UNIVERSITY OF CALIFORNIA, SAN DIEGO
MARINE PHYSICAL LABORATORY
SCRIPPS INSTITUTION OF OCEANOGRAPHY
SAN DIEGO, CALIFORNIA 92152

FLIP

AS A SEAGOING MEASUREMENT PLATFORM

C. B. BISHOP

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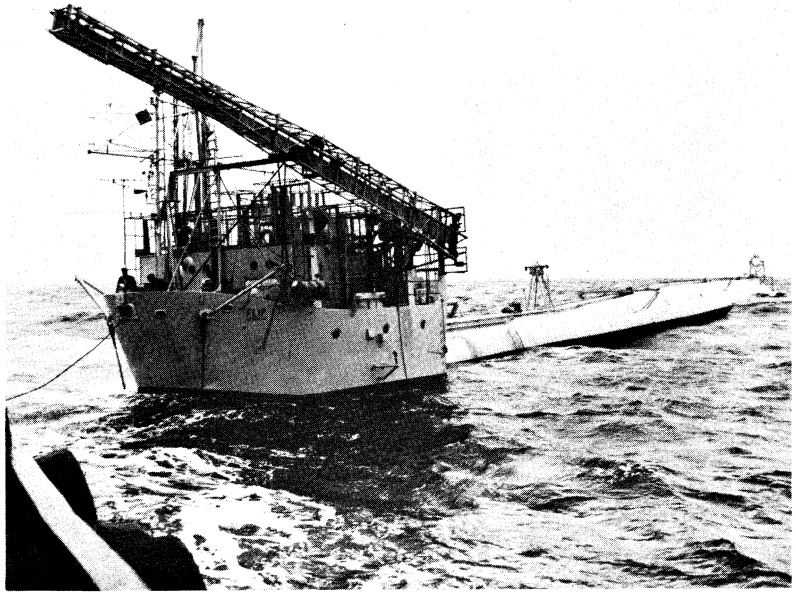

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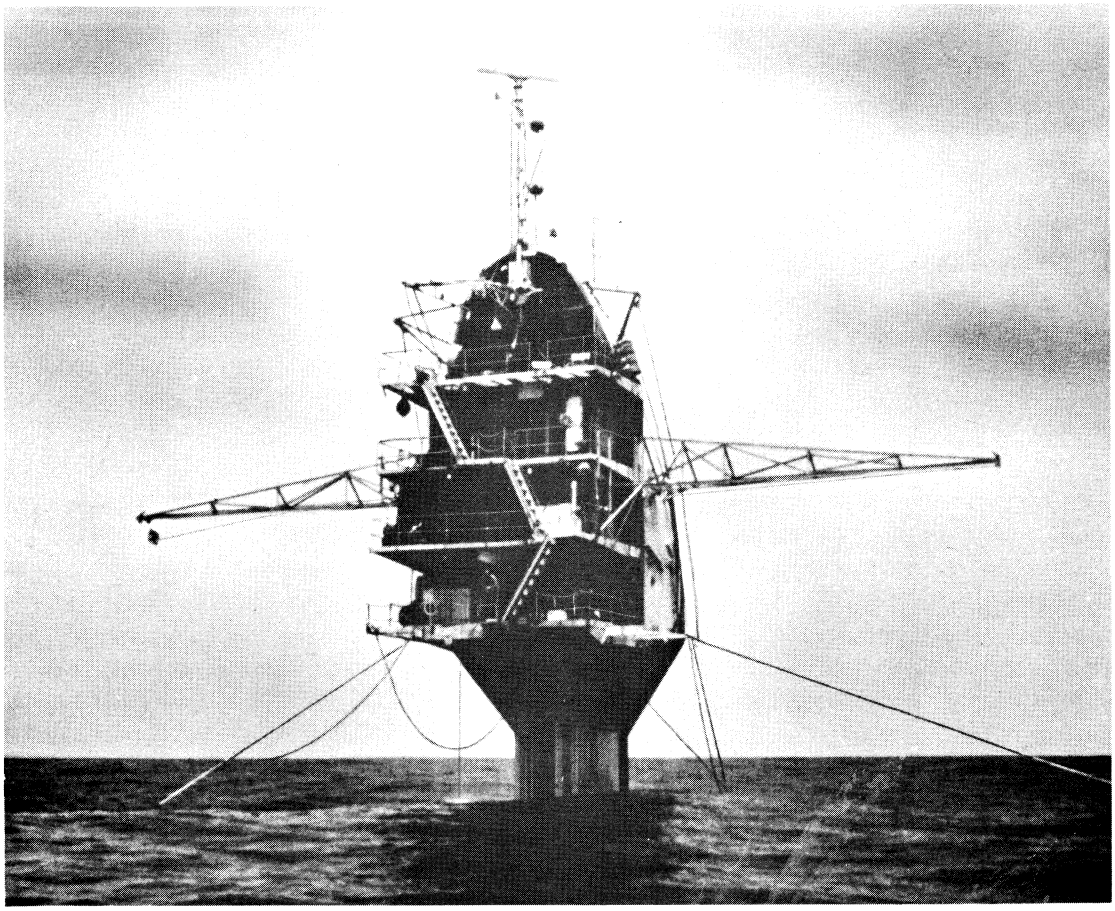

PRINCIPAL DIMENSIONS

Length Overall		355′ - 0″
Hull Diameter, Maximum		20′ - 0″
Hull Diameter, Minimum		12′ - 6″
Breadth, over outriggers		50′ - 0″
Skeg Draft below Bottom of Hull		2′ - 0″
Draft Horizontal Normal	aft	13′ - 8″
	fwd	8′ - 10″
Draft Vertical Normal		300′ - 0″

OPERATIONAL LIGHT SHIP CHARACTERISTICS

Ship in operating condition with average amounts of fuel and water on board.

Displacement	700.0	Long Tons
Transverse Center of Gravity	0.4′	Below Centerline Axis of Hull
Longitudinal Center of Gravity	182.0′	Forward of After End

These values do NOT include any free flooded water but DO include the effect of the solid concrete ballast which is located as follows:

Tank No. 4	87 Long Tons
Space No. 5	15 Long Tons
Tank No. 6	25 Long Tons
Space No. 10	23 Long Tons

TOWING DISPLACEMENT

Approximately 1500 Long Tons

VERTICAL DISPLACEMENT

Approximately 2000 Long Tons

FLIP AS A SEAGOING MEASUREMENT PLATFORM

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Abstract

A description of the characteristics, employment and potential of the Research Platform FLIP. FLIP, i.e., FLoating Instrument Platform, designed as a super-stable open-sea free-floating platform, provides a unique and effective facility for research in the field of physical oceanography - primarily underwater acoustics.

I. PURPOSE

The purpose of this report is to provide potential users of the Research Platform FLIP with information to assist them in the formulation of initial plans for its use. As plans develop, arrangements can be made to obtain more detailed information from the Officer-in-Charge FLIP and from appropriate members of the Marine Physical Laboratory staff.

II. PAST OPERATIONS

FLIP was built as a platform to support the investigations of acoustic fluctuations conducted by the Marine Physical Laboratory. In addition to this research, a number of other programs have taken advantage of its unique characteristics. The studies include:

acoustic propagation	hull arrays vertical array	F. H. Fisher G. B. Morris
ambient noise	vertical array DIMUS array	G. B. Morris V. C. Anderson
storm generated waves	various sensors	W. H. Munk
seismic anisotropy	acoustic receivers	R. Raitt G. Shor
sea surface radar backscatter	radar	Lincoln Lab
sea surface acoustic backscatter	hull arrays	S. McConnell APL/UW
near surface temperature profiling	hull thermisters	J. Northrop F. H. Fisher

internal waves - temperature profiling	thermister lines	R. L. Zalkan R. Pinkel
internal waves - acoustic layers	HF sonar	R. Pinkel
biological scattering	HF sonar	R. Pinkel P. Greenblatt
high resolution bottom profiling, acoustic layering	HF sonar	F. H. Fisher
scatterer distributions	horizontal array	G. T. Kaye
air-sea interaction	various sensors	R. Davis, C. Gibson C. Friehe
sonobuoy tests		T. Stixrud, NOSC

In addition, FLIP has operated as a sonar training platform for Navy ships and aircraft, by using its hull as an acoustic reflector and by radiating signals from a suspended transducer. (Reference 1) It has also demonstrated low self-noise, and capability for measuring acoustic noise radiated from a Navy surface ship. (Reference 2)

FLIP has spent some 1000 days at sea and has completed the transition from horizontal to vertical and return more than 200 times.

Although designed with an endurance capability of two weeks at sea, an operation of 45 days duration was scheduled and completed in late 1963. During this operation in the North Pacific 1800 miles from San Diego, FLIP was vertical for 27 consecutive days. Stores, fuel and water were transferred by highline once during this period. Ten men subsisted on board with relative comfort during the entire operation. Towing time to station was 10 days, the return trip 8 days.

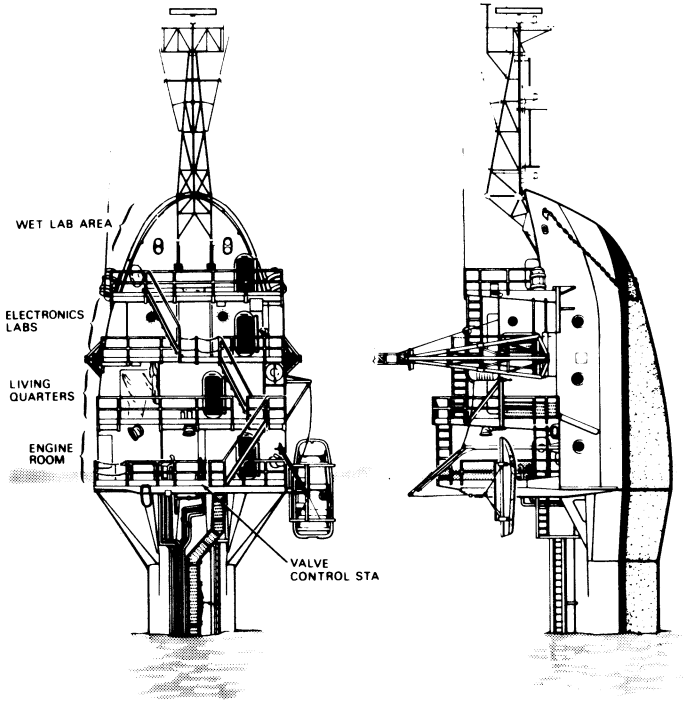
While on station, gale force winds and seas were practically continuous and offered ample opportunity to evaluate FLIP's capabilities. Maximum vertical oscillation was measured at less than 1/10 wave height. Seas to 35' were encountered during this period. Since this operation there have been several deployments to Hawaiian waters.

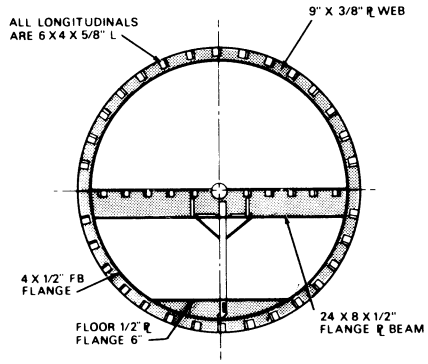
From late March to early August 1969 FLIP operated in the Caribbean as a valuable unit supporting micrometeorological work in the huge BOMEX operation off Barbados and then north to Puerto Rico collecting more data on sonar bearing accuracy.

As operating experience and confidence have been gained, it is no longer considered necessary to keep a vessel in attendance while on station. Tugs have been released for periods of over four weeks when it is desired to keep the local noise level to a minimum and/or reduce expenses.

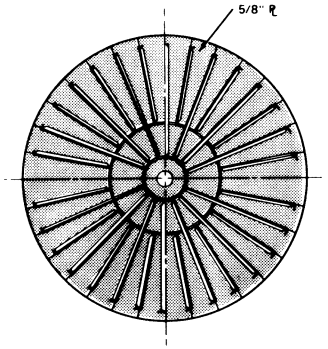
III. GENERAL DESCRIPTION

Figure 1 shows the general arrangement and inboard profile of FLIP in the horizontal towing position, and to a larger scale, two views of the upper portion of the platform in the vertical or operating position, FLIP is essentially a long, slender tubular hull 20 feet in diameter for almost half its length from the stern, and tapering to a cylinder 12-1/2 feet in diameter as the bow is approached. The bow, itself, of a full, deep spoon type, is unconventional principally in the fact that it terminates abruptly at the point where it joins the cylindrical hull some 40 feet from the forward end. Length overall is 355 feet. FLIP is designed to tow in a horizontal attitude ballasted with water so as to float at approximately half-diameter with a draft of about 10 feet. Arriving at the scene of a research operation, controlled



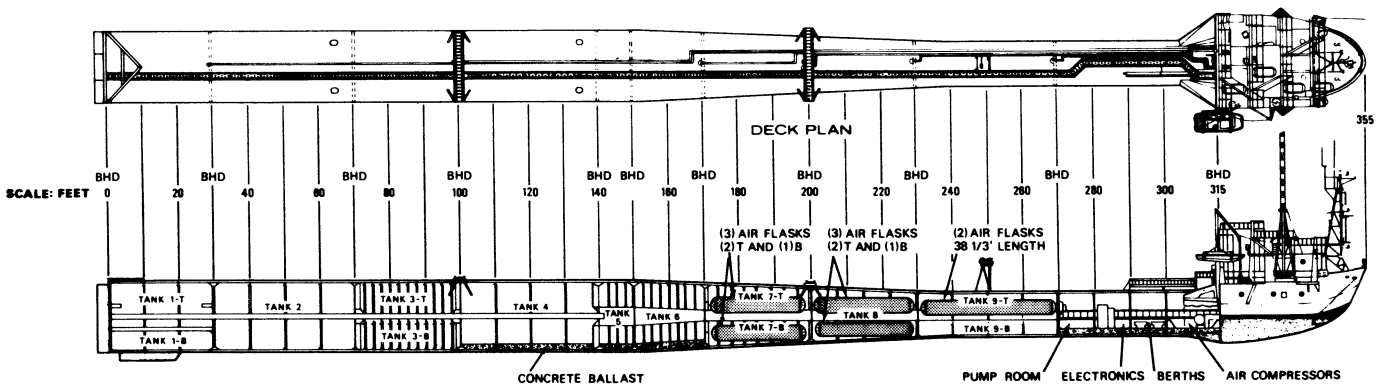


TYPICAL FRAME
FR 80 - LOOKING FWD



TYPICAL BHD
BHD 70 - LOOKING AFT

0 5 10
SCALE: FEET



INBOARD PROFILE

FIGURE 1

flooding of tanks will cause the platform to raise her bow and drop her stern until she floats in a vertical position drawing some 300 feet of water with the bow rising 55 feet into the air. As shown in Figure 1, in this position there are four operating levels in the bow section - a machinery space, living quarters, an electronics space and crews quarters in ascending order. There is a boarding platform at the lowest level and larger, external working and observation platforms at the two upper laboratory levels - the platform at the Engine Room level is also the location of the operating station from which the flipping maneuver is controlled. The spaces in the hull proper are essentially tanks flooded with water or held empty or partially full as necessary to give the desired draft and stability characteristics. The uppermost tank has been converted to space for auxiliary machinery and additional berthing.

Detailed description of the platform and of its operation are contained in reference (3).

IV. CHARACTERISTICS

FLIP can be towed at speeds up to 8 knots, depending on the towship horsepower, and rides comfortably in most sea conditions. The concrete in the keel gives added stability and reduces rolling tendencies.

During transition to the vertical, which takes about 30 minutes, all personnel are outside and share the unique experience of transformation from a horizontal barge to a vertical spar buoy. Detailed discussion of this evolution is contained in reference (4).

Once vertical, the keel faces upwind and the working deck areas are sheltered. The platform becomes quite stable, with motions of only a few degrees experienced even in strong wind and wave conditions. FLIP was designed primarily to have small response to forces producing vertical motion, as shown in Figure 2, and as described in reference (5). This makes it an excellent platform from which to suspend instruments, and the stability of the platform permits highly accurate measurements to be made of the spatial and temporal characteristics of important physical parameters of the ocean.

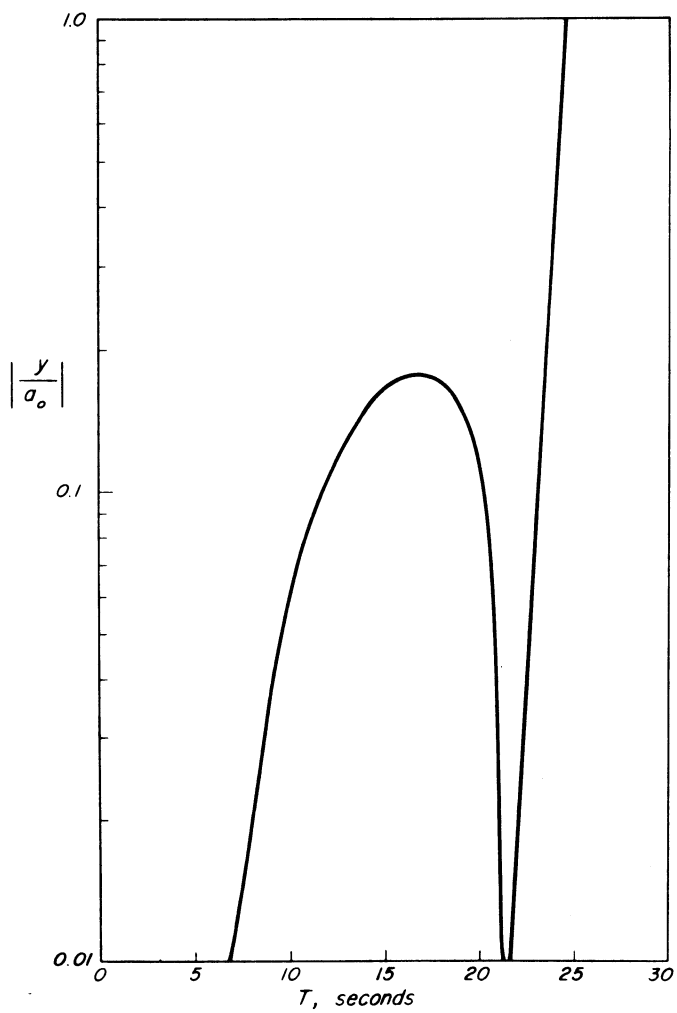


Figure 2. Vertical motion response of FLIP as a function of wave period; y represents the motion of FLIP, and a_o is the wave amplitude at the surface. The resonant period is 27 sec, and a null occurs at about 21.5 sec due to cancellation of the downward forces on the conical section by the upward forces on the bottom of FLIP.

Transducer and hydrophone arrays can be mounted at various locations along the 300' depth of the submerged hull for acoustic studies in the upper levels of the ocean. Similar measurements can be made from sensors mounted on the bottom of FLIP, looking vertically down to the sea floor. Vertical long-line arrays can be lowered from FLIP to position hydrophones at chosen depths throughout the entire water column. These arrays can be deployed and retrieved at will to facilitate changes in experimental setups.

Various measuring devices can be deployed from one or more of the three 60'-75' booms which can be swung out from FLIP's upper deck structure when vertical. These include current sensors, temperature profilers and wave height measurers.

Meterological instruments, radar and optical devices can be mounted topside for sea surface and atmospheric measurements. Antenna height of 85 feet is available using the hydraulically operated mast.

FLIP can be allowed to drift or it can be secured in a three-point moor in depths to 3000 fathoms. In the latter case, it will hold position within a few hundreds of yards. Mooring and unmooring require about 12 hours of daylight each, and the services of a towship with 1000 sq. ft. of deck space to carry the mooring lines and ground tackle.

Commercial tugs are used for towing when Navy fleet tugs are not available.

In the drifting mode, FLIP is an excellent platform for making measurements of the properties of the surrounding water mass, and their fluctuations with time.

In the moored mode, FLIP provides an ideal platform for conducting time-series investigations from a fixed location at sea, including measurements of energy radiated from ships and submarines.

Based in San Diego, the home port of nearly all types of Fleet units, FLIP has all-year, good weather access to deep water with short travel times. MPL can provide fabrication, installation, and checkout support for test equipment.

V. AUXILIARY MACHINERY

A. Diesel Generators

Power to all electrically operated machinery is obtained from two 150 kw, 440 volt, 3-phase, a.c. generators directly driven by Caterpillar Model D334TC diesel engines; engine speed is 1800 rpm. Power is delivered to the switchboard through generator-mounted automatic voltage regulators. Engines are trunnion-mounted for operation in either horizontal or vertical positions, and are mounted on air ride cushions to reduce sound transmission.

A 40 kw, GM 3-53 diesel generator set is mounted on trunnions, adjacent to the main switchboard. This set is used mainly for housekeeping but is capable of maintaining the normal research load as well. When orientation or air compression is required, one of the larger engines must be utilized. Usually the small generator is left on the research circuits in order to maintain finer voltage and frequency control.

B. Compressed Air

The Ingersoll-Rand Model H25M Circular Space Air Compressors are located between frames 300 and 315. These are two-stage air-cooled compressors and are rated for 250 psi, and will automatically shut off at 250 psi. A constant watch is maintained while charging. About 5 hours are required to charge all banks from 100 to 250 psi, using both compressors. These machines are trunnion-mounted for operation in either horizontal or vertical attitudes.

There are 8 air storage flasks in 3 banks which store a little more than 3000 cu.ft. of air at a maximum pressure of 250 psi. No. 1 bank, three bottles, is located in No. 7-T and 7-B ballast tank; No. 2 bank, three bottles, is in No. 8-BT; bank 3, consisting of two larger bottles, is in No. 9-T ballast tank. Air from the bottles in each tank is piped to a common riser which terminates at the control platform. Thus, there are three risers and three cut-in valves at the manifold. They are plainly marked and make it possible to utilize any combination of banks for air service. Each bank may be isolated from the rest by an individual stop valve at the operating manifold. Each bottle has a 3/4" drain plug at the aft end bottom.

A low pressure blower is used to void residual water after returning to the horizontal attitude. This blower is located in tank No. 10 at frame 312 on the partial flat and is piped directly to the high and low pressure manifolds. Blower control is also at the control station.

C. Fresh Water

Fresh water is carried in a 1500 gallon tank, and replenished daily by a 20 gal/hour distiller.

D. Electrical Distribution

The main switchboard is located in the forward port corner of the engineering space. In general, the board is split into two sections, port and starboard. Shore power is on the starboard bus. Each diesel generator supplies its side of the board, and distribution switches are duplicated so that all lights and electrically operated machinery have a source on each side and from any engine. No provision is made for paralleling generators.

Interlocks are provided so that both sources cannot be applied to any circuit simultaneously. Breakers are individually marked. Power to the board is 440 volt, 3-phase, a.c.; from the board 440 volts and through transformers 110 volts for lighting, etc. 220-volt power both single and three-phase is available in the engine room.

An additional 110 volt circuit has been added in order to supply the electronics laboratory with separate power whenever uninterrupted voltage and exact frequency regulation is required beyond the capacity of the small generator. This circuit is fed off the main board through a transformer bank mounted in No. 10 tank under the Engine Room access landing.

E. Laboratories

The upper laboratory, created by the deck house addition, houses ship's Radar, LORAN, radio transceivers, orientation controls, anemometers, fathometer and space for one frame of research instruments (4½' x 2½' x 6'). Entry for instrument cables is located in the horizontal overhead. Communications are provided by either VHF, or HF-SSB transceivers for voice radio and by UQC for underwater telephone.

The main laboratory located adjacent to the upper laboratory when vertical, below when horizontal, provides space for 4 instrument frames. These frames (6' x 2½' x 6') are provided with hold down fittings and electrical outlets at each location, and accommodate 3 standard relay racks side-by-side.

Normally, racks are instrumented in the shoreside laboratories, shop tested, and loaded on board FLIP thru the large hatches provided in the horizontal overhead of the labs while the platform is horizontal.

F. Orientation

A hydraulically operated orientation system has been installed in order to maintain headings in the vertical position. This system consists of two separate hydraulic units each operated by 20 hp motors driving A-end pumps which in turn drive B-ends directly shafted to propellers which are mounted on the hull at the 100-foot elevation.

The motors and A-ends are mounted in the pump room and are controlled by switches and valves on a control stand located in the electronics laboratory adjacent the entrance.

An additional component for this system is the MK 18 gyro-compass mounted on gimbals in tank 10. This compass drives two repeaters, one located at the orientation control platform for use in either H or V position. A third repeater is located in the automatic control system, which provides either manual or automatic orientation.

VI. HABITABILITY

The space between frames 313-1/2 and 331-2/3 is divided into four compartments and fitted out as (1) galley and messing, (2) wardroom, (3) berthing and (4) head.

In the horizontal position the four compartments are two over two. In the vertical position the four become adjacent rooms on one level.

1. The galley includes a deep freeze, refrigerator, four element range, oven, and sink. Working areas are adjacent to the deep freeze and range. All the above is trunnion-mounted in one large frame so that all units are usable in either position.

A system of plywood shelves and cabinets have been attached near the freezer, range and sink so that they too are always upright and usable. A mess table and folding chairs are provided for seating five. These must be folded and stored during flipping operations.

2. The wardroom, directly under the galley in the horizontal position but becoming adjacent when vertical, consists of a two-position transom, a table capable of seating five, and book and magazine racks. The table and chairs are folded and stored for flipping but the transom is rigged so that the seat becomes the back and vice versa for the two operating positions. Lockers for provision storage are located behind and under the transom cushions.

3. The berthing compartment is adjacent the wardroom and contains four trunnion-mounted bunks along with lockers for occupants, linen lockers and ventilation fans. Access from the bunk room to the head and wardroom is provided in the vertical position but only to the wardroom while horizontal.

Berthing facilities for crew and junior scientific personnel are located in the crew's quarters forward and in a portion of the tank 10 conversion, and for the ship's officers in a cabin which contains two bunks, a shower (horizontal) and head.

4. The washroom and head is located over the starboard end of the berthing compartment in the horizontal position, adjacent when vertical. There are two wash basins - one for vertical, one for horizontal located at 90° angles, a shower usable only in the vertical position, the hot water heater which operates in either position, the medical locker, the water closet on telecoping standards and attached to a swivel-jointed drainpipe, plus other minor items.

5. Access to all these compartments is by "L" shaped doors or in the horizontal position by ladders. Food storage lockers built along the outboard bulkheads are fitted with small compartments to prevent spilling of contents.

In addition a large, trunnion-mounted refrigerator is installed topside on the weather deck. Additional bulk dry storage is located adjacent the engine room in tank No. 10.

6. A 7½ ton chilled water air conditioning unit has been installed in the pump room. This is a closed system which supplies chilled water to evaporators in all compartments except the engine and Air Compressor rooms. Each compartment has its own thermostat for individual temperature control.

The entire hull from frame 270 forward has been insulated to enhance performance of the air conditioning system.

VII. ARRANGEMENTS

FLIP is a U.S. Navy owned seagoing research platform which is operated by the Marine Physical Laboratory of the Scripps Institution of Oceanography, University of California, San Diego, primarily in support of research funded by the Office of Naval Research. It is manned and maintained by the SIO Marine Superintendent, and scheduled by the Director of the Marine Physical Laboratory.

With berthing available for 10 scientific party personnel, different research groups are able to conduct experiments on FLIP on the same cruise when their experimental procedures are compatible for simultaneous or time-sharing operations. This capability can result in reduced costs for individual projects.

Arrangements for its use can be made by contacting:

Mr. Charles B. Bishop
Assistant Director
Marine Physical Laboratory
Scripps Institution of Oceanography
University of California, San Diego
San Diego, California 92152

Telephone: (714) 452-2303 or Autovon 933-7176

REFERENCES

(1) C. B. Bishop and F. H. Fisher, FLIP Aids Fleet Training, Naval Research Reviews, May 1975.

(2) C. B. Bishop and G. B. Morris, FLIP as a Platform for Measuring Radiated Noise of Surface Ships (U), Marine Physical Laboratory Technical Memorandum 286, 18 January 1977 (MPL-U-6/77).

(3) E. D. Bronson and L. R. Glosten, FLIP - FLoating Instrument Platform, SIO Reference 73-30, 15 November 1973.

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