 1959 off Mission Beach, California, by the Navy Electronics Laboratory. This tower consists of a platform containing an instrument house, supported by a steel pipe structure, similar to that of an oil well derrick. The pipe structure is fastened to the sea floor by pins driven 63-feet into the bottom through each of its four hollow legs. ↙

The tower is situated in 56 feet of water (MLLW). The Mission Beach site was chosen because it provided the best combination of desirable oceanographic features and practical operating convenience. ↙

The new NEL tower will be used to acquire more knowledge of the shallow water ocean environments. This knowledge will then be applied to the development of (1) improved methods for detecting and neutralizing enemy mines, sneak craft, and submarines, and (2) improved communications and navigation systems for the Navy.

A few other offshore platforms have been used for the study of the sea. For example, Texas towers on the east coast have been utilized for measurements of current and waves, but their main purpose is for radar. Oil derricks in the Gulf of Mexico have also been utilized for heat budget and other oceanographic studies. In Buzzard's Bay, windmill structures have been set up in shallow water for studies of waves. However, the NEL tower is the first one designed for exclusive use in oceanographic and acoustic research.

ADVANTAGES OVER SHIP:

The main advantage of a fixed platform, such as the N.E.L. tower, over a ship anchored in the same location is stability. With the tower, the motions caused by waves, wind, and current are eliminated. Instruments may be stabilized in depth and orientation, which is not feasible from a ship. Stability is required for time lapse studies as, for example, the photographing of changes in the sea by time lapse movies which cannot be taken from a ship.

The second advantage is that continuous measurements can more readily be made from a permanent installation than from a ship. Instruments may be suspended in the water or mounted on the structure and allowed to record continuously in the instrument house. This makes it feasible to record oceanographic variables for periods of weeks or months.

The third advantage over a ship is economy. The tower can be operated by two or three people periodically tending the recorders and maintaining instruments. A ship requires, in addition to the instrument personnel, a regular crew. Even though the crew's duties would be minimal while the ship was anchored, the cost of the crew would continue. To operate day and night, as will be done with the tower, a ship would have to change crews for different watches, thus necessitating numerous personnel. In addition, maintenance and supply of the ship are expensive items.

THE LOCATION:

The sea floor off Mission Beach is a sandy, gradually sloping shelf devoid of rock and kelp. The site of the tower is near a boundary

between coarse sand (seaward) and fine sand (shoreward). The cause of this boundary and of the difference in acoustical properties of the coarse and fine sand bottoms is not now known and will be studied. Another acoustical study will be made of the effects of sand ripples on the bottom which vary in size throughout the season. In addition, previous oceanographic studies revealed wide fluctuations in thermal structure and acoustic transmission in the vicinity of the tower, and the origin of these variations will be studied.

The area surrounding the tower is relatively free of ship traffic and, therefore, has a low noise level for acoustic measurements. With a view to preserving this low-noise level, power to the tower is supplied by underwater cables from shore rather than by motor generators. Only a short cable run is required; in the same depth of water off Coronado Strand, another possible location, the cable would have had to be several times as long.

PHYSICAL CONSTRUCTION AND FACILITIES:

The general shape of the tower is that of a pyramid truncated at the top. The pipe framework construction is similar in shape to that of an oil well derrick. The mean lower low tide level on the tower is 56 feet from the sea floor. The main deck of the tower is 27 feet above this water level. The main deck, which is a slab of concrete 22 X 22 feet, supports a 13 X 15-foot instrument house. The strong, flat roof of the instrument house supports electrical transformers, emergency generator, meteorological instruments, and the motor for the hydraulic winches. Below the main deck is a catwalk around the four sides for handling equipment. Below this is a second catwalk on the shore side.

The underwater power cable from Mission Beach comes up one tower leg to the instrument house where its 4160 volts are converted to 440, 220, and 110 volts. Thirty kilowatts are available.

In the instrument house are numerous recorders, instrument racks, benches, space heaters, a head, sleeping facilities, a stove-refrigerator-sink combination, and a tank of fresh water. A trap door in the center of the house floor permits instruments to be lowered and water samples collected at any depth to the bottom. Two guide cables extend up from the sea floor through this trap door to the house ceiling. It is planned to use a diving bell from this central location inside the tower framework.

Vertical railway tracks (30-inch gauge) are installed on three sides of the pipe structure. Instrument carts run on these tracks, raised and lowered from protruding overhead beams on the house by a hydraulic winch system. Various sensing instruments are attached to the carts, and their electrical leads are run to the instrument house. A loading boom on the shore side is powered by the same hydraulic system.

Radio communications are available from the tower to the Laboratory and the oceanography office.

INSTRUMENTATION AND STUDIES:

The instruments to be used on the tower will depend on the specific studies to be made at the time. The intent is not to survey one environment in detail but, rather, to find the factors which control and cause changes in the environment.

Many studies will be of the surface, the sea floor, and the water in between. They will be concerned with the physical, biological, and

chemical properties of the water, and with atmospheric conditions and their relation to the sea surface and water structure. The general fields of study and instrumentation are given below.

Studies

Meteorological

A recording Friez (AN/UMC-5C) anemometer will be mounted on the roof to give wind speed and direction at that level.

Sea Surface

Swell will be recorded by a Mark X Snodgrass wave recorder mounted outward from the northeast leg at 20 feet from the bottom.

Fine structure of the sea surface will be studied by a narrow beam acoustic transducer directed vertically upward to the surface. It will be mounted on the northwest leg.

Water Temperature

Thermistor beads are to be mounted on the northwest leg every 6 feet through the water column. Electrical cables from these will run up the tower leg to the instrument house. Another bead is to be mounted on a cart for obtaining vertical profiles.

For studying temperature oscillations caused by internal waves, isotherm followers will be used on the tower and at two other points nearby. In addition, thermistor

Studies

Instrumentation

beads can be mounted on five 45-foot tripods now on the bottom near the tower, with electric cables leading to a 16-channel recorder in the instrument house.

Biological

Sampling of water for plankton will be done by a submersible electric pump and hose. The pump may be attached to a cart or lowered through the center well.

Chemical

Water samples will be collected for chemical analysis by the electric pump or by water bottles lowered through the well. In addition, dissolved oxygen content of the water will be determined by means of one or more Carritt-Kanwischer type oxygen-sensing elements. These elements will be suspended out from the tower at different levels and connected to a recorder in the instrument house.

Optical

An ambient light meter (ALI) will be mounted on a cart. It can be oriented in any direction. In addition, a hydrophoto-meter will be affixed to a cart for measuring transparency at any depth. Both instruments will record in the instrument house.

Studies

Water Motion

Water motion at any depth is to be determined by means of a BUSHIP'S Telemetering Current Meter (C10 Model) suspended from the center of the tower through the well. Surface movement of slicks will be studied by time lapse movies using anchored range markers as reference. Internal temperature wave speeds and direction will be determined by thermistors on the five submerged tripods and isotherm followers.

For turbulence, it is planned to photograph dye marker streaks in front of a fixed background grid in the water with an underwater movie camera to be mounted on a cart.

Acoustical

Transducers of various kinds will be mounted on the cart. These can be directed horizontally or at any angle for studying transmission through the water or reverberation from the bottom or surface.

Scattering in the water column and from the surface will be studied by means of bottom-mounted transducers directed upward.

In addition, acoustic targets will be placed on the bottom as well as on a 45-foot vertical underwater tripod, which is ready

Studies

Instrumentation

for installation at some distance from the tower. This tripod will support hydrophones for providing direct acoustic transmission.

CONCLUSION:

NEL's unique new oceanographic tower promises to be an invaluable tool for extending the Navy's knowledge of the shallow ocean environment, including the sea floor and surface, the water between, and the meteorological conditions immediately above the ocean.

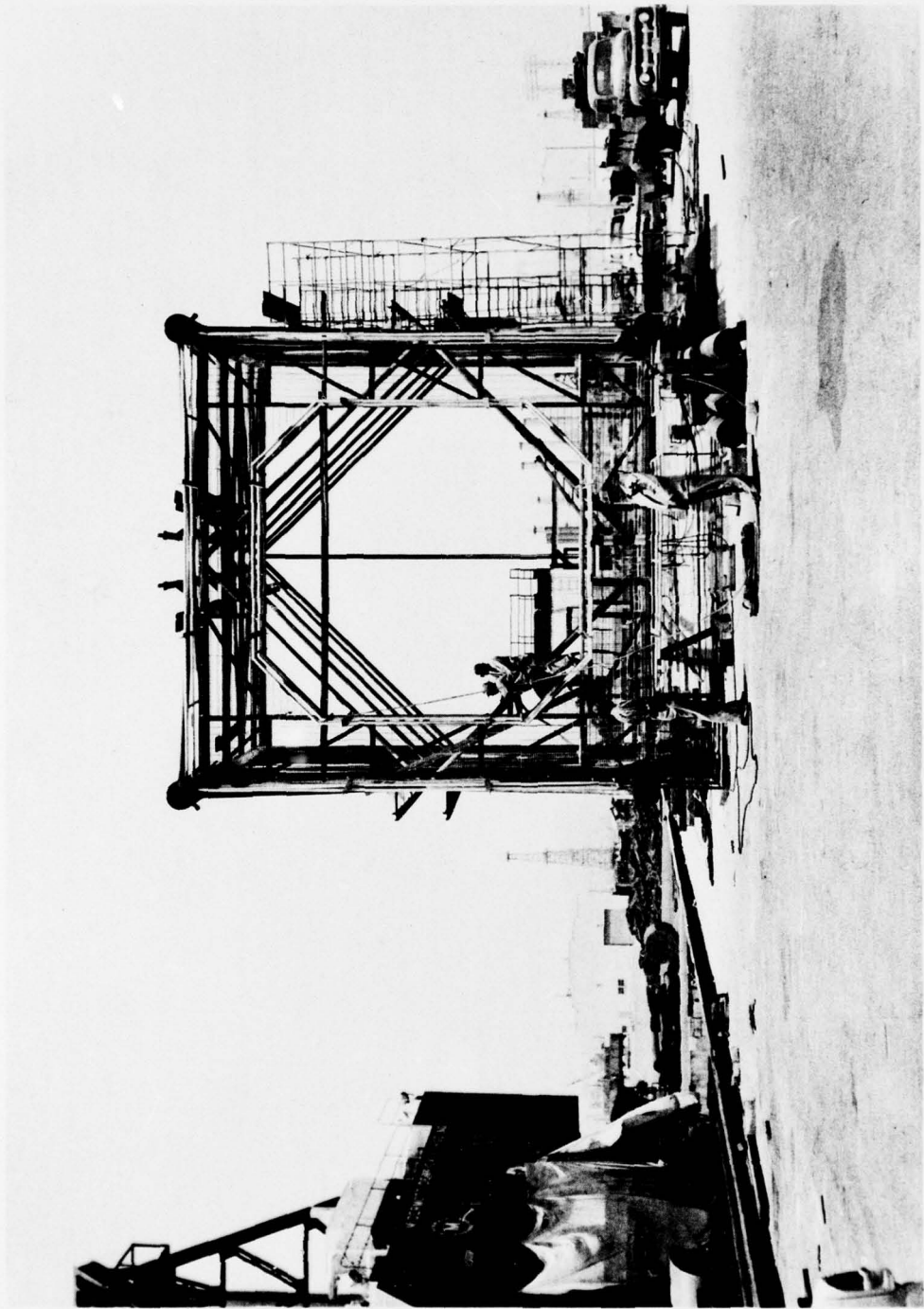


Figure 1. Tower framework looking from a top aspect. (Under construction at Long Beach on 20 May 1959)



Figure 2. Tower framework looking from a bottom aspect (Under construction at Long Beach on 28 April 1959)

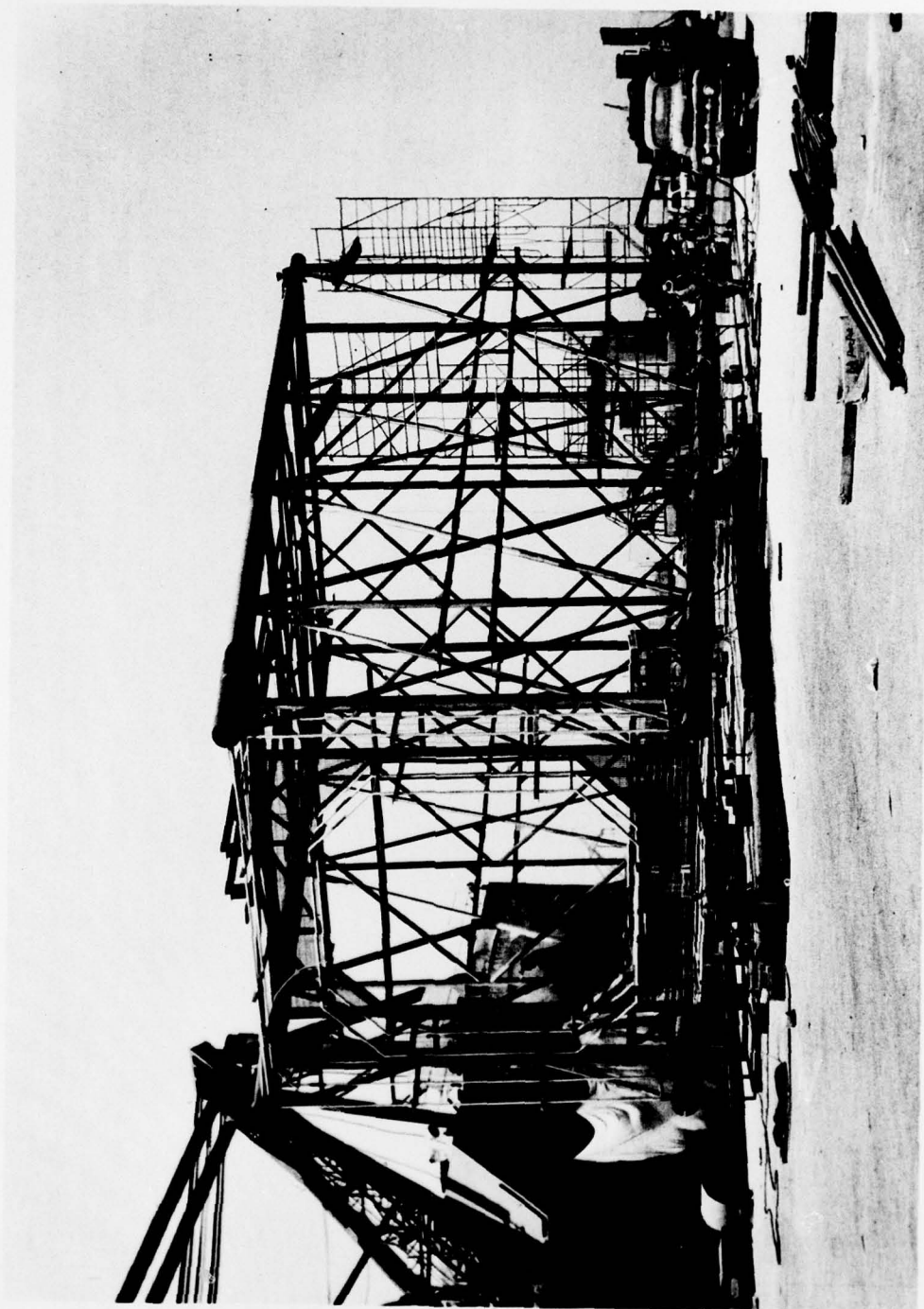


Figure 3. Tower framework looking from a side aspect. (Under construction at Long Beach on 20 May 1959)

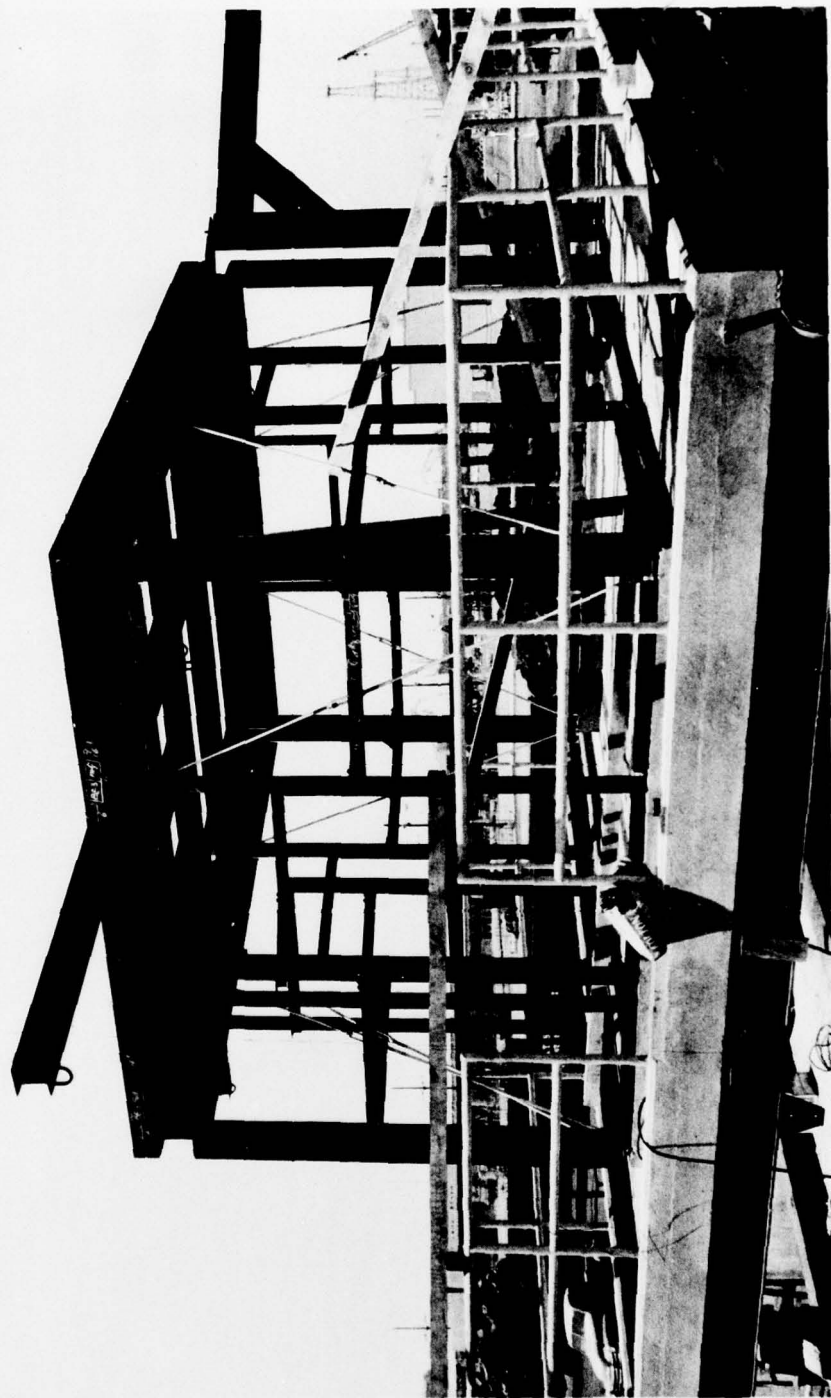


Figure 4. Tower instrument house looking from a southeast aspect.
(Under construction at Long Beach 28 April 1959).



Figure 5. Tower instrument house looking from a southeast aspect.
(Under construction at Long Beach on 20 May 1959).



Figure 6. Tower being transported by large barge and crane.
(11 June 1959)

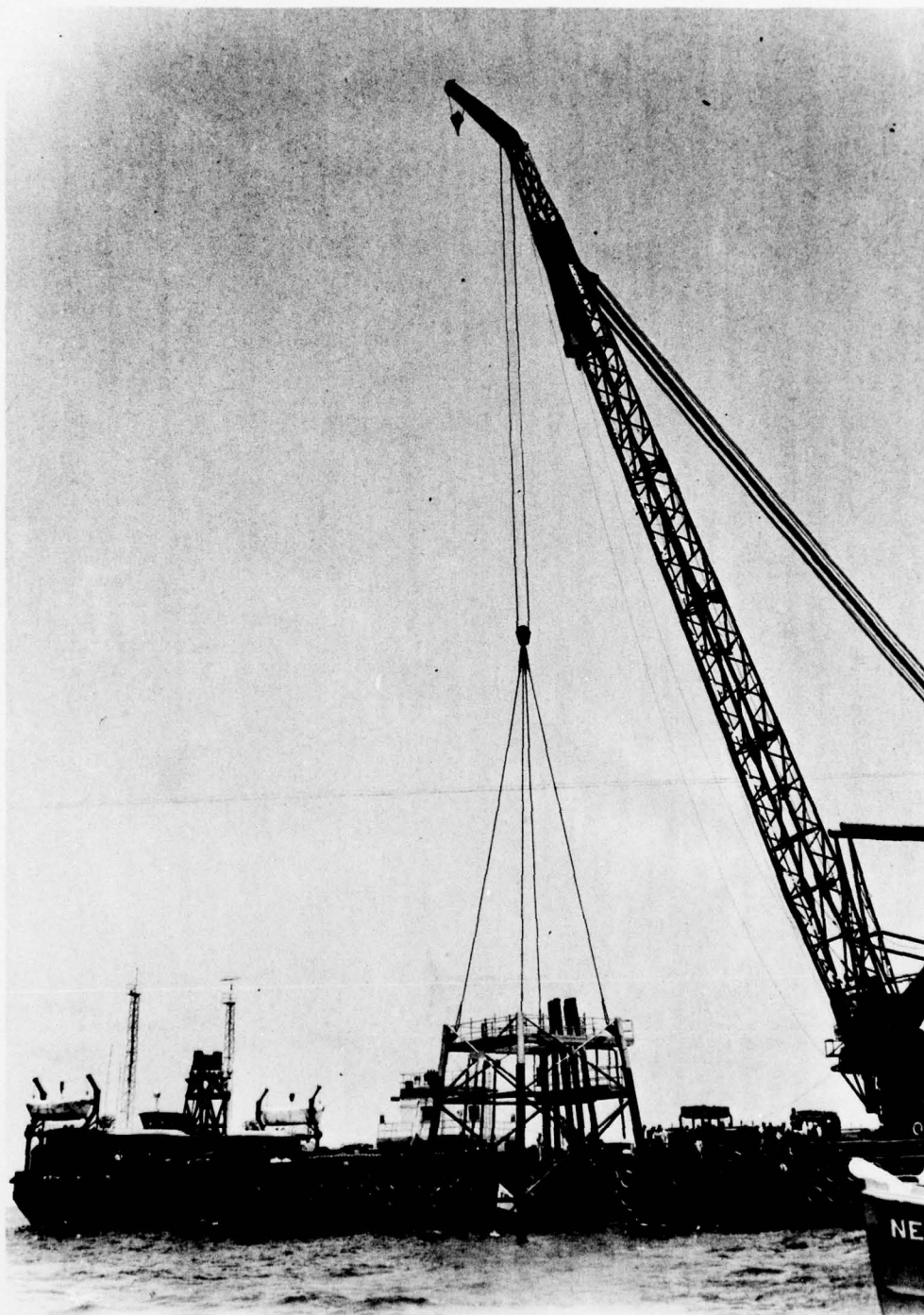


Figure 7. Tower framework being lowered into the sea.
(11 June 1959)

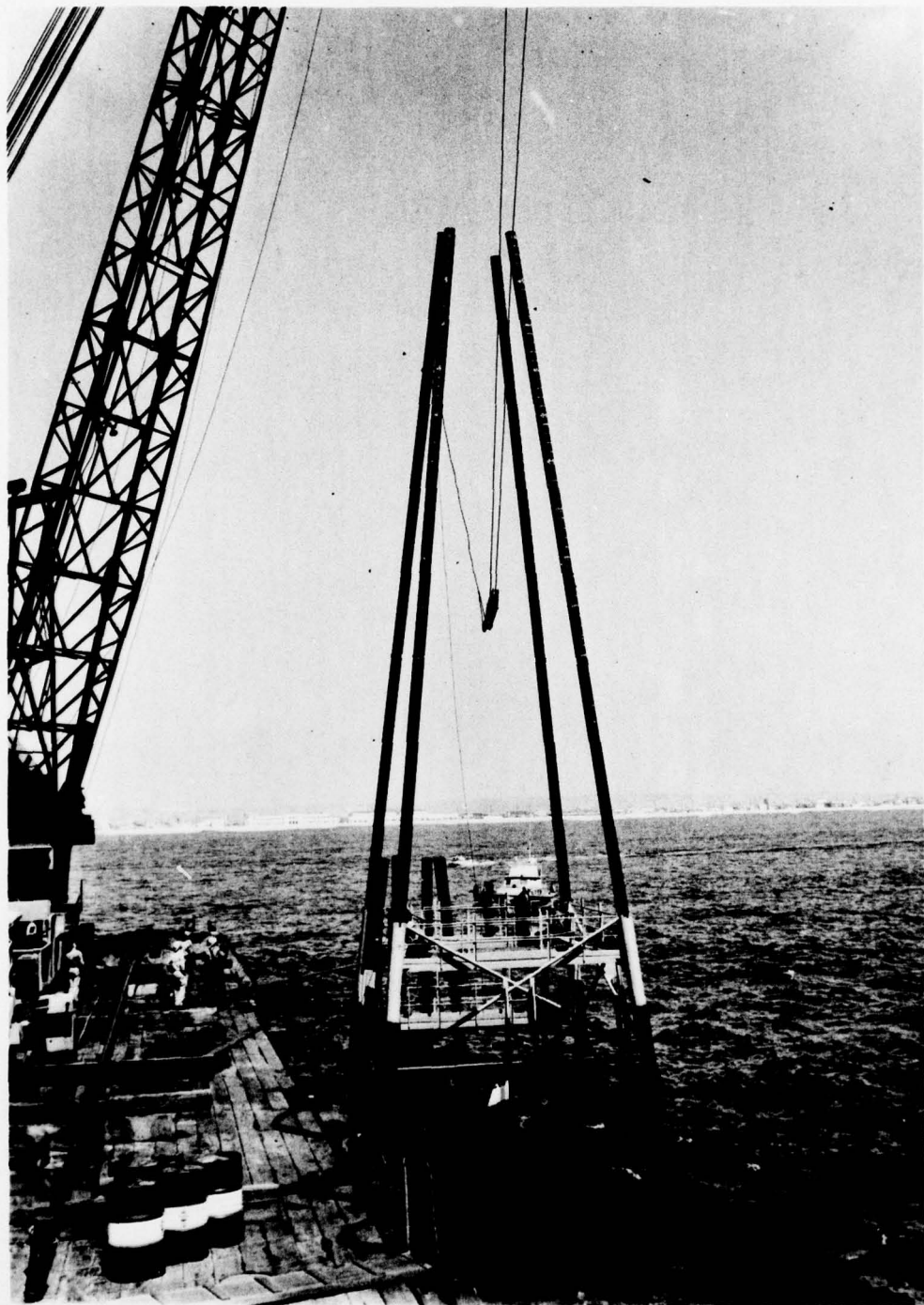


Figure 8. Anchor pins inserted in corner legs prior to being driven 63 feet into sea floor. (11 June 1959)

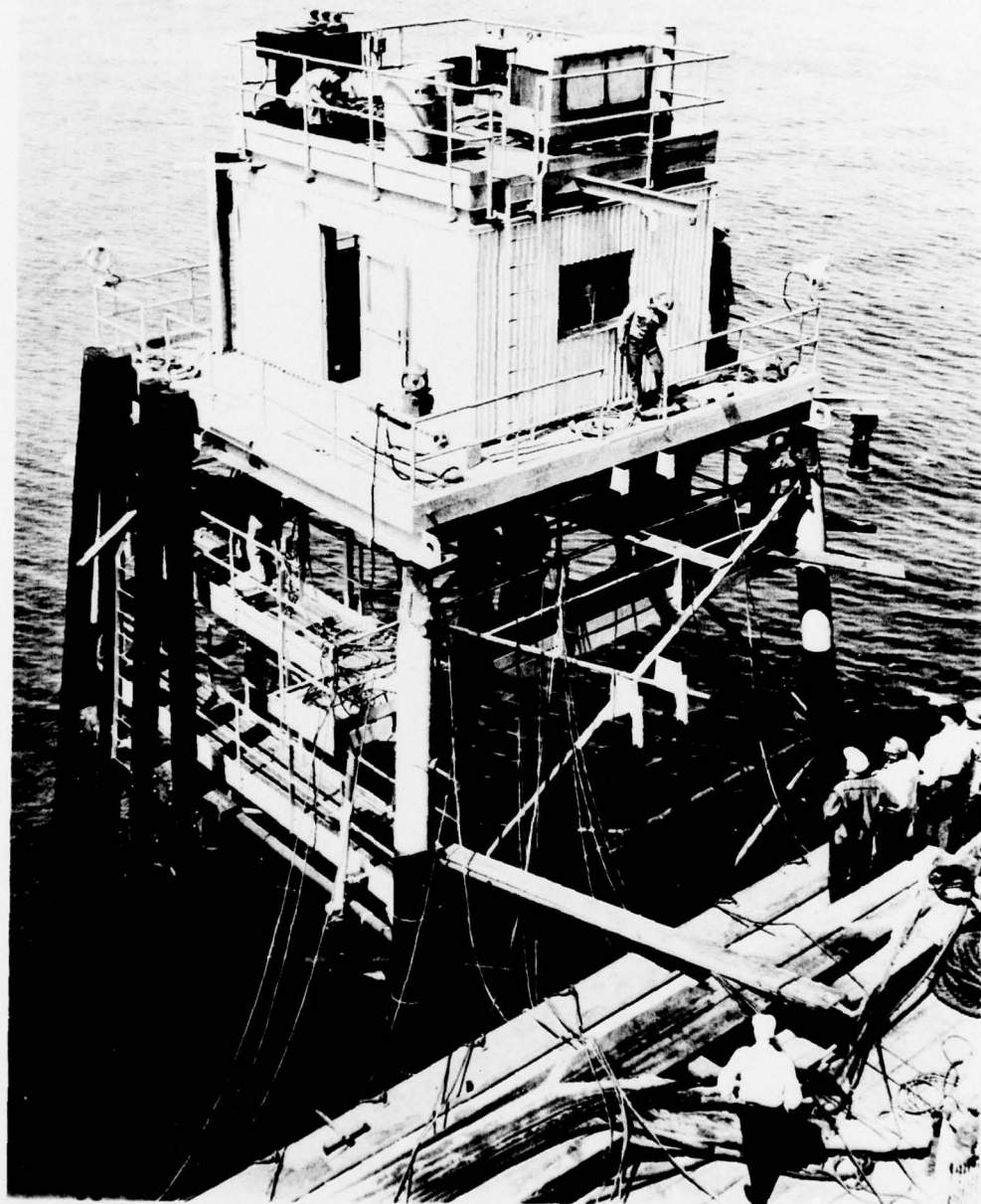


Figure 9. Tower instrument house placed on top of frame work and being welded in place. (12 June 1959)



Figure 10. Final tower installation. (24 June 1959)