

## TECHNICAL SPECIFICATIONS

### FOR THE GULF STREAM DRIFT MISSION

with THE MANNED SUBMERSIBLE "BEN FRANKLIN"

Operation No. 919047

#### I. INTRODUCTION

1.1 SCOPE - These specifications contain the technical requirements and objectives for an underway drift mission to be performed with the Grumman Aircraft Engineering, Corporation's manned submersible BEN FRANKLIN. The mission is divided into three (3) phases: Phase I consists of a mission rehearsal off West Palm Beach, Florida (5-15 May 1969); Phase II consists of drifting submerged 30 days in the Gulf Stream (2 June-2 July); and, Phase III will consist of towing BEN FRANKLIN back to West Palm Beach (approximately 5-10 July 1969).

1.2 LOCALE OF SURVEY - Operations during Phase I (drift rehearsal) will be conducted in an area due east of West Palm Beach, Florida within the Gulf stream in water depth not greater than 2000 feet (Figure 1). Phase II will commence at latitude 26°42'N; longitude 79°44'W; water depth 1350 ft. The vehicle will dive to the bottom and then cruise in the Gulf Stream for 30 days; termination is anticipated to be somewhere northeast of Cape Hatteras. Following the drift mission, the submersible will be towed to the nearest port, possibly New York City, and personnel and equipment will be offloaded. Phase III will consist of towing the submersible back to West Palm Beach from the point of drift mission termination.

1.3 BACKGROUND - The U.S. Naval Oceanographic Office (NAVOCEANO) has established a fixed price research and development contract (N62306-69-C-0025) with the Grumman Aircraft Engineering Corporation (GAEC) to conduct a Gulf Stream Drift Mission. Grumman will supply the submersible for 10 and 30 days for the phases I and II, respectively. NAVOCEANO will supply two scientists and oceanographic instrumentation to ride in the vehicle and a support ship to accompany and track the submersible. Twice-weekly overflights of the ASWEP's aircraft are also scheduled in order to ascertain the location of the submersible in relation to the Gulf Stream boundaries. These specifications explain the details and execution of this mission.

#### II. U.S. NAVAL OCEANOGRAPHIC OFFICE PARTICIPATION

2.1 PERSONNEL - The following NAVOCEANO technical personnel will participate in this mission:

PX-15 Personnel -	Roswell F. Busby	Oceanographer	GS-14
BEN FRANKLIN	Kenneth R. Haigh	British Exchange Scientist	

PX-15 Alternates -	Michael Costin	Oceanographer	GS-11
BEN FRANKLIN	Roger Merrifield	Oceanographer	GS-12
Support Ship Personnel -	Roger Merrifield	Oceanographer	GS-12
PRIVATEER	Joseph Pollio	Oceanographer	GS-12
	Michael Costin	Oceanographer	GS-11
	Peter Bockman	Oceanographer	GS-11
	Larry K. Hawkins	Oceanographer	GS-11
	L. Freeman	Phy. Sci. Tech.	GS-9
	Martin Fagot	Elec. Eng.	GS-11
	Roger Delort	Elec. Tech.	GS-8
	Robert Oser	Oceanographer	GS-12

Rehearsal only

2.2 EQUIPMENT - The following NAVOCEANO equipment will be shipped to West Palm Beach, Florida for loading and installation aboard BEN FRANKLIN and the chartered support ship.

- Water Sensor Pod
- Volume Reverberation System
- Acoustic Bottom Loss System
- Ambient Noise System
- Current Meter System
- Current Meter
- Transmissometer
- Ambient Light Measurement System
- Gravimeter
- Magnetometer
- 35mm Camera System (2 cameras; 2 strobes; control box; film)
- 70mm Camera; strobe w/film
- Side Scanning Sonar
- Sub-Bottom Profiler
- Single Side Band Radio
- Amphenol Citizen Band Radios (3)
- SCUBA Diving Tanks (4 doubles - 4 singles)
- Tape Recorder (UHER)
- 70mm Still Camera w/film
- 16mm Movie Camera w/film

### III. CERTIFICATION

3.1 APPROVAL TO USE BEN FRANKLIN - In accordance with policy, permission to use BEN FRANKLIN has been obtained from the Assistant Secretary of the Navy (R&D); a copy of this approval is attached.

3.2 MATERIAL ADEQUACY - BEN FRANKLIN is now undergoing certification for material adequacy at NAVSHIPS. Correspondance is attached which documents these efforts. Certification is expected by 5 May 1969.

3.3 PILOT COMPETENCY - Following the procedures of OPNAVINST. 9290.3, the attached letter has been sent to GAEC requesting the particulars of their training programs and requirements. Certification is expected by 5 May 1969.

3.4 OPERATIONAL SAFETY - The aspects of operational safety will be satisfied through area clearances obtained by NAVOCEANO Code 018 (OPNAVINST. 9290.3).

#### IV. TECHNICAL PROCEDURES

4.1 EVENTS LOCATION AND SCHEDULE - The dates of various events and the personnel scheduling is presented in Table 1 and the areas of operation shown in Figure 1. These dates are tentative and are wholly dependent upon the submersible's satisfactory completion of sea trials. Personnel scheduling is also tentatively dependent upon instrumentation performance as well as submersible performance. The location of the submersible at the end of 30 days is extremely difficult to predict. It appears, however, that the minimum distance would be to a point slightly northeast of Cape Hatteras. If a 1 knot speed can be maintained throughout the 30 days of drift, the termination point will be approximately 673 miles from the starting point off West Palm Beach.

4.2 SUPPORT SHIP - The support ship will be a chartered vessel from which the submersible will be continuously tracked during Phases I and II of the drift mission. The support ship will also serve as the towing platform and communications center prior to, during, and after the mission. Oral communications with the submersible will be maintained by the support ship which will also conduct certain work in conjunction with the submersible. All ship-to-shore communications (described in 4.3) will be conducted from the support ship. In operation, the ship will stay in constant tracking range of the submersible; ideally, directly above it when safety allows. When surfacing is required the ship will see that the area is clear of ship traffic. A dinghy and a rubber raft will be carried aboard the support ship and will be used to carry personnel, stores and equipment between it and the submersible. The details of the support ship's role and its specification are contained in the attached enclosure. Operations during rehearsal are as tabulated in Table 2.

#### 4.3 NAVIGATION

Surface - The support ship's geographic position will be plotted continuously from fixes obtained by LORAN-C. The ship's position relative to the Gulf Stream boundaries will be obtained from the ASWEPS aircraft which will also recommend a course to keep the submersible within the center of the stream.

Subsurface - The submersible will be continuously tracked from the surface and its position plotted. To obtain the submersible's bearing relative to the ship a 4 kHz pinger will be used, which will emit pulses a maximum of every two (2) seconds which are received on the support ship by a baffled hydrophone. The operation of this pinger is controlled by the submersible crew and it will be secured

during acoustic tests. The transponder is controlled by actuation from top-side and is not operated by the submersible crew. Both pinger and transponder have their own battery packs. Another method of tracking the submersible is through its underwater telephone which can, if required, be keyed to provide range and/or bearing. These systems are shown graphically in Figure 2.

4.4 AIRCRAFT SUPPORT - Utilizing its ART (Airborne Radiation Thermometer) to establish the Gulf Stream's boundaries, the aircraft will determine the support ship's position within the stream. This information will be transferred to the support ship confines by radio at-sea. This assistance shall be provided every three days during the cruise, commencing on the first day.

#### 4.5 COMMUNICATIONS

Ship-to-sub - Oral communications with the submersible when submerged shall be maintained on a Straza Model ATM-503 underwater telephone (UQC). Communications with the vehicle shall be conducted with the submersible every 4 hours. In the event the UQC fails completely, a backup system will be used consisting of mechanically keying a 12 kHz transducer to transmit to the surface. The support ship will mechanically key its 12 kHz sounding transducer to respond to the submersible.

On the surface, the submersible will communicate with the ship via an HF transceiver - Simpson Model 150A, 150 watt, and, for backup, a citizen band Amphenol radio (5 miles range). (Figure 3)

Ship-to-Shore - Shore communications will be maintained through a single side band transceiver aboard the support ship. Calls (SITREPS) will be made to NAVOCEANO on a daily (24 hr.) basis. A backup radio system will be provided through an appropriate Marine Operator from the support ship.

Ship-to-Aircraft - Communication with the ASWEPS aircraft will be maintained through the single side band transceiver on frequencies: 7835, 7500 and 11535 kHz. Dye tracers will be introduced by the support ship for photography, and visual observation of this dye from the aircraft will augment its support potential to BEN FRANKLIN.

#### 4.6 SUBMERSIBLE OPERATIONS (GENERAL)

The entire submersible scientific program during the drift mission is governed by the amount of electrical power required to maneuver the submersible into the core of the stream, and by the amount of air required to blow ballast to ascend from 2000 feet to the near-surface (600 ft.) In the first instance a projected 2 hour of main propulsion is budgeted daily. In the latter instance a total of six (6) complete ascents and descents to 2000 feet are possible on one air charge. During the rehearsal mission, attempts will be made to establish techniques for recharging batteries and air tanks in order to extend the

usefulness of the vehicle for scientific work. Under the present ground rules of power, and air supply, the cruising plan shown on Figure 4 will be followed. When the vehicle is not cruising 20 to 30 feet above the bottom, it will be at 600 feet depth.

#### 4.6.1 EQUIPMENT MOUNTING

All NAVOCEANO equipment will be mounted on BEN FRANKLIN as shown in Figure 5.

#### 4.6.2 MEASUREMENTS SCHEDULE

Data will be collected on the following schedules: continuously, periodically, and aperiodically throughout the mission.

<u>Continuous</u>	<u>Periodic</u>	<u>Aperiodic</u>
water sensor pod	ambient light	side scan sonar
gravimeter	light transmission	sub-bottom profiler
magnetometer	current meter	photography
	ambient noise	stereo-photography
		volume reverberation
		bottom reflection
		visual observations

The employment of oceanographic instruments is shown in Figure 6. The duration of employment will depend upon the amount of electrical power required to keep BEN FRANKLIN in the Stream's core.

#### 4.6.3 RESEARCH SHIP'S MEASUREMENTS

Between 2 to 14 June and 18 June to 2 July, a research ship is scheduled to accompany the support ship and BEN FRANKLIN. The ship's role will be to conduct measurements in conjunction with the submersible that would be infeasible from the support ship. Additionally, GAEC personnel on board the ship are planning to conduct various laboratory analyses on skin swabs, urine samples, etc. of personnel aboard BEN FRANKLIN. The ship will return to the most convenient port for four (4) days after 12 days at sea to change scientific personnel. The details of the ship's operation are described under separate specifications.

#### 4.7 SCIENTIFIC INSTRUMENT ABORT CRITERIA

In addition to safe operation of the submersible itself, failure of certain instruments and systems both common to and separate from the boat's operation are cause to abort the mission and effect repairs. The scientific abort criteria are presented in Table 3. It is pointed out that if communications and/or tracking instruments fail at any time for longer than four (4) hours the submersible is required to surface.

5. DATA CONTROL

All scientific data collected on this mission will be retained by NAVOCEANO personnel and hand-carried to NAVOCEANO for reduction. A copy of the unclassified data will be made available to GAEC following reduction.

From: Commander, Naval Oceanographic Office  
To : Assistant Secretary of the Navy (Research & Development)  
Via : Oceanographer of the Navy

Subj: Utilization of the Grumman Aircraft Corporation's  
Deep Research Vehicle PX-15

Ref : (a) ASN (R&D) Memo of 14 Dec 1965

1. In accordance with reference (a) all leasing of Deep Research Vehicles by U.S. Naval Activities must be approved by the Assistant Secretary of the Navy (Research and Development).
2. Accordingly, it is requested that approval for the Naval Oceanographic Office to participate in a Gulf Stream Drift Mission on the Deep Research Vehicle PX-15 be granted for a forty five (45) day period within the first half of FY-69.
3. PX-15 will serve as an undersea platform from which oceanographic measurements and observations will be conducted during the submerged drift in the Gulf Stream from Miami, Florida, to a point south of Halifax, Nova Scotia.
4. NAVOCEANO is not leasing PX-15 from Grumman Corporation, but will provide a support ship, instrumentation and services in support of the mission. In return, two NAVOCEANO observers will ride the vehicle for the mission duration and the scientific portion of the operation will be at NAVOCEANO's direction and the resulting data under its control.

N616/ssn  
Ser 1302  
22 NOV 1967

FIRST ENDORSEMENT ON COMNAVOCEANO ltr Code 9120 ser: 8081 of 9 Nov 1967

From: Oceanographer of the Navy  
To: Assistant Secretary of the Navy (Research and Development)  
Via: Chief of Naval Operations

Subj: Utilization of Grumman Aircraft Corporation's Deep Research Vehicle PX-15

Ref: (a) OPNAV INST 9290.2  
(b) NAVOCEANO ltr ser 8078 of 20 Oct 1967 (NOTAL)

1. Readdressed, in accordance with reference (a). Forwarded recommending approval. The proposed support by NAVOCEANO of the Gulf Stream Drift Mission (accepted by Grumman) is attached as Tab A for information.
2. Material certification for the PX-15 was requested by reference (b).



JAMES E. AMES  
By direction

Copy to:  
CNM (0327)  
COMNAVOCEANO

ASX(R&D) Control No. 2192-

OP-31 CONTROL

NO. 1634-67

36409



OP-311/rg  
Ser 235P31

1 020 157

SECOND ENDORSEMENT ON COMNAVOCEANO ltr Code 9120 ser 8081  
of 9 Nov 1967

From: Chief of Naval Operations  
To: Assistant Secretary of the Navy (Research and  
Development)  
Subj: Utilization of Grumman Aircraft Corporation's  
Deep Research Vehicle PX-15 (U)

1. Forwarded recommending approval of Naval Oceanographic  
Office participation in a Gulf Stream Drift Mission on the  
Deep Research Vehicle PX-15 as requested in the basic letter.

*P. A. Beshany*  
P. A. BESHANY

By direction

Copy to:  
CNM (0327)  
OCEANAV  
COMNAVOCEANO

3930

8 JAN 1968

THIRD ENDORSEMENT on COMNAVOCEANO ltr Code 9120 ser 8081  
of 9 Nov 1967 3930

From: Assistant Secretary of the Navy (Research and  
Development)

To: Commander, Naval Oceanographic Office

CNO-931

Subj: Utilization of Grumman Aircraft Corporation's  
Deep Research Vehicle PX-15 (U)

✓ Oceanographic of the Navy

1. Participation by the Naval Oceanographic Office in the  
Gulf Stream Drift Mission on the Deep Research Vehicle  
PX-15 is approved subject to the PX-15 completing material  
certification.

ROBERT A. FROBEN  
*[Signature]*

Copy to:  
CNO (Op-31)  
CNM (0327)  
OCEANAV



DEPARTMENT OF THE NAVY  
HEADQUARTERS NAVAL MATERIAL COMMAND  
WASHINGTON, D. C. 20360

9240  
IN REPLY REFER TO  
MAT 0327:DUB  
3 NOV 1967

From: Chief of Naval Material  
To: Commander, Naval Ship Systems Command

Subj: Material Certification of the Gruman Aircraft Corporation's "FX-15"

Ref: (a) COMNAV 0327:DUB ltr of 26 Oct 67

Encl: (1) COMNAVOCEANO ltr code 0110-24, Ser 8073 of 20 Oct 67 9-90.

1. Commander, Naval Ship Systems Command is directed to initiate procedures for material certification of "FX-15" as requested in paragraph (3) of enclosure (1).
2. The submersible "FX-15" will be included in the revised priority list of non-combatant submersibles requiring certification procedures. This revised list will be promulgated after receipt of user activity responses to reference (a).

Copy to:  
NAVOCEANO

SAM P. GANTZ  
By direction

Code 9120-hi  
Ser 8078

From: Commander, Naval Oceanographic Office  
To : Chief of Naval Materials

Subj: Material Certification of the Grumman Aircraft Corporation's "PX-15"

Ref : (a) SECNAVINST 9290.1 (NOTAL)

1. By reference (a) material certification is requested for non-government owned submersibles to be used by the Navy Department.
2. The Naval Oceanographic Office plans to use Grumman Aircraft Corporation's "PX-15" for approximately 45 days commencing on or about 15 July 1968. NAVOCEANO personnel will participate as scientific observers aboard "PX-15" during the tenure of the operation.
3. It is therefore requested that the procedures for material certification of "PX-15" be initiated to meet the 15 July 1968 operation commencement date.

Copy to: MAT (Code 0327)

Prepared by R.F. Busby, Code 9120, ext. 83793. Typed by H. Hayden  
21 Sept 1967 - R.S.-none

*Grumman Address  
Bethpage, Long Island, New York  
Mr. Ellis A. Egan, Dept 11714  
Ocean Systems Division Director  
Grumman Aircraft Engineering Co*

Code 9120-01  
Ser 3312

Mr. Walter Muench  
Grumman Aircraft Engineering Corporation  
Box 9756  
Miami Beach, Florida 33104

Dear Mr. Muench:

In order to comply with all certification requirements for our forthcoming  
HW FRANKLIN operation, it is necessary that the competence and physical  
fitness of submersible operators be certified. This requirement origi-  
nates from OPNAVINST 9290.3, a copy of which is enclosed.

The information we require to comply with this instruction is:

- a. Physical qualification requirements for operators as prescribed  
by your organization.
- b. A statement of physical examination and certification by a medical  
doctor of your operator's physical fitness in accordance with the require-  
ments.
- c. Training and experience requirements for operators as set forth by  
your organization.
- d. For each proposed operator (to be obtained from his employer):
  - (1) A resume of background and general experience in this field.
  - (2) An operator's qualification notebook, if required by your  
company.
  - (3) An operator's diving log, if required by your company.

It is requested that this information be assembled and forwarded directly  
to Mr. R.T. Busby, Code 9120, U.S. Naval Oceanographic Office,  
Washington, D.C. 20390.

Encl:

(1) OPNAVINST 9290.3

Prepared by R.T. Busby, Code 9120, 33359, Typed by E. Burt  
5 March 1959 - R.S. & NONE.

BEN FRANKLIN SUPPORT SHIP  
STATEMENT OF WORK

The chartered ship will be used as a surface support ship, towing platform, communications/command center prior to, during and after the Gulf Stream drift mission of the manned submersible BEN FRANKLIN.

The charter will consist of three phases. The first phase will be a 12 day period prior to the drift mission during which a rehearsal of the mission will be conducted off West Palm Beach, Florida. The second phase will consist of the actual drift mission and will be a maximum of 36 days during which the support craft will tow BEN FRANKLIN to its starting point off West Palm Beach and then track and communicate with the submersible during its projected 4 week submergence and drift in the Gulf Stream. Phase two will be completed when the submersible has surfaced and the support ship tows her to the nearest designated port facility, probably New York City. Phase three will consist of a minimum of 10 days during which the support ship will tow BEN FRANKLIN from its termination point back to West Palm Beach where the charter will terminate. A NAVOCEANO representative will be aboard at all times and will direct the ship's support and scientific efforts concerning all matters not pertaining to the ship's safety or its actual operation schedule.

DUTIES

During all phases of this operation the support ship will be required to carry sufficient crew to perform all routine underway ship-board duties for 24 hours each day during the tenure of each phase.

Crewing will also be necessary to perform the special duties of towing, when required, and continuously tracking the submersible during its submerged periods. The support ship may also be required to transfer small goods and personnel to and from the submersible via its rubber raft or small boat. Transfer may also be required between the support ship and another ship which will accompany BEN FRANKLIN during the 28 day drift mission.

TRACKING

During any period of BEN FRANKLIN's submergence the support ship, when directed, will attempt to stay directly over the submersible or at a distance not jeopardizing safe surfacing of the vehicle. Continuous manning of the submersible tracking system on the support ship is required during the entire tenure of submergence. When the vehicle is preparing to surface the support ship will be required to clear the area of any surface traffic that may hinder the vehicle's safe surfacing. It is likely that the support ship will cruise the entire 28 day duration at minimum speed and, possibly, even heading south to counteract the streams northerly flow. The actual tracking/operating procedure will be determined during the pre-mission 12 day cruise of Phase 1.

At specified times during the mission the ships fathometer will be required to ascertain and record depth. Surface navigation will be conducted and plotted by Naval scientific personnel during the entire mission, who will also determine the ships position relative to the submersible and recommend proper course and speed to maintain the optimum tracking position.

#### COMMUNICATIONS

Routine or emergency surface communication will be conducted by the ship's master or his designate. Communications with NAVOCEANO by single side band will be conducted by NAVOCEANO personnel, as will communication with the attending research ship or other craft involved with this mission. Sub-surface communication with the submersible will be conducted by the NAVOCEANO representative or his designate.

#### DIVING SUPPORT

As determined by the senior NAVOCEANO representative, scuba diving support may be required. In this case NAVOCEANO divers will be used and the small boat or rubber raft will be launched to support the divers every time they are required. When divers are in the water, their safety will be considered paramount over all other aspects of the mission.

#### SCIENTIFIC STUDIES

Scientific experiments in conjunction with the submersible will be performed at various periods. During these periods NAVOCEANO will provide all the necessary personnel and equipment and will perform their work in accordance with safe ship operations and in conjunction with the master's designated representative.

BEN FRANKLIN  
SURFACE SUPPORT SHIP SPECIFICATIONS

Minimum speed: 2-3 Knots

Cruising Speed: 10 Knots

Towing Speed: 5 Knots in Sea state 0 (BEN FRANKLIN)

Length: 135 feet (min)

Beam: 25 feet (min)

Draft: 11 feet (min)

Duration (at sea): 36 days; 24 hr/day operation at min. speed.

Decking Accomodation: 10 scientific passengers.

Echo-Sounder: Capable of 15000 feet, with Giffit recorder or equivalent.

Underwater Telephone: Range to 6000 ft (min). Compatible with AN/JQG-2D at 8.0875 kHz, 400 w.

Navigation: A Loran A and C receiver will be required during the tenure of this charter.

Radar: Raytheon Model 4000, or equivalent.

Tracking: A directional hydrophone, ship-mounted, is required to provide tracking of a sub-mounted pinger and transponder in directivity of  $\pm 1.5$  degrees horizontal and  $\pm 12$  degrees in the vertical.

Life Saving Equipment: Sufficient to meet all maritime and Coast Guard regulations affecting lifesaving equipment and regulations concerning the use thereof.

Towing Equipment: Equipment and spaces will be required to tow the BEN FRANKLIN in sea states expected for the North Atlantic Ocean in June. (See attachment)

Air Compressor: One (1) compressor for scuba charging. One (1) high pressure (min 4,500 psi) and storage tanks for recharging BEN FRANKLIN.

Radio (Ship to shore): 1) A single side band radio will be G.F.E. 2) Communications (Ship-to-shore) will be required. A suitable radio with appropriate crystals for the marine operators at Miami, Jacksonville, Charlestown, Norfolk and New York.



Motor Launch: A minimum 16 ft. (101) motor launch will be required for sub-to-ship transportation.

Rubber Raft: A 10 man capacity rubber life raft with min. 10 h.p. motor is required for sub-to-ship transportation in rough weather.

Encl. (2) to Code 9120 items  
of 12/4/52.

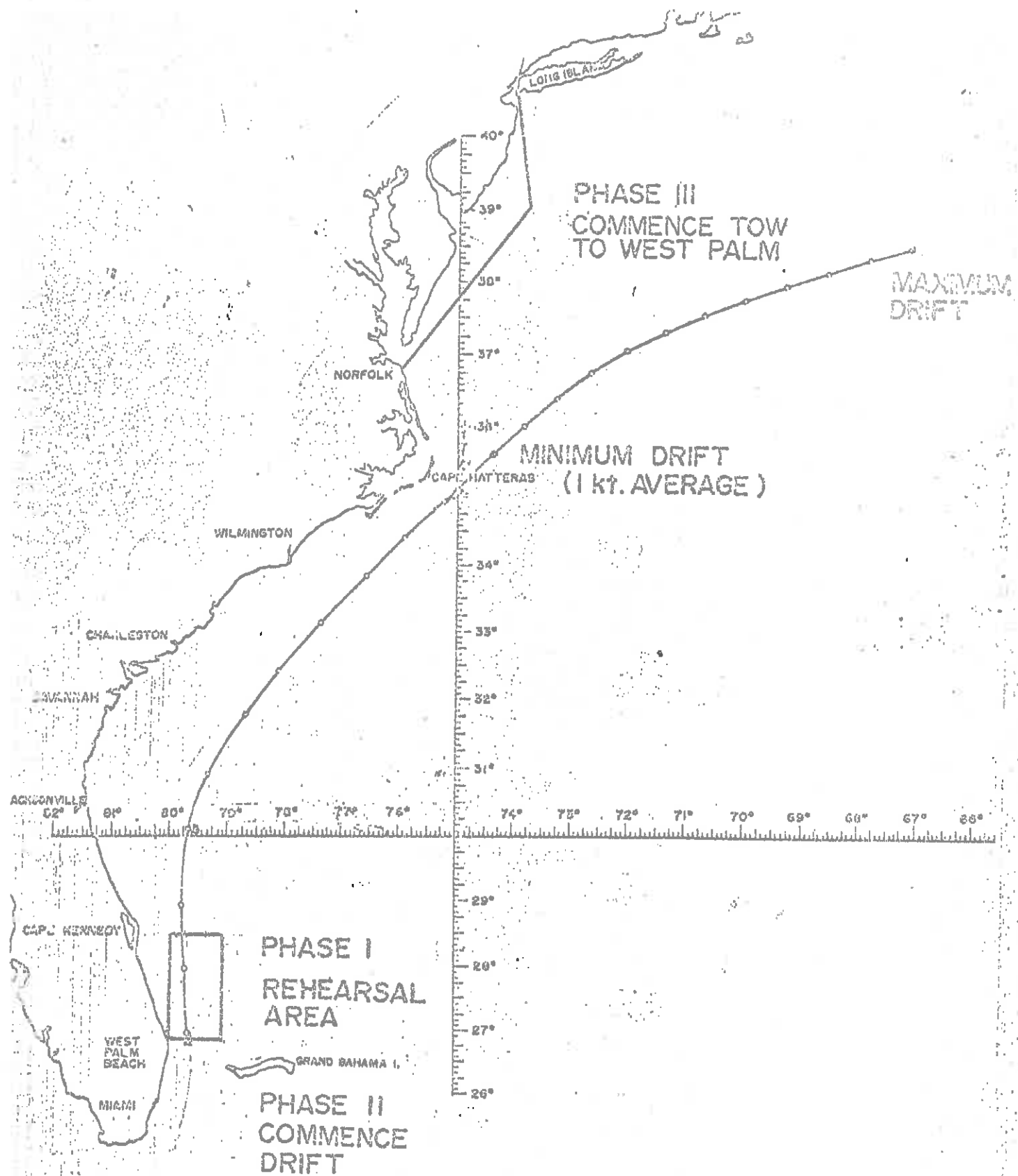


FIGURE I. GULF STREAM DRIFT AREA OF OPERATION

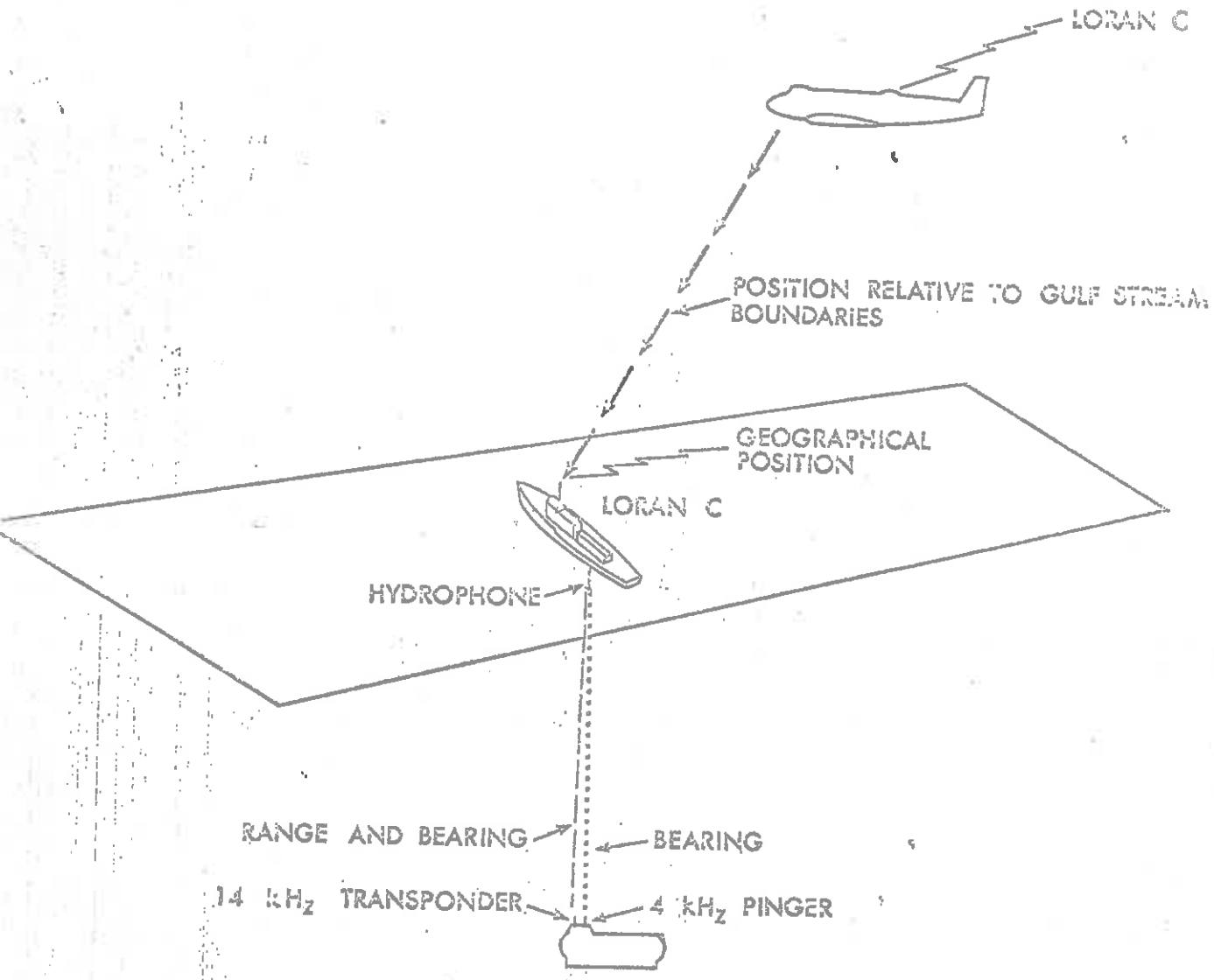
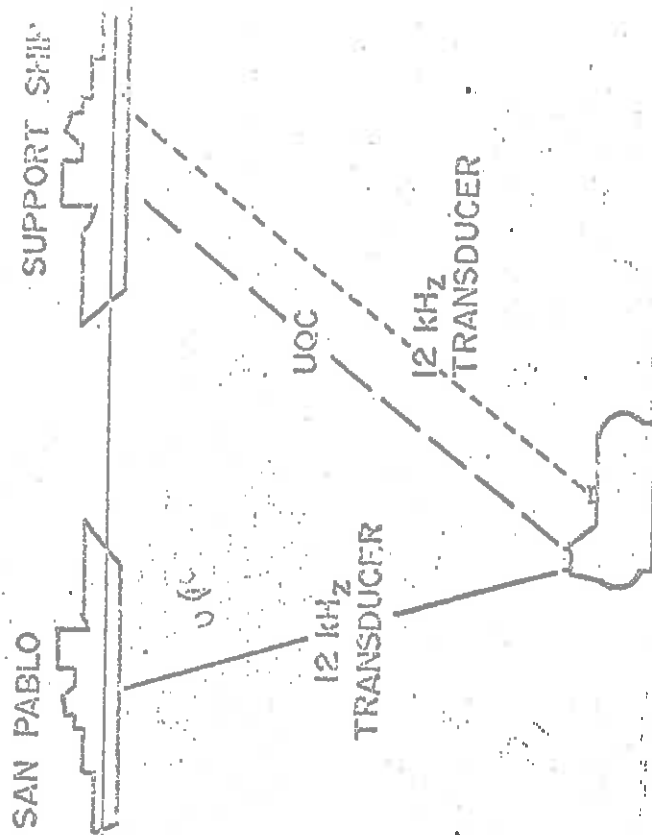
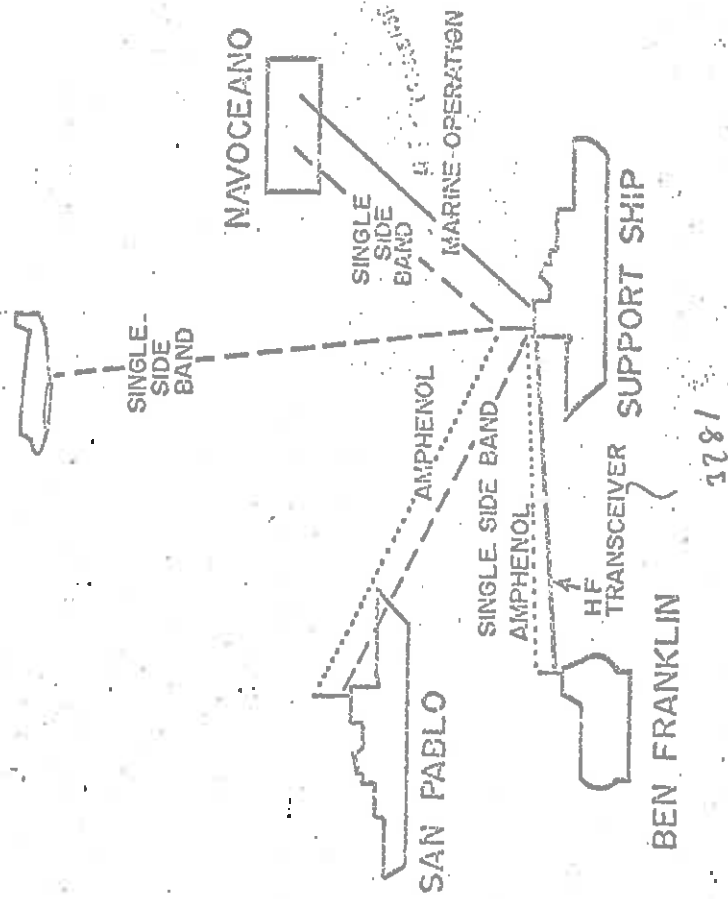
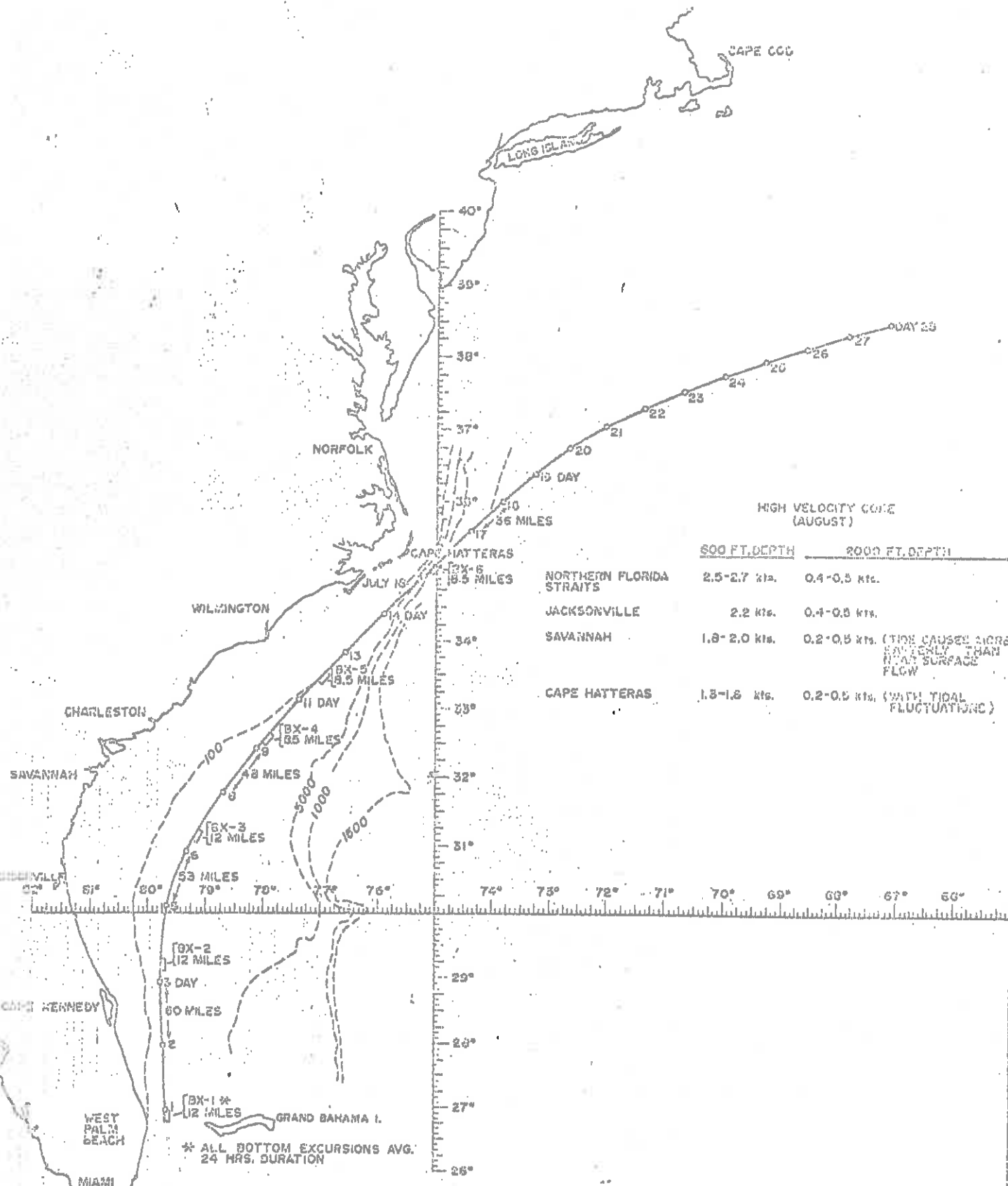


FIGURE 2. POSITIONING SYSTEM FOR GULF STREAM DRIFT MISSION



COMMUNICATIONS

FIGURE 3



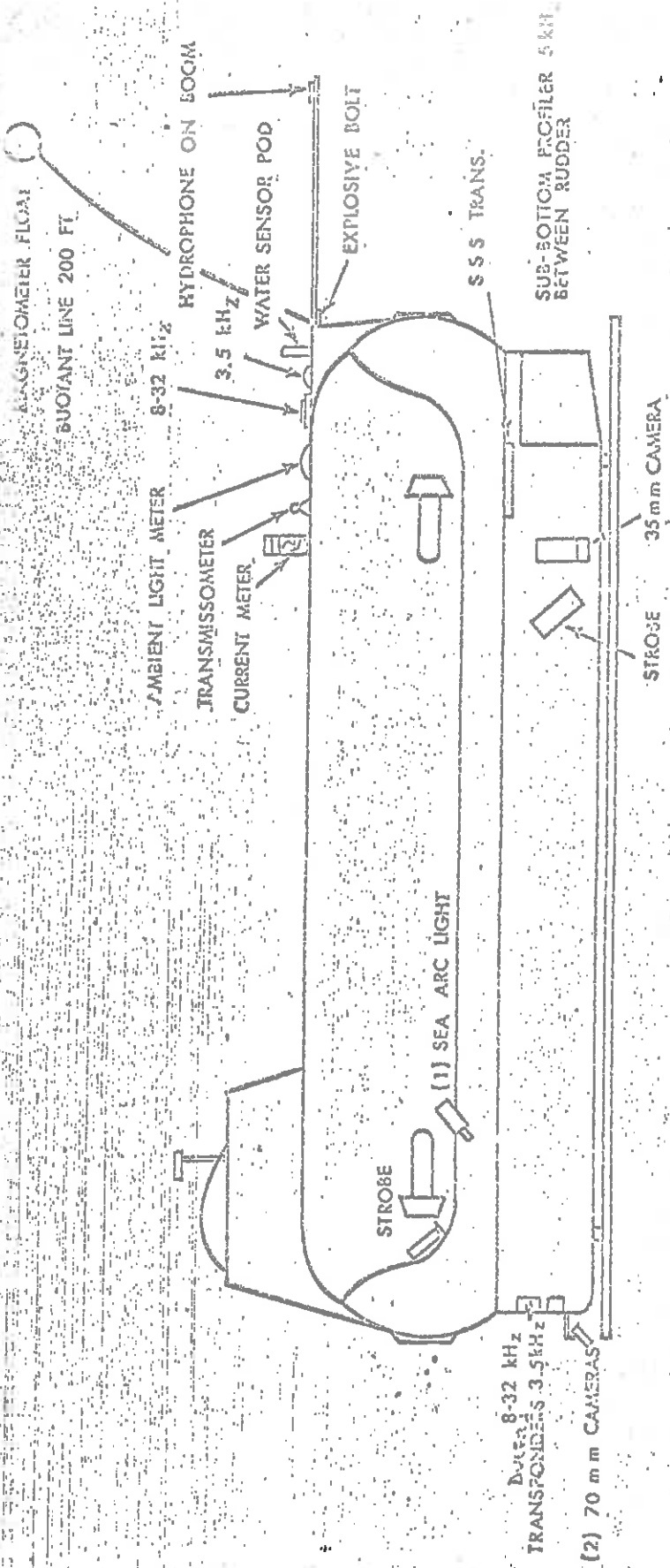
HIGH VELOCITY CORE  
(AUGUST)

	600 FT. DEPTH	2000 FT. DEPTH
NORTHERN FLORIDA STRAITS	2.5-2.7 kts.	0.4-0.5 kts.
JACKSONVILLE	2.2 kts.	0.4-0.5 kts.
SAVANNAH	1.8-2.0 kts.	0.2-0.5 kts. (TIDE CAUSES MORE SURFACE THAN NEAR SURFACE FLOW)
CAPE HATTERAS	1.3-1.8 kts.	0.2-0.5 kts. (WITH TIDAL FLUCTUATIONS)

FIGURE 4

ANTICIPATED BEN FRANKLIN DRIFT

\* ALL BOTTOM EXCURSIONS AVG. 24 HRS. DURATION



BEN FRANKLIN INSTRUMENTATION ARRANGEMENT

FIGURE 5