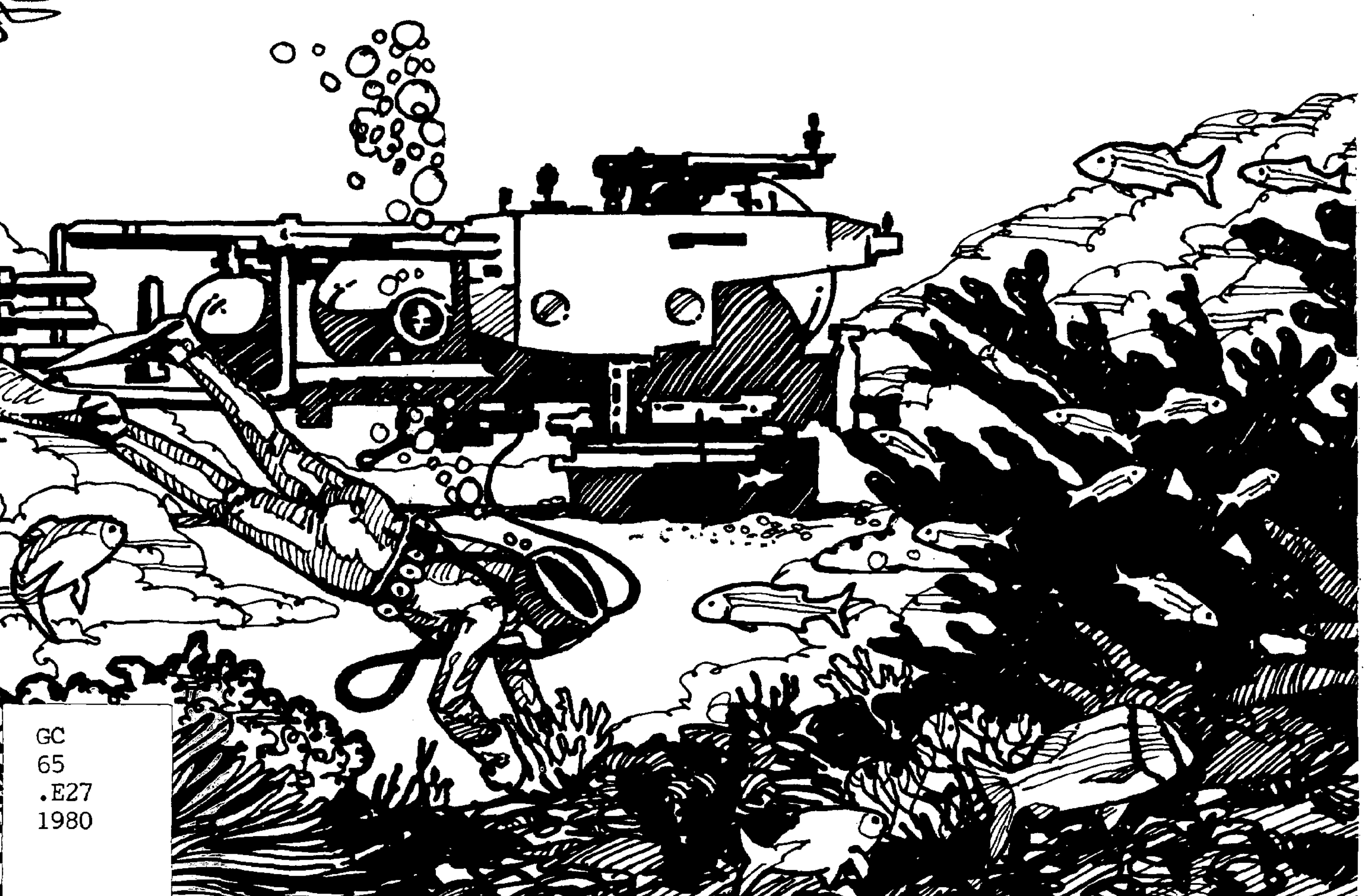
Operations Manual

East Flower Garden Bank Brine Seep Biological Assessment



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of Coastal Zone Management

OPERATIONS MANUAL

EAST FLOWER GARDENS BANK

BRINE SEEP

BIOLOGICAL ASSESSMENT

August 28 - September 18, 1980

Sponsored by

OFFICE OF COASTAL ZONE MANAGEMENT
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
DEPARTMENT OF COMMERCE

in cooperation with

HARBOR BRANCH FOUNDATION, INC.

and

TEXAS A & M UNIVERSITY

EAST FLOWER GARDENS BANK
BRINE SEEP
BIOLOGICAL ASSESSMENT
OPERATIONS MANUAL

This Operations Manual satisfies the requirements of NOAA Circular 78.31 (June 1, 1978) entitled Leasing and Operation of Submersibles and NOAA Circular 74-62 (August 12, 1974) entitled NOAA Diving Regulations

7/30/80
Date

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Assistant Director
NURPO

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SUMMARY

INTRODUCTION

The Marine Protection, Research and Sanctuaries Act of 1972 (Public Law 92-532) authorizes the Secretary of Commerce with Presidential approval to designate ocean areas with distinctive conservation, recreational, ecological or aesthetic values as marine sanctuaries. The Flower Garden Banks, lying more than one hundred miles offshore Texas and Louisiana in the Gulf of Mexico, have been nominated as a candidate site for marine sanctuary designation by Texas State Senator A.R. Schwartz in conjunction with the Texas Coastal and Marine Council. The Banks are biologically unique and important. They contain not only the northwestern most living reefs on the Gulf of Mexico Outer Continental Shelf, but also many important habitats for unusual marine organisms. Included in these habitats is the East Flower Garden Brine Seep System, appropriate for study because of its (1) unique physical, chemical, and biological systems; (2) the extreme fragility of the system; and (3) the importance of the systems in general for science and in particular for the understanding of the evolution of benthic community structure.

The National Oceanic and Atmospheric Administration, Office of Coastal Zone Management, in cooperation with scientists from Texas A & M University (TAMU) and Harbor Branch Foundation, Inc. (HBF), will sample in the brine seep and adjacent canyon and hard-bottom community resources and equipment provided by HBF. This manual presents the operations plan for this resource sampling survey.

OFFICE OF COASTAL ZONE MANAGEMENT

The National Oceanic and Atmospheric Administration (NOAA), Office of Coastal Zone Management (OCZM) was established to administer the Coastal Zone Management Act of 1972 (P.L. 92-583). In addition to this responsibility, the Secretary of Commerce delegated the authority to OCZM to administer Title III of the Marine Protection, Research and Sanctuaries Act of 1972 (P.L. 92-532).

The authority granted under Title III is for the purpose of setting forth the procedure by which areas may be nominated as marine sanctuaries and the concepts, policies, and procedures for the processing of nominations as well as for the selection, designation, and operation of a marine sanctuary.

Through its desire to undertake an active role in management and research in the proposed East and West Flower Gardens Marine Sanctuary, OCZM is acting cooperatively with TAMU and HBF in planning, preparation, and execution of this deepwater resource survey.

As project manager and coordinator, OCZM is providing technical personnel responsible for designing and executing the project, contacting the necessary outside scientific experts and is funding part of their equipment shipping and personnel travel expenses.

TEXAS A & M UNIVERSITY

The University's College of Geoscience's Department of Oceanography is involved in oceanographic research, including surveying and sampling of unusual marine biotic communities. The Department is providing technical personnel who are responsible for developing the scientific plan for the mission, preparing and analyzing all samples collected, constructing or making available any supplies or equipment needed for scientific research, and for writing the final cruise and scientific report.

HARBOR BRANCH FOUNDATION, INC.

The Harbor Branch Foundation, Inc. (HBF), is a not-for-profit organization established in 1970 primarily for research in the marine sciences and for the development of oceanographic tools and systems for undersea research. Outlined below are HBF's program objectives:

1. Accumulating and computerizing knowledge in the field of oceanology, particularly as it applies to the effects of pollution.

2. Sponsoring and engaging in scientific research and development for the purposes of making inventories and observing the behavior of marine plants and animals through various stages of their life cycles in unpolluted and polluted waters.

3. Developing new engineering tools and improved safety equipment for marine and oceanographic research and operating laboratories for the furtherance of such research.

4. Developing methods for changing the character of pollution, by eliminating the harmful effects and by utilizing the nutrients and beneficial effects.

5. Sponsoring and engaging in underwater archaeology projects through the use of new engineering tools and methods.

6. Preparing and distributing publications, research materials, lectures, and seminars which serve to disseminate knowledge of marine plants and animals and ocean engineering research and development.

HBF is providing technical personnel, both surface and underwater vessels, and equipment to meet the operation requirements for proposed East Flower Gardens Bank Brine Seep Assessment.

I. OVERVIEW OF THE OPERATION

The area to be surveyed is part of the proposed East and West Flower Gardens Marine Sanctuary, located approximately 110 nautical miles (nm) southeast of Galveston, Texas, and 120 nm south of Cameron, Louisiana. The proposed sanctuary would include the waters overlaying the banks and extending to within 4 nm of the 100 m (328 ft.) isobaths of each bank, a total area of approximately 173.25 square nautical miles. Personal communication with Thomas J. Bright and Eric N. Powell (Texas A & M University) indicates the East Flower Garden (EFG) Brine Seep system (Figure 1) is biologically important for the following reasons: (1) the bacteria of the seep oxidize sulfide in high salinity water at low light levels. Data suggest that a bacterial association, under the conditions found here, occurs rarely, if at all, anywhere else; (2) the benthic communities found downstream of the seep may exist primarily on sulfur bacteria as a food source. As such, community composition and structure are exotic and population densities are unusually high (in fact, the communities are analogous to the Galapagos Rift hydrothermal vent community in this regard--see Ballard et al., 1979); (3) one of these communities --the one associated with the white sulfur bacterial mat in the overflow canyon--is absolutely unprecedented. This community is dominated by gnathostomulids, a relatively unknown phylum restricted to sulfide system-like environments. A community dominated numerically (and possibly in biomass also) by this phylum has never been reported before, and in fact, may be unique. There is every reason to believe it is a "living fossil" community;

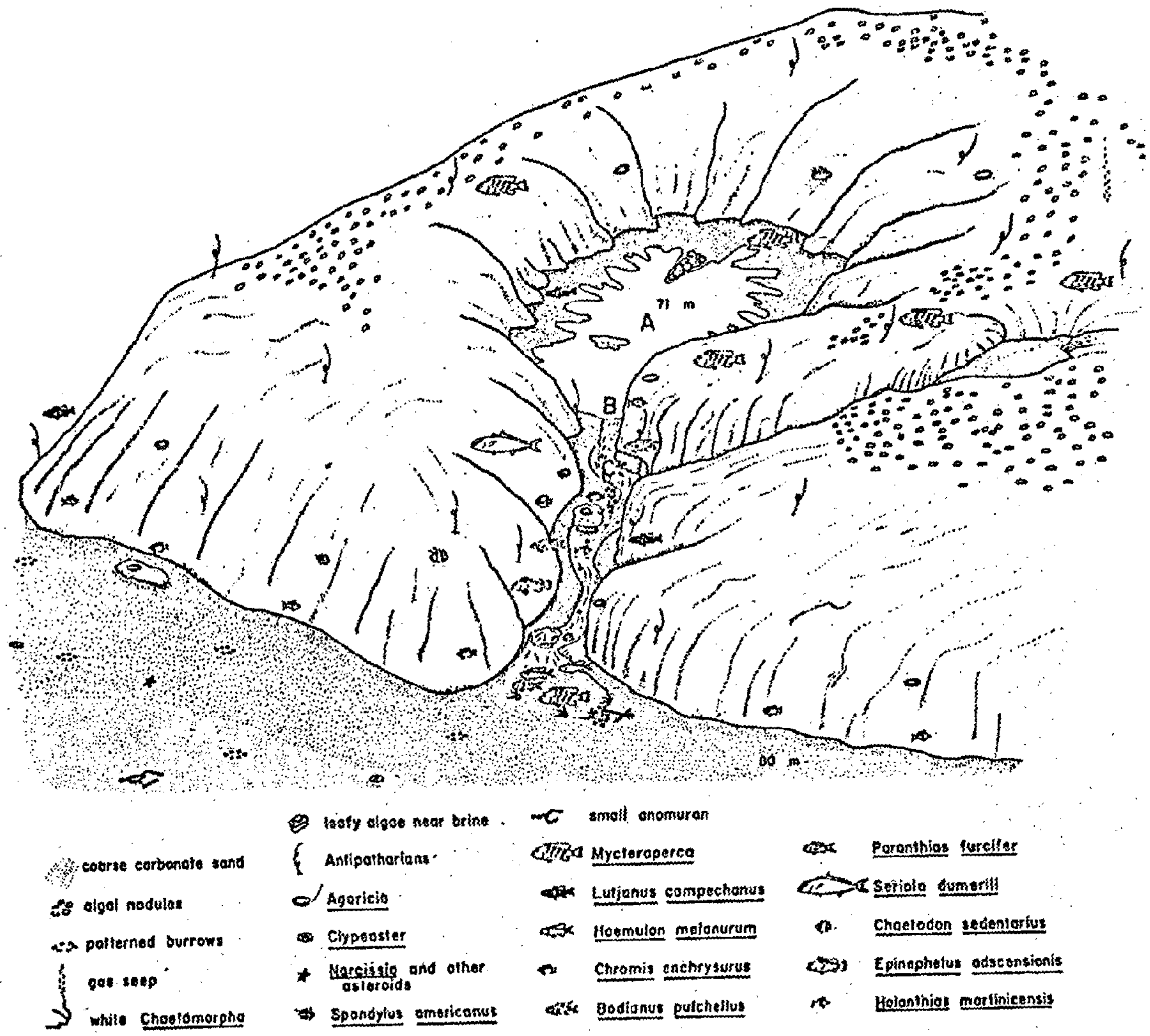


Figure 1 East Flower Garden Bank Brine Seep

(4) the gnathostomulid species may themselves be unique. We have not yet consulted with a systematic expert in the group, but the large size of the organisms involved, coupled with the general knowledge of the group which we do have, leads us to believe that the species may indeed be undescribed. Thus it is clear that the biological associations found at the EFG brine seep are unusual and deserving of careful study.

II. MISSION OBJECTIVE

Doctors Bright and Powell of Texas A & M University, with the support of the Office of Coastal Zone Management (OCZM) will use Harbor Branch Foundation facilities and equipment, including the submersible JOHNSON-SEA-LINK (J-S-L) to undertake a series of dives to quantitatively sample marine resources in the East Flower Garden Bank Brine Seep System, near the overflow canyon and coral reef, and adjacent soft-and hard-bottom communities. J-S-L diver lock-out capabilities will be used to collect any necessary biological samples for species identification. Video tape and still photography will be used to document observations.

III. MISSION PLAN

A. Operating Area

Figure 2 shows the project operating area. The onshore base of operations will be located at Texas A & M Marine Biomedical Institute at Galveston, Texas. The physical characteristics of the area are as follows:

Depth: Operating area depths vary from 100-300 feet for observations and 100-200 feet for lock-out dives.

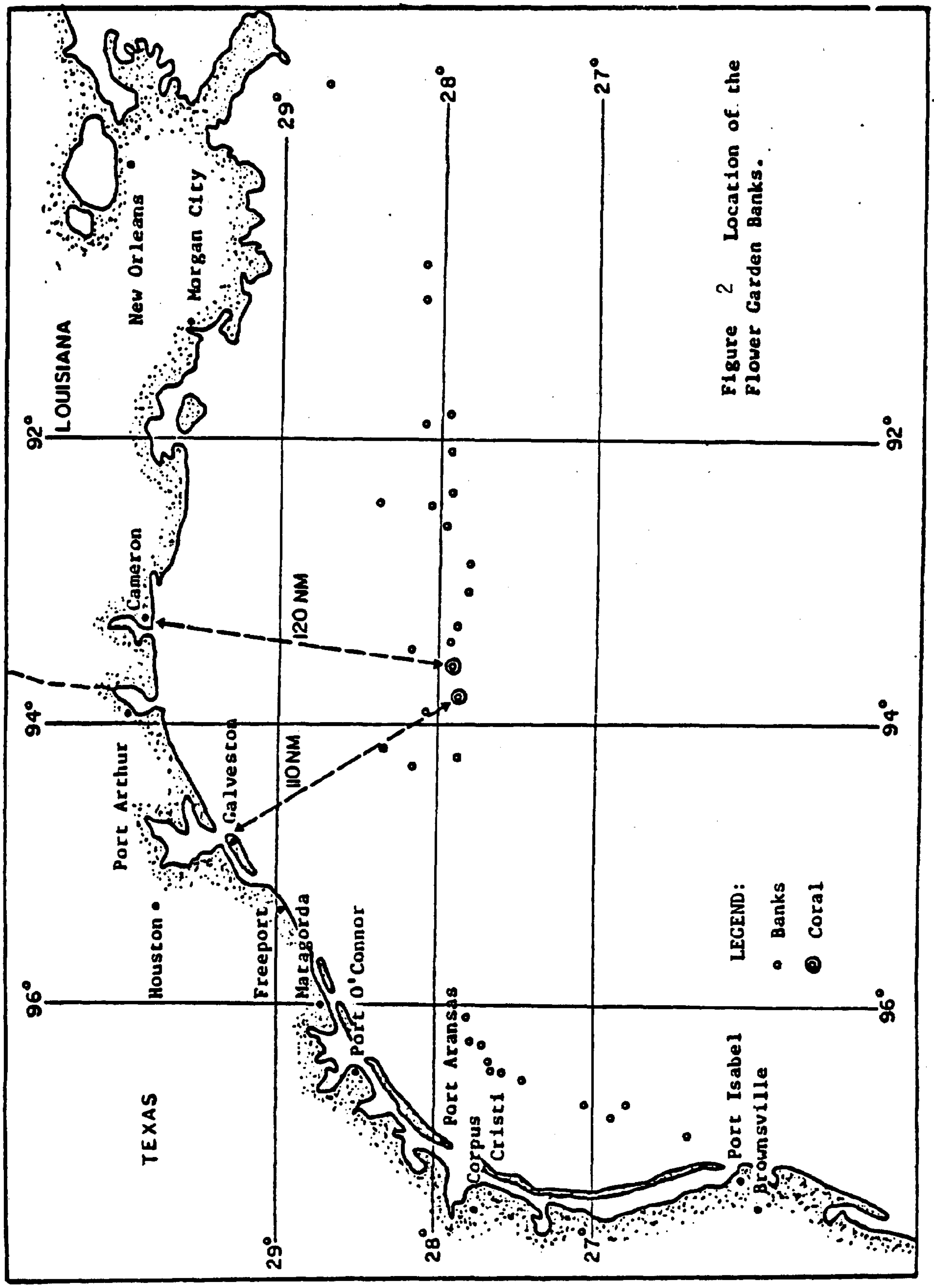


Figure 2 Location of the Flower Garden Banks.

Currents: Predominately east to west at surface. Bottom current directions correspond to those of surface currents in early Fall.

Obstacles: None.

Temperature: Diving September temperatures range from:

Surface:	27°C
150 feet:	22°C
300 feet:	19°C

Bathymetry: The East Flower Garden Bank is distinguished by several distinct biotic zones lying at depths from 20 to 120 meters. (Figure 3)

B. Chronology

19 January — Meeting at HBF with NOAA and TAMU to discuss operation.

28 August — R.V. Johnson departs Link port.

1 September — Arrive Galveston. Onload scientist and supplies. Depart for operations area.

PHASE I:

2 September — Arrive operations area.

Dive 1: Submersible dive, Pilot and Bright
Locate brine seep, emplace marker buoy.

Sample soft bottom in vicinity of brine seep using sediment scoops or appropriate sediment samplers (20 samples.) Salinities at each sample site using salinometer or conductivity meter. No lock-out diving required.

Dive 2: Lock-out submersible dive, depth 250' approximately
Sample overflow canyon
4 sediment samples (for meiofauna)

1 sample of blue-green or bacterial mat
4 samples of epibenthos from bacterial mat
2 salinity samples (water)
2 sulfide samples (water)
2 dissolved oxygen samples (water)
2 total organic carbon samples (water)
2 temperature measurements
1 photographic transect with frame (36 photos)

Video documentation of sampling effort.

3 September

Dive 1: Lock-out submersible dive, depth 250' approximately
Complete sampling described for September 2, Dive 2.

Dive 2: Submersible dive, Pilot and Bright
Detailed measurements of dimensions of brine pool, basin, canyon overflow and over flow stream.
Flow meter measurements in stream.
High resolution temperature and salinity profiles in brine pool and stream.
Photographic documentation.
Video documentation of sampling.

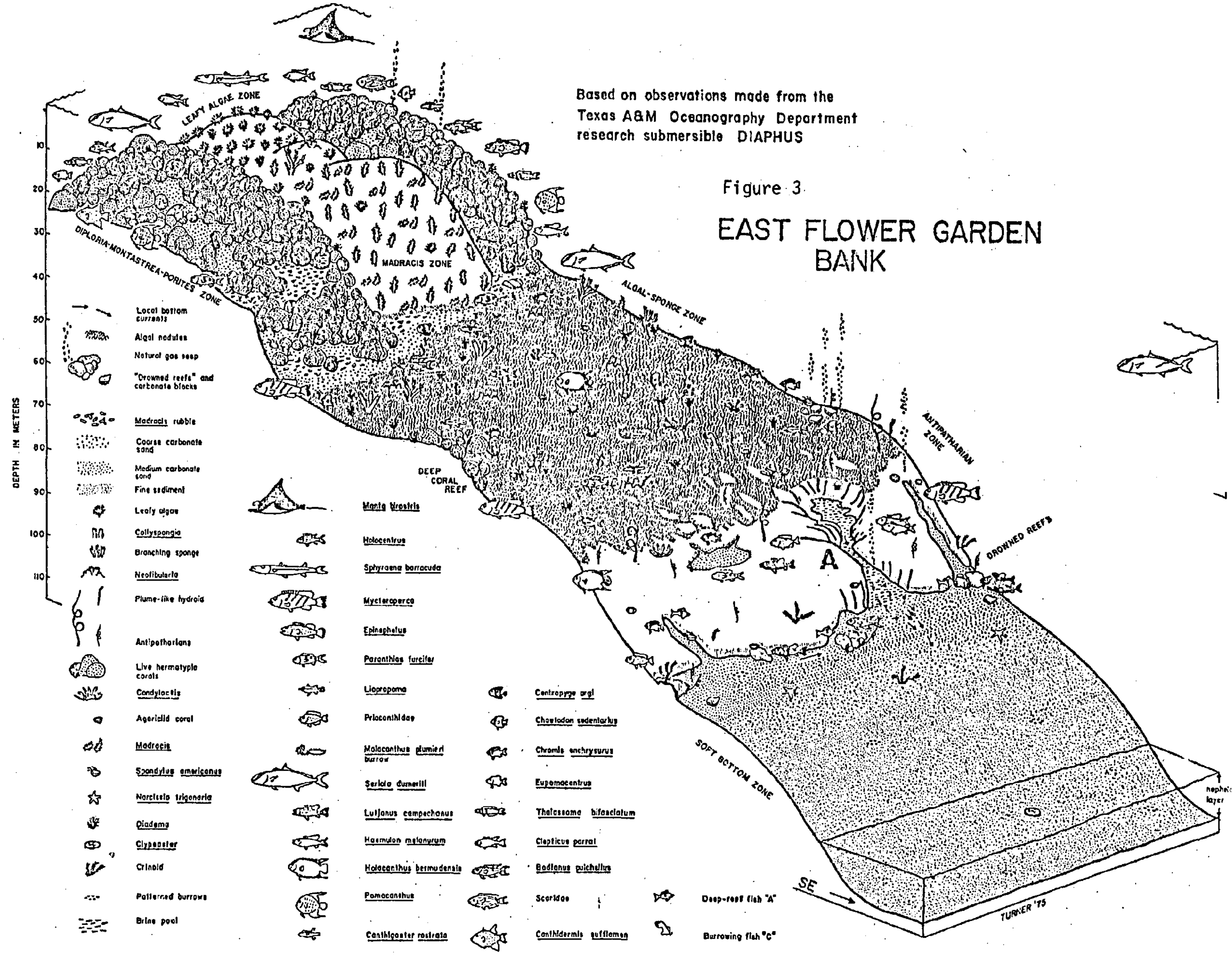
4 September

Dive 1: Lock-out submersible dive, depth 235' approximately
Sample main brine pool
4 sediment samples (for meiofauna)
4 bacteria samples
4 samples of epibenthos from hard bottom
2 salinity samples (water)
2 sulfied samples (water)
2 dissolved oxgen samples (water)
2 total organic carbon samples (water)
2 temperature measurements
1 photographic transect with frame (36 photos)
Video documentation of sampling.

Dive 2: Submersible dive, depth 235' approximately
Complete sampling described in Dive 1.

5 September

Dive 1: Submersible dive, Pilot and Powell
Sampling of soft bottom adjacent to brine seep at varying distances away from seep at corresponding depths.



Based on observations made from the Texas A&M Oceanography Department research submersible DIAPHUS

Figure 3

EAST FLOWER GARDEN BANK

Dive 2: Lock-out submersible dive, depth 270' approximately
Same sampling effort as described for September 2, Dive 2 but at mouth of canyon.

6 September

Dive 1: Lock-out sumbersible dive, depth 270' approximately
Complete sampling started on September 5, Dive 2.

Dive 2: Submersible dive, Pilot and Bright
Descriptive transect on a line between coral reef and brine seep.
Collection of benthic biota for systematic determinations.

7 September

Dive 1: Submersible dive, Pilot and Bright
Locate and mark gas seeps.

Dive 2: Submersible dive, depth 150' approximately 4 sediment samples.
Sampling substratum and biota associated with natural gas seeps.

8 September

Dive 1: Lock-out submersible dive, depth 250' approximately
4 sediment samples.
Sampling substratum and biota associated with natural gas seeps.

Dive 2: Lock-out submersible dive, depth 300' approximately
4 sediment samples.
Sampling substratum and biota associated with natural gas seeps.

9 September Return to Galveston. Onload new scientist and supplies. Return to operations area.

PHASE II:

10-14 Sept. Dr. Nat Eiseman of HBF will be conducting the required observational transect from the shallow (coral reef) area of East Flower Garden Bank to a point below the brine seep. He will also be conducting a series of lock-out dives at 100', 125', 160', 200' and at selected points around the "brine lake" and "canyon". These dives are necessary to augment the transect work. The distribution and species of algae collected will be reported. Light meter and thermograph instruments will be deployed in the study area and recovered at the conclusion of the mission.

Dr. Robert Jones of HBF will be making observations and photographic recordings of marine fishes in and around the brine seep. This will be a continuation of work begun by

Dr. Bright. Of special interest will be the behavior of these fishes toward the brine stream.

15 September — Depart operations area. Return to Galveston to offload scientific party. R.V. Johnson returns to Link Port.

18 September — R.V. Johnson arrives Link Port.

C. Training Requirements

No specific training will be required for this operation as HBF will be using experienced staff familiar with the equipment and procedures required for this mission.

D. Routine Reports

The only routine report which will be made during the mission is a scheduled call to Link Port each morning 0900 to inform HBF of the happenings of the day before and the scheduled activities of the day. Because a NOAA Representative will be on-site throughout the operation, reports will be submitted to OCZM on an as-appropriate basis, followed by a report at the end of the operation.

E. Limiting Environmental Conditions

Limiting environmental conditions which have a significant impact on the execution of the mission are:

Sea State - The surface support vessels cannot operate in a Sea State greater than 5 as they are unable to launch or recover the J-S-L. Therefore, any time such condition arises, the operation will be halted until calmer seas prevail. The weather forcast will be monitored on Channel WX and NOAA will contact the National Weather Service to inform them of the planned mission so they may provide up-to-date information upon request.

Currents- Because the operational propulsion of the J-S-L is 1.5 knots, any curents over 1.5 knots will result in review of the planned dive.

Turbidity- Reduced visibility in the water could have an impact on good photographic data and limit submersible operations.

F. Alternative Mission Plans

If the Sea State is such that the vessels cannot operate, no mission plans can be substituted as the purpose of this operation is to conduct a biological assessment which requires vessel operations. If operating days are lost due to weather, first priority will be given to TAMU for completion of their research.

G. Scientific Reports

HBF will provide final reports on their algae and fish investigations by December 30, 1980.

TAMU will provide NOAA with a cruise report by November 1, 1980 and a final scientific report in publishable form by August 31, 1981.

IV. Organization and Personnel

Figure 4 illustrates diagrammatically the organization of the participants in the operation.

A. Chain of Command and Responsibilities

Director, Operations and Enforcement (OCZM)- is responsible for overall program planning and coordination. He will be advised by the NOAA representative and the operations director of any event which could affect the safety of the open-sea operation. Substantial alterations to the mission plan must have the prior approval of the Director for Operations and Enforcement. He will be responsible for keeping the Assistant Administrator for Coastal Zone Management informed of all ongoing activities.

NOAA Representative - is responsible for the safe and efficient operation of the mission. Safety of the operation will be foremost in his mind, and he will keep the Director, Operations and Enforcement informed of any problems affecting the mission. He may, in the event it is necessary and only under circumstances where he observes that the safety of personnel or failure to observe pre-arranged agreements arises, suspend further open-sea operations.

Operations Director - has the responsibility for the overall safe and efficient operation of the mission. Safety of the operation will be foremost in his mind, and he will keep the NOAA Representative advised of any event which could alter the mission's plan or affect the safety of the operation. He is also responsible for the coordination of launching, operating, tracking and recovery of the submersibles. He will make the final decision as to the readiness of the submersible to operate and will direct those technical personnel responsible to him in carrying out their assigned duties and assure that all diving equipment is functional and properly maintained.

Chief Scientist - is responsible for the scientific mission, and for coordinating the science plan of the mission. He will coordinate the activities of the scientists with the Operations Director and keep him informed of any alteration which would affect the daily operations schedule.

Support Ship Captain - is responsible for the safe operation of the support ship and its equipment and personnel. He will coordinate with the Operation Director all support ship activities with respect to submersible operations.

B. Participants and Their Duties

National Oceanic and Atmospheric Administration

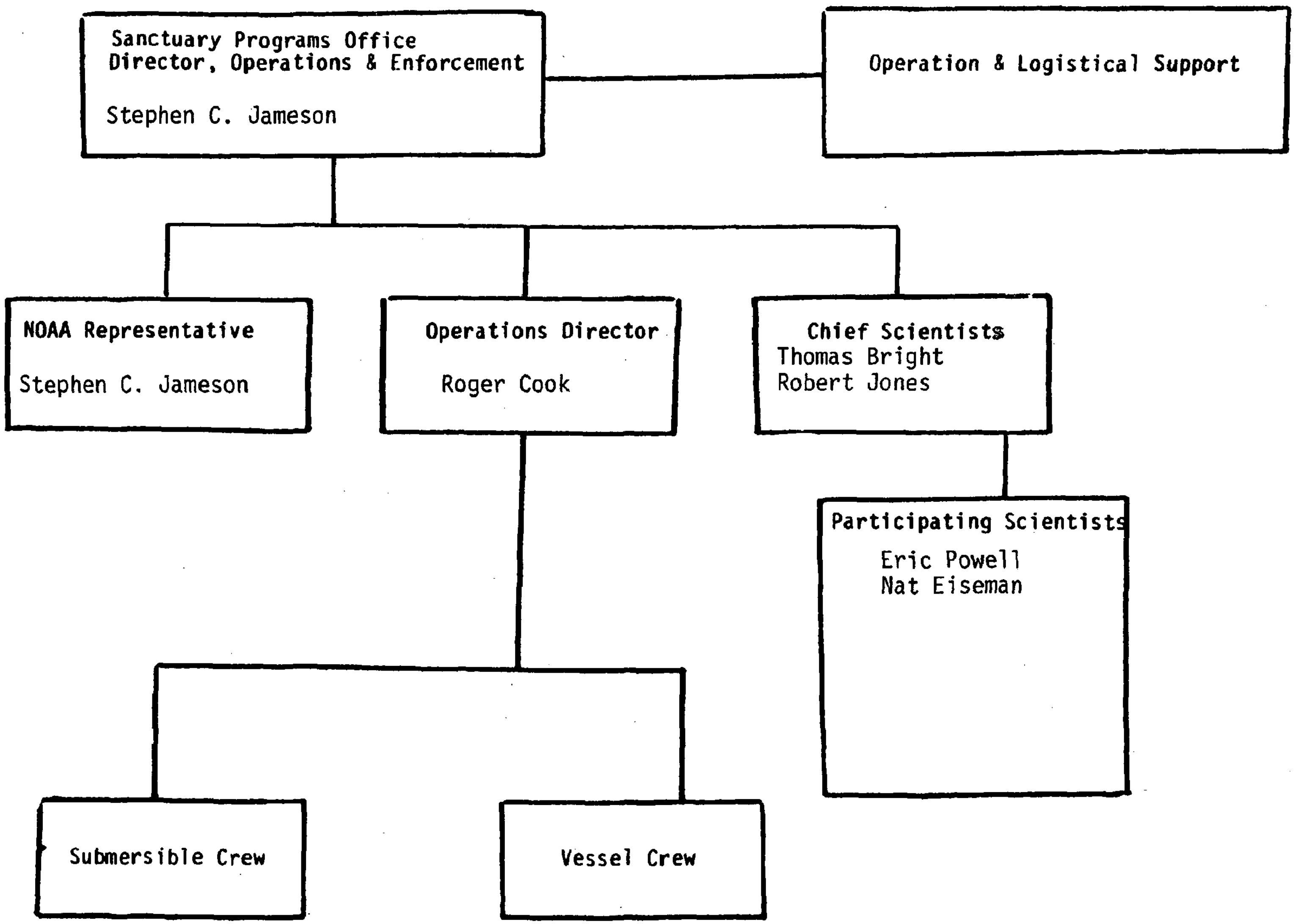

Sanctuary Programs Office
Director, Operations & Enforcement
Stephen C. Jameson
Operation & Logistical Support
NOAA Representative
Stephen C. Jameson
Operations Director
Roger Cook
Chief Scientists
Thomas Bright
Robert Jones
Participating Scientists
Eric Powell
Nat Eiseman
Submersible Crew
Vessel Crew

Figure 4

Stephen Jameson	Director, Operations and Enforcement NOAA Representative

Texas A & M University

Thomas J. Bright	Chief Scientist - Phase I
Eric N. Powell	Research Scientist

Harbor Branch Personnel

Robert Jones	Chief Scientist - Phase II
Nat Eiseman	Research Scientist

V. Facilities and Equipment to be Used

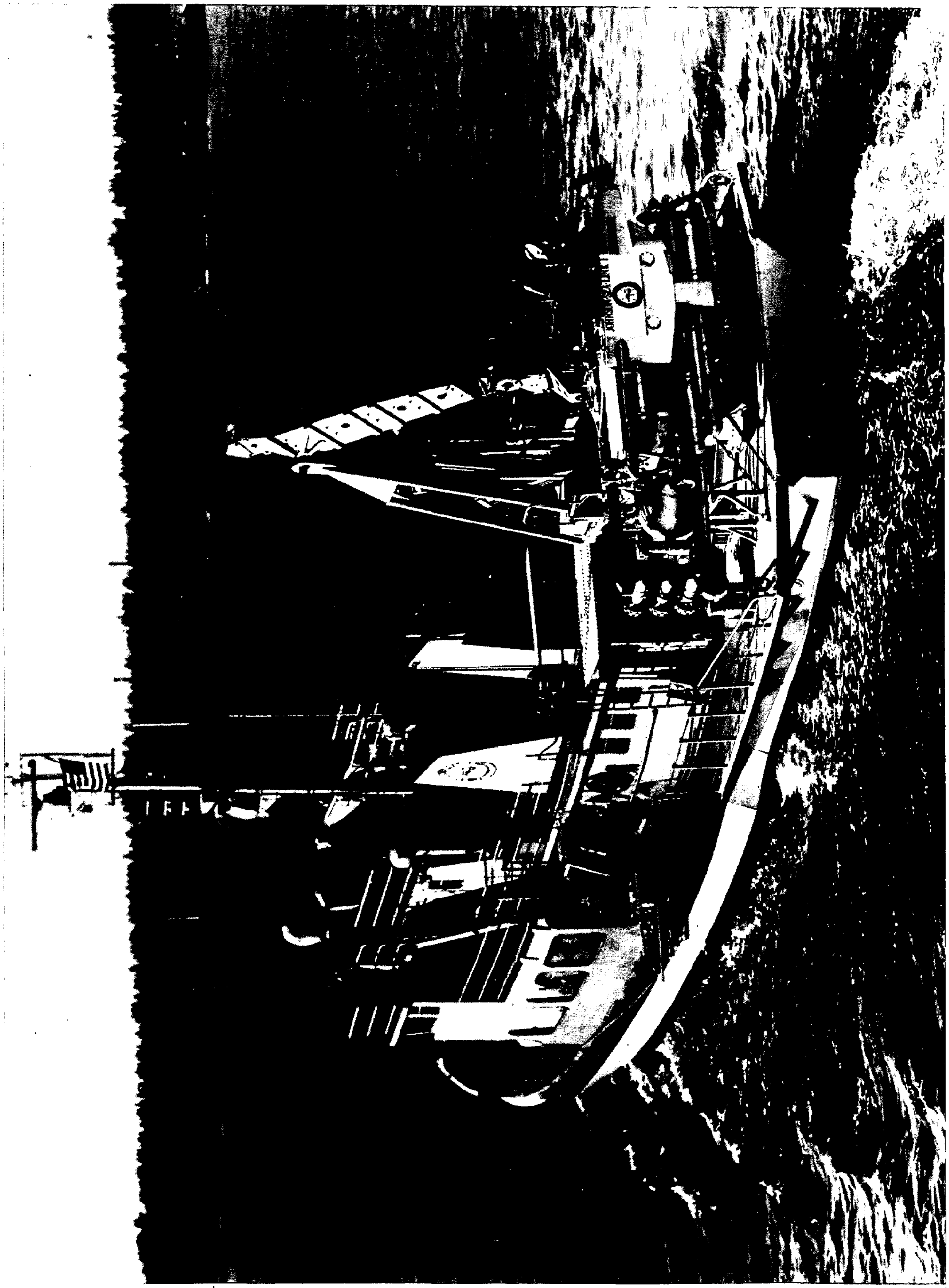
A. Surface Support System Description

1. R/V JOHNSON

The R/V JOHNSON is a converted 125-foot Coast Guard Cutter. It was redesigned specifically to support the lock-out submersible, J-S-L, and is an intergral part of a 1000-foot submersible lock-system. the vessel provides a stable platform for the safe launch and retrieval of the submersible in seas up to State 5, a lock-on decompression facility, a scientific lab, and support facilities for 22 people.

a. General Specifications

1)	Length, Overall	123'8"
2)	Beam, Molded	26'8"
3)	Displacement, Full Load	350 tons
4)	Draft, Maximum	10'8"
5)	Draft, Amidships Full Load	8'10"
6)	Diesel Fuel	10,000 gallons
7)	Potable Water	2,295 gallons
8)	Dry Storage and Lockers	691 cu. ft.
9)	Frozen Stores	53 cu. ft.
10)	Berthing	18 berths
11)	Galley Messing	6 seats
12)	Lounge Messing	8 seats
13)	Propulsion	2 - CAT 3408TA diesels, 400 BHP at 1800 RPM 365
14)	Transmissions	MG514 (Omega) 4.5-1 Reduction Twin Disc



15)	Bow Thruster	80 H.P. Schottel unit
16)	Electrical Power	2 GM 471 diesels 75 KW ea.
17)	Distillers (2)	Maxim distillers Model HJ-10 20 gal. per hour
18)	Air Condition Compressors (2)	7 1/2 tons
19)	Maximum Speed	14 knots
20)	Cruise Speed	12 knots
21)	Fuel Consumption at Cruise	34 gallons per hour
22)	Foredeck Cargo Crane	4 tons

2. J-S-L Handling System for R/V JOHNSON

The handling system consists of one hydro crane, two capstans, a battery pod footprint, two vertical supports to support the after end of the J-S-L and various padeyes, chains, and turnbuckles for securing the J-S-L to the deck. In addition to this the R/V JOHNSON has aluminum pipe back stops with gates that can be moved through 90° to accommodate an inner and outer tiedown position.

The hydro crane was designed principally for the launch and retrieval of the J-S-L over the stern of a small ship. It can be used for other purposes provided the design loads are not exceeded.

It is constructed entirely of aluminum alloy 6061-T6 welded with 5356 electrode and has a 100 percent hydraulically operated system. Incorporated in the crane head is a hydraulic braking system that dampens roll and pitch of the suspended load when it is in the housed position.

The R/V JOHNSON receives its hydraulic power for the submersible handling system from two sunstran 55 G.P.M. pumps which are clutched to the frame of each main engine. The crane hydraulic power can be cross-connected with the forward hydraulic system which furnishes power to the bow thruster, anchor windless, and cargo crane.

a. Pertinent Data

1) Crane Maximum Hydraulic Pressure -- 2500 PSI

2) Brake Maximum Hydraulic Pressure -- 1000 PSI

3) Cable type - 7/8" dia. 6 x 25 IWRC, extra improved plow steel, pre-stretched, right regular lay, bright finish, breaking strength 80,000 lbs.

4) Average pick-up velocity - 1.4 ft. per second

b. Maximum Sea Condition

1) Sea State 4 with 22,000 lbs. load

2) Sea State 5 with 20,000 lbs. load

3) Pitch $\pm 10°$ for 6 seconds

4) Roll $\pm 10°$ for 8 seconds

B. Manned Undersea System Description

J-S-L I will be used during the mission.

1. General Description

The J-S-L is a small research submarine designed to operate at depths to 3,000 feet. The J-S-L has two manned pressure hulls: a two-man sphere constructed of four-inch thick plexiglass and a separate dive compartment made of welded aluminum. The sphere provides the pilot and one observer with panoramic visibility and is maintained at one atmosphere. The diver compartment has two view ports for scientific observation at one atmosphere and is designed for a diver lock-out to 1,500 feet and mating to a deck decompression facility. The frame, ballast tanks, and electrical/electronic housing are all constructed from aluminum. It is equipped with SONAR, underwater communication, FM system, echo sounder, mechanical arm, life support systems, and closed circuit diving equipment. Eight thruster units provide three dimensional mobility. An oil battery and a static inverter which converts DC to AC provide power.

2. General Specifications

1) Overall

a)	Length	22'10.25"
b)	Beam	7'10.75"
c)	Height	10'7"
d)	Draft	7'6"
e)	Weight	21,481 lbs.
f)	Payload	1,335 lbs.
g)	Gross Weight	22,816 lbs.

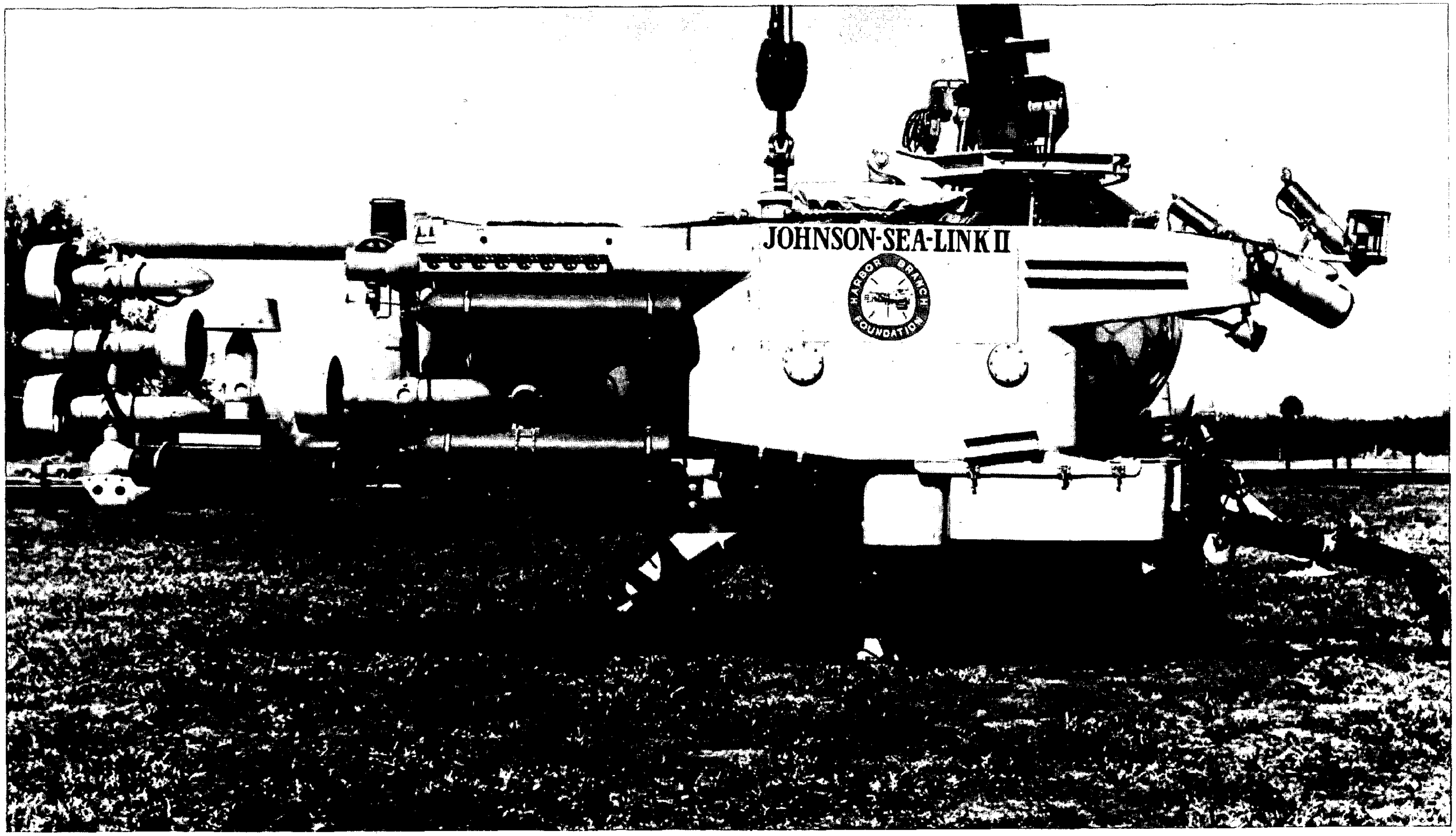
2) Pilot's Sphere

a)	Inside Diameter	58"
b)	Hull Thickness	4"
c)	Internal Volume	59 cu. ft.
d)	Hatch Opening	18" diameter

(1)	Operating Depth	3,000'
(2)	Classification depth	1,000
(3)	Test Dept	3,300
(4)	Crush Dept	8,000

<u>Description</u>

The sphere contains the following: sphere electrical control panel, sphere junction box, electronic equipment rack, Straza sonar electronics, Straza underwater telephone electronics, Sperry Doppler Navigator, Magnesyn compass, echo-sounder, one FM transceiver, underwater loud-


JOHNSON-SEA-LINK II
HARBOR BRANCH FOUNDATION

speaker amplifier, diver's communications amplifier, sound powered phone, thruster control unit, freon detector, PO2 and PCO2 analyzers, diver compartment PO2 and PCO2 monitors, two CO2 scrubbers, air conditioning coil and fans, mechanical arm control unit, two seats, two oxygen breathing regulators, oxygen flow meter, flow pressure air regulator, two emergency breathing regulators, two face masks, high pressure air manifold, high pressure gas manifold, variable ballast flood valves, diver's bilge flood and exhaust valves, battery drop mechanism, two inflatable vests, tool kit, spare fuses, first aid kit, two saltwater desalter kits, fifty pounds of spare LiOH, two flash lights, external pressure guage, internal pressure guage, diver compartment pressure guage, fire extinguisher, flares and potable water.

The sphere is manned by a J-S-L pilot and one observer who has been briefed on the sphere or is a J-S-L crew member. The sphere is always maintained at one atmosphere but is capable of withstanding 60 psi over external pressure. Decompression of the diver compartment is normally controlled from the sphere.

3) Diver Compartment	
a) Length	8"
b) Internal Diameter	52.78"
c) Hull Thickness	
(1) Side Wall	3.36"
(2) Heads	2.33" - 2.80"

d)	Internal Volume	73 cu. ft.
e)	Medical Lock	4" I.D. x 11.5" deep
f)	Side Ports	10" dia. x 4" thick
g)	"A" Hatch Port	7" dia. x 2" thick
h)	"B" Hatch Port	7" dia. x 2" thick
i)	"A" Hatch Opening	27" diameter
j)	"B" Hatch Opening	24" diameter
k)	Manway Opening	20" diameter
l)	External Pressure	
	(1) Operating Depth	3,000'
	(2) Classification Depth	1,000
	(3) Test Depth	4,500
	(4) Crush Depth	6,000
m)	Internal Pressure	
	(1) Test Pressure	1,000 psi
	(2) Operating Pressure	670 psi

Description

The diver compartment is a welded aluminum cylinder with spherical heads. It has a medical lock, a front and two side view ports as well as a viewpoint in "A" hatch, two penetrator plugs, a bilge under a plexiglass floor that serves as a ballast tank, and a manway with an internal hatch that seats with internal pressure and an external hatch that seats with sea water pressure. The entrance to the manway is a 32 inch-bolt circle flange used to mate the submersible to a decompression facility. The diver compartment contains the following: an electrical junction box, CO2 scrubber, two oxygen masks with overboard dump, one Bio-Marine closed cycle rebreather , or appropriate diver breathing apparatus, two emergency breathing regulators, two umbilicals, one fan, one overhead rigging gear, dive tables, morse code, 02 flow meter, external pressure gauge, internal pressure guage, sound powered phone, one intercom speaker and headset, spare light bulb, an emergency main ballast blow system, and medical lock.

The tender compartment is always manned by one J-S-L diver and one observer, who has been briefed on the diver compartment system or another J-S-L diver in the case of planned lock-out dive. It is maintained at one atmosphere except when preparing for a lock-out. "A" hatch has a view port for observing obstruction on the bottom that might impede lock-out. A front view port is provided for viewing between the sphere and diver-compartment and two side viewports are provided for lateral visibility. The diver compartment is always equipped for a lock-out at the maximum depth of the mission, not to exceed 1,500 feet. Blow down and decompression can be carried out from the pilot's sphere or the diver compartment.

c. Construction Materials

1)	Pilot's sphere	Acrylic Plexiglass Grade "G" Annealed
2)	Diver Compartment	Aluminum 5456
3)	Frame	Aluminum 6061

d. Air Supply

1) Air

a) Eight aluminum lined fiberglass wrapped

(1) Maximum Pressure 3200 psi

2) Volume at 3200 psi 324 cu. ft. ea.

Air System

Description

1. Air is stored in two separate banks of four cylinders each. The cylinders are attached to the frame on the port and starboard sides. Both banks are piped into the pilot's sphere and connected to the pilot's five-way valve, diver and mask five-way valves (3.1-A) and the air cross-connect. Either bank may be selected or both banks by opening the air cross-connect. Each bank has a common charging connection located on the charging manifolds. The air banks are pressurized to maximum allowable working pressures prior to each dive.

2) Oxygen

a) Two Steel Aluminum Lined Fiberglass wrapped Cylinders

(1) Maximum Pressure 3000 psi

(2) Volume at 300 psi 252 cu. ft. each

Description and Operation

1) Oxygen is stored in two separate cylinders. The oxygen cylinders are attached to the submersible's frame on the port and starboard sides of the diver compartment. Both cylinders are piped into the pilot's sphere. The port cylinder supplies oxygen to the pilot's sphere metabolic metering valve and flow meter, the diver compartment metabolic metering valve and flow meter and mask system five-way valve. The starboard cylinder is used as a back-up supply and can be used by opening the oxygen

cross-connect valve located in the pilot's sphere. Each cylinder has a common charging connection located on the charging manifolds.

2) Oxygen is piped from the pilot's sphere into the diver compartment oxygen metabolic metering valve. Oxygen then enters the dispersal tube or the closed circuit rebreather.

3) Gas

a) One Aluminum Sphere

(1)	Maximum Pressure	1900 psi
(2)	Volume at 1900 psi	1769 cu. ft.

b) Eight Steel "T" Cylinders (J-S-L II)

(1)	Maximum Pressure	3200 psi
(2)	Volume at 3200 psi	234 cu. ft. each

Description

1. Gas is stored in two separate banks, the gas sphere and the auxiliary bank. The gas sphere is located aft of the rear "A" frame between the lower frame and the strong back and is held in place by three bolts. The auxiliary gas bank, consisting of eight cylinders, is located on the port and starboard sides of the main battery. Both banks are piped into the pilot's sphere and connect to the pilot's five-way valve and diver and mask five-way valves. Either bank may be selected and cannot be cross-connected. Each bank has a separate charging connection located on the charging manifolds. The gas sphere and the auxiliary gas bank are pressurized to maximum allowable working pressure prior to each dive.

e. Ballast Capacities

1)	Main Ballast Tanks	3455 lbs. S.W.
2)	Variable Ballast Tanks	352 lbs. S.W.
3)	Dive Ballast Tanks	402 lbs. S.W
4)	Diver Compartment Bilge Tanks	286 lbs. S.W.

f. Power

1) Battery

a) Fourteen, 2 VDC EXIDE DTG-33 Lead-acid Batteries
b) 1152 Ampere-hours
c) Oil Compensated (25 gal. mineral oil)

Description

The battery is built from fourteen 2 VDC lead-acid batteries wired in series and center tapped to the provide + 14 VDC, and DC common. The batteries are housed inside an aluminum pod with a plexiglass top and are attached to the bottom of the submersible frame under the sphere. The pod is filled with mineral oil and pressure compensated through two 1/2 inch lines from two oil filled bladders housed in a compartment on the front of the battery pod. The plexiglass top contains an oil filling port, vent valve set approximately .25 lbs., a four conductor penetrator to connect the water detection and battery charging, and two battery posts. When the battery is fully charged it will indicate 31 VDC, and when it is about depleted it will indicate approximately 24.5 VDC.

2) Static Inverter

a) Input

(1)	Voltage	24 to 32 VDC
(2)	Current	4 to 16 amp.

b) Output

(1)	Voltage	115 VRMS $\pm$ 5%
(2)	Power	0 to 250 VA
(3)	Frequency	60 Hz $\pm$ .6 Hz

Description

The DC to AC inverter is mounted in a pressure proof cylinder attached to the frame of the submersible under the after end of the port main ballast tank. The inverter is energized by closing a switch and the sphere electrical control panel. The AC is routed into the sphere junction box and then out to the sonar and one outlet on the sphere electrical control panel.

g. Propulsion

1) Eight Identical Thruster

a) Propeller - Four Blades 14 x 14 L.H.
b) Motor

(1) Permanent Magnet Continuous Duty
(2) Reversible
(3) 1.25 H.P. at 3900 RPM
(4) 28 VDC

c) Planetary Reduction Gears 9 -1 100 lbs. ea.

d) Thrust

Description

The J-S-L obtains its three dimensional mobility from eight thruster units. All thrusters are controlled by individual switches on the thruster control unit inside the pilot's sphere.

h. Life Support

1)	Endurance	480 man hours (20 man days)
2)	Carbon Dioxide Scrubbers	
	a) Diver Compartment	Lindbergh-Hammer #787M9 H.B.F. Mod.
	b) Pilot's Sphere	Harbor Branch Foundation, Inc., Scrubber

Description

The dive chamber scrubber is a metal container consisting of a sealed continuous duty motor that is magnetically coupled to dual turbines and refillable scrubber cannister. It is mounted in the after end of the diver compartment and power is applied by closing switch on the sphere electrical control panel.

The HBF scrubber is a round container consisting of two boxer fans in series, a refillable scrubber cannister and a filter. It is mounted under the sphere hatch and power is applied by closing a switch on the sphere electrical control panel.

The units are cycled on and off as necessary to keep the CO2 level within normal limits. Fifty pounds of spare LiOH is carried in both the sphere and diver compartment, for refilling the cannisters, and yields 480 additional man hours of scrubbing ability.

3) Bio Marine CCR-1000

a) Operational Duration — 6 hours per scrubber charge

Description

As a life support system, the Bio-Marine CCR-1000 can be used in the close cycle diving mode or the units can be used to scrub the CO2 from the atmosphere. To use the unit as a scrubber, disconnect the exhaust side of the breathing hose and breath normally through the mouthpiece. Gas supply and electrical power is secured.

4) Emergency Breathing Regulators

a) Pilot's Sphere — 2

Description

Emergency breathing regulators are provided in the pilot's sphere. Air or gas may be selected as a breathing medium. In case of fire, flooding or atmosphere contamination, emergency breathing regulators will be donned.

5) Oxygen Masks

a) Diver Compartment 2

Oxygen masks with overboard dump are provided in the diver compartment.

6) Metabolic Oxygen Bleed

a) Pilot's Sphere 1
b) Diver Compartment 1

Description

Prior to each mission the J-S-L oxygen banks are charged to 3000 psi, and capable of sustaining life for 20 man days. Low pressure oxygen flow meters are provided in both the pilot's sphere and the diver compartment. The oxygen banks can be cross-connected in the pilot's sphere. Oxygen regulator by-passes are provided. Oxygen can be fed directly from the pilot's sphere into the diver compartment through a sampling line.

7) Oxygen Analyzer

a) Pilot's Sphere

(1) Beckman Atmosphere Oxygen Monitor (AOM) 6602

Description

A portable Beckman AOM 6602 is calibrated and placed in the pilot's sphere during the pre-launch check before each mission and removed during the post dive check after each mission. This AOM requires a self contained power source.

(2) One Remote Meter AOM 6602 from Diver Compartment

b) Diver Compartment - One Beckman Minos Atmospheric Oxygen Monitor Model AOM 6602

Description

During the pre-launch check before each mission a bulkhead mounted Beckman Minos AOM 6602 is calibrated and clamped to a frame in front of the diver compartment. It is removed during the post dive check after each mission. A remote monitor is permanently installed in the pilot's sphere. Either external or internal power may be selected on the diver compartment AOM 6602. The sensor is insensitive to other gases, and the output current is directly proportional to the partial pressure of oxygen.

8) Carbon Dioxide Monitors

a) Pilot's Sphere

(1) One Beckman Minos Atmospheric Carbon Dioxide Monitor (ACDM)

(2) One Bendix Gastec Analyzer - hand pump type

(3) One Remote ACDM Meter Monitor from Diver Compartment

b) Diver Compartment

(1) One Beckman Minos ACDM

(2) One Bendix Gastec Analyzer - hand pump type

j. Operating Characteristics

1) Depth — 0-1000 feet

2) Speed

a) Cruise	.75 knots 2 motors
b) Maximum	1.50 knots 4 motors

C. Diver Description and Equipment

1. JOHNSON-SEA-LINK Lock-out Dives

a. Breathing Equipment

Primary	Umbilical-supplied, open circuit , KMB-10 hat with communications
Secondary	Small Auxiliary Bail-out Bottle (KMB-10 only)

b. Breathing Mixture

Air
1200 cubic feet total-air
600 cubic feet total-O_2

Description

Normally a lock-out dive from the J-S-L will consist of one tethered diver who is tended by another diver from inside the dive compartment.

As the J-S-L approaches a lock-out site, the pilot positions the J-S-L on the bottom, pointing into the current at the work site, reports his depth to the support ship and requests permission to flood down.

After the divers are dressed-out and report ready for lock-out, the pilot requests permission from the surface to blow down. The divers secure their 02 bleed and CO2 scrubber, check "A" hatch undogged and report to the pilot standing by for blow down. Then the pilot initiates a count down over the underwater telephone and the J-S-L intercom. The diver-tender controls blow down in the diver compartment and maintains a 100' per minute descent rate. The rate of descent is monitored by the pilot. (If necessary, the pilot can override the tender). When the diver compartment equalizes and the "A" hatch seal is broken, the pilot reports to the support ship.

When the "A" hatch seal is broken the diver-tender secures the blown down, pushes "A" hatch of the manway and gives the diver a last minute check before he enters the water.

When the diver initially enters the water he gives the J-S-L a lift test by trying to lift it off the bottom, and makes a communication check with the pilot before leaving and diver compartment. The pilot reports to the support ship that the diver is out.

The diver is continuously monitored by the pilot and observer throughout the dive. The diver's bottom time is kept by the diver-tender, pilot, and support ship. The diver's umbilical is tended throughout the dive by the diver-tender.

When the diver returns to the J-S-L at the completion of his task, the diver-tender takes up the umbilical and assists the diver through the manway, lifts and dogs "A" hatch, drops "B" hatch and over pressurizes the diver compartment 5'-10'. The pilot reports the over-pressurization depth in the diver compartment to the support ship and requests permission to surface.

The divers blow the bilge ballast tanks and the pilot commences blowing the diver ballast tanks. The pilot reports to the support ship when the ballast tanks are blown dry.

As the J-S-L leaves the bottom, the divers commence venting the diver compartment to their first stop. The venting is monitored by the pilot and observer. Venting can be controlled either from the pilot's sphere or the diver compartment.

2. Surface Support

   a. Communications will be maintained between divers and pilot during swimming excursions, via hard wire.

   b. Communications will be maintained during lock-out dives from diver to submersible to R/V JOHNSON.

   c. Should prolonged decompression or treatment be necessary following a lock-out dive, the submersible will return to the surface and be mated to the decompression chamber aboard the R/V JOHNSON.

   d. All diving will be via diver lock-out.

D. Photographic Equipment

1. Camera Strobe

Hydroproducts Underwater Electronic Strobe Mode PF-730

Specifications:

1)	Pressure Proof Cylinder	7.75" dia. x 13"
2)	Test Depth	20,000 FSW
3)	200 watt second flash	--
4)	Power	24 - 30 VDC
5)	Charging time at 9 amps is 6 seconds	
6)	Weight: (a) In air	24 lbs.
	(b) In sea water	8 lbs.

Description

The Hydroproducts PF-730 Sea Strobe is clamped on the top of the forward starboard diver ballast tube and is moveable for adjusting flash cover-coverage. The power cable plugs into the #1 E.0 junction block and flash synchronization. Power is applied to the strobe by closing a switch on the electrical control panel. A standard flash photo contact cord is provided in the sphere for triggering the flash. Exposure is set by following a distance-aperture and visibility chart.

2. Flasher

Pelagic Electronics, Ind. Instrument IM4133

Specifications:

1) Aluminum Cylinder	3.5" dia. x 15.9"
2) Weight: (a) In air (b) In sea water	7 lbs. 2 lbs.
3) Flash intensity	1.2 watts-seconds
4) Flash duration	less than 100 uses
5) Flash rate	1 flash every 2 seconds
6) Battery type	240 volt dry cell, Ever-ready 491 (or equivalent)
7) Battery life to .5 output power	40 hours
8) Flashtube life	approximately 1 million flashes
9) Depth rating	2000 meters (proof tested to 5000 PSI

Description

The Model 4133 deep-sea flasher is a high intensity xenon flashing beacon powered by its own battery. The flasher is clamped to the aft top port side "A" frame with breakaway nylon .25" - 20 bolts. It is turned on by closing a switch on the sphere electrical control panel. The switch cable plugs into the forward starboard #1 E.O junction block.

3. Deep Sea Camera

Benthos Deep-Sea Standard Camera, Model No. 372

Specifications:

1)	Film Capacity	750 exposures on 30-meter (100-foot) spools of 35 mm film
2)	Objective Lens Focal Length	(1) 35 mm in water; (2) 28 mm in air
3)	Objective Lens Aperture	Adjustable from F3.5 to F22

4) Objective Lens Focus

Adjustable focus for distance in water from 0.6 meters to infinity. The focus scale is calibrated in both meters and feet underwater. The depth of field is automatically shown depending upon distance and aperture settings.

5) Data Lens

Aperture adjustable from F2.S to F22. Fixed Focus.

6) Shutter

Electrically operated and controlled from a remote source of 28 volts D.C. power. Speed set at 1/20 second (50 ms).

Adjustable from 1/25 (40 ms) to 2/5 seconds (400 ms).

7)	Viewing Angle	4° x 54°
8)	Alignment	
	Pin on Camera chassis positively aligns chassis with respect to the housing. Four orientations (90° apart) are possible.	
9)	Rated Depth	12,000 meters
10)	Temperature Rating	-20C to 50°C (28°F to 120°F)
11)	Capacitance	6000 mfd; 2 watt-seconds when charged to 28 volts DC
12)	Voltage	28 VDC
13)	Current	0.7 amperes peak during film advance
14)	Fuses	1 ampere, Slo-Blo
15)	Connector	Amphenol 14-pin
16)	Data Chamber Actuation	
	Internal batteries (2 1.5 V Alkaline "C" Cell). Everyready E93 or equivalent.	
17)	Camera Cycling Rate	
	Advance cycle completed in less than 3 seconds.	
18)	Materials	
	(a) Housing	17-4PH Stainless Steel
	(b) Window Retainer	303 Stainless Steel
19)	Weight	
	(a) In air	48 lbs.
	(b) In seawater	35 lbs.
20)	Dimensions	4.842" dia. x 25.281"

4. Benthos Deep-Sea Standard Flash Model No. 382

Specifications

1) Depth Rating — 12,000 meters

2) Power Source

Benthos Model 389 Battery Pack mounted with Flash housing. 28 VDC nickel-cadmium rechargerable type (24 Gould 1.2 volt, No. 4-OSCL, connected in series)

3) Capacitance — 262 microfarads; 800 volts: 100-watt-seconds

4) Number of Flashes — Approximately 1,000 with fresh battery

5) Flash Duration — Approximately 1 milli-second

6) Recycle Time — 3 seconds with charges battery

7) Spectrum of Light Output — White - Essentially the same spectrum as sunlight

8) External Materials - Housing

Hardened 17-4PH stainless steel. Lamp Cover Annealed glass. Lamp Cover Retainer: PVX plastic.

9) Weight

(a) In air — 63 lbs.

(b) In seawater — 50 lbs.

10) Dimensions — 8.25" dia. x 35,625"

Description

Photographs may be taken from inside the pilot's sphere by pressing a switch or automatically by setting the programmer in the flasher. The programmer inside the flasher can be set to take photographs as often as one every three seconds. A delay timer may be set so photographs are only taken after the J-S-L is on the bottom. A light emitting diode chamber, located in the camera, gives time, date, and run number on each frame exposed.

Suggested exposure with 100 WS flash, approximately 10 to 13 feet over the bottom:

Film	ASA	f
High Speed Ektachrome	160	4 - 5.6
Plus-X pan	125	3.5
Tri-X	400	5.6 - 8

E. Emergency Equipment Description

See Appendix 2.

F. Communications

1. Surface Unit Communications

Surface unit communications will be conducted via channel 16 between all surface vessels. Communication to J-S-L will be via Sub Base VHF 153.260 and 158.280 MHz.

No interference as a result of other radio operators in the area is anticipated.

2. Support to Undersea Platform

Underwater communications (UQC) sound frequency will be used.

3. Diver Communications

The lock-out diver will be able to communicate with the submersible pilot via open circuit, hard wire communication.

4. Communications and Sounding Equipment

a. Radio - (1) VHF - Modar Triton (M) 25W 12-channel, (2) SSB-Northern N-550 150W 12-channel, and (1) DSB/AM radiophone Konel KR-132CA 135W - 8 channel

b. Echo Sounders (1) EDO Western 9057 1 - 6000 fathoms and (1) Furuno 1 - 2000 feet

c. Under Telephone - (1) Straza ATM 504-14

d. Passive Tracking Sonar - (1) Straza Model 9010

5. Radio Frequencies

R/V JOHNSON	Expires 10/7/81
Fla. # FL 8402 BP1	WYG 9140 (HB-402 VHF (13 Monitor)
	Channels WX2-6-12-13-14- 22-26-27-28-68-80A

Sub Frequency

Sub Crew Channels WYG
9140 (HB 249)

16 - Sub Freq. - 80A

S.S.B #1	2082.5	4090.9	2182.0	2638.0
	2096.5	4385.3	-	2670.0
	4489.5	18590.2	4143.6	8291.0
	2031.5	-	-	-
	12345.2	12429.2	8207.4	8198.0
	13116.3	12432.2	8731.2	8722.0
S.S.B. #2	4143.6	W00410	16590.2	WOM 1206
	-	-	-	-
	W001203	12429.2	W00808	WOM 805
	-	-	-	-
	8291.1			

G. Navigation Control

1. Surface System

a. Navigation Equipment On Board Surface Support Vessels

<u>R/V JOHNSON</u>

1) Magnetic Compass - Plath Hanseat I

2) Gyro Compass - Sperry MK37 with 2 Repeaters

3) Radar - (1) DECCA 916 and (2) DECCA 914

4) Loran - (1) North Star 6000 (Loran C) (2 units with LAT/LON.)

5) Auto Pilot - Sperry

b. Sonar System (J-S-L)

The Straza Industries Model 500 CTFM (Continuous - Transmission - Frequency - Modulated) sonar electronic stack is mounted on the forward end of the electronics equipment rack in the center of the sphere. The training mechanism, with hydrophone and projector attached, is mounted on top of the pilot's sphere hold assembly. The high resolution sonar can detect and view underwater objects at all bearings and at ranges from 3 to 1500 yards. The system provides both audio and visual outputs and has the capability of maintaining simultaneous contact with multiple targets and markers or transponders.

c. Transponders

One Straza transponder Model 7030 is attached to the support ship's underwater electronics tower and is powered by 14 VDC from the electronics control station on the bridge. When the Straza transponder is interrogated by a signal from the submersible's sonar it transmits a pulse, shows up on the sonar PP1 scope as a "blip" and indicates range and relative bearing to the surface ship. A second Model 7030 transponder is carried on the support ship. It is battery powered and can be used as a back up or a location marker at depths to 100 feet.

d. Loran C

The R/V JOHNSON will use a Loran C (Two Northstar 6000's) for navigation.

e. Tracking

Tracking the J-S-L is accomplished with a Honeywell R57 indicator. This unit displays a signal received from a beacon mounted on J-S-L. The R57 displays two channels at one time on a bridge mounted cathode ray tube. This unit shows range and bearing and can track and display both submersibles simultaneously.

2. Undersea System

a. Pingers

The Straza pinger is mounted in a bracket on the after "A" frame and is turned on by a saltwater activated switch. The Helle pinger is a similar bracket on the after "A" frame and is switched on by closing a switch on the sphere electrical control panel.

These pingers are tracked by the support ship with a Straza marker receiver Model 9010/MRM-503 passive tracking sonar. Accurate relative bearings out to 2500 yards on the Straza pingers are normal.

b. Doppler Sonar Navigation System

The Sperry SRD-101 Doppler Navigation System consists of the following major components: The transducer assembly, the electronics pressure can, the control and indication unit, and the magnesyn compass.

The SRD-101 employs beams of continuous wave ultrasonic energy, directed obliquely at the ocean floor, to obtain true speed and distance covered over the bottom in the fore-aft and starboard-port directions. Speed and distance are displayed on a heading-drift indicator, along with desired magnetic course and actual magnetic heading.

d. Echo Sounder

The data marine digital echo sounder is mounted on top of the sonar stack in the forward part of the pilot's sphere. Power is applied by closing a switch on the sphere electrical control panel. A Model 3023 transducer is mounted on the after bottom "A" frame.

VII. Emergency Procedures

A. Advance Notification

The Coast Guard base located in New Orleans, La., has been informed in advance of the operation mission plans and will be monitoring the area in conjunction with their role prescribed by the Rules and Regulations of the Marine Sanctuary. Notification of the operation will be placed in the Notice to Mariners.

B. Search and Rescue Facility Availability

In advance of operations, the 8th Coast Guard District Operations office in New Orleans (504/589-6225) was notified. For emergencies, call 8th Coast Guard District Rescue Coordination center, day or night at 504/589-6225. There is also a 8th Coast Guard District Strike Team for oil pollution which has underwater salvage officers at Bay St. Louis, Miss., FTS 494-2380, civilian 601/688-2380.

C. Medical Treatment

Onboard the R/V JOHNSON is DDC facility which will be used to treat diver decompression accidents. A medical technician will be on-site throughout the diving operations. The DDC facility and the medical technician, who will operate the chamber, will meet all the requirements described in NOAA Circular 75-88. Additional medical treatment may be provided aboard the R/V JOHNSON dispensary facility.

D. Possible Emergencies and Planned Responses

HBF has developed the following four rescue systems to assist J-S-L-submersibles in emergency situations:

1. SEA GUARDIAN/CORD - This unmanned tethered vehicle can be fitted with an hydraulic cable cutter or can be used to carry a drop-lock mechanism attached to a hauling wire.

2. J-S-L submersible - A second J-S-L submersible can be fitted with a reel of hauling wire with a drop-lock mechanism on one end and an inflatable buoy on the other for emergency rescue.

3. Lock-out diver - A diver can be locked out of the disabled submersible or a second J-S-L submersible to use a cable cutter or for general reconnaissance.

4. Emergency buoy - Each J-S-L submersible carries a self deployed emergency buoy which carries 0.19 inch-Phillystran rope for attaching a hauling wire (see Appendix 2 for details).

Additional details on emergencies including fire, flooding, entanglement, etc. can be found in Appendix 2.

E. Emergency Notifications

1. Rescue and Assistance Forces

U.S. Coast Guard - see Section VII., B. and Appendix 3.

2. If any emergency situation arises the NOAA Representative on-site will report to the Director, Operations and Enforcement of Marine Sanctuaries who will immediately brief the Assistant Administrator for Coastal Zone Management, the Director of the OOE Office, the NOAA Diving Coordinator, and the Director of Public Affairs on the emergency, the steps which have been taken and planned remedial action. Following the close of the emergency situation the events which occurred will be documented for the record.

APPENDIX 1

Resumes of

Key Personnel

Thomas J. Bright
Associate Professor
Oceanography Department

Texas A&M University
College Station, Texas 77843
713/845-7131

Thomas Bright received his B.S. in zoology from the University of Wyoming in 1964 and his Ph.D. in oceanography from Texas A&M in 1968. His research activities have involved considerations of the ecology of pelagic and demersal deep-sea fishes. He has used manned underwater habitats in the Virgin Islands and Bahamas in pursuit of a continuing study of acoustical behavior of reef fishes.

Dr. Bright, associate professor of oceanography, returned to Texas A&M in 1969 after a year of teaching at Jacksonville University in Jacksonville, Florida.

LT Stephen C. Jameson
Director, Operations & Enforcement
Sanctuary Programs Office
National Oceanic and Atmospheric Administratiion

3300 Whitehaven Street, NW.
Washington, DC. 20235
202/634-4236

LT Jameson graduated from the University of Houston with a Bachelors Degree in Biology. During his undergraduate days he worked as a student-trainee in Marine Biology for the U.S. Naval Research Laboratory in Washington, DC, where he participated in 7 worldwide oceanographic cruises aboard the USNS GIBBS, USNS MIZAR, USNS HAYES and CRV KAPUSKASING. LT Jameson's interest in coral reefs and the Orient took him to the University of Guam Marine Laboratory where he obtained a Masters Degree in Biology and published several papers on coral reef ecology. He accepted a commission in the NOAA Corps in 1976 and spent his first sea assignment aboard the NOAA Ship OCEANOGRAPHER studying the effects of deep ocean mining of manganese nodules in the SE Tropical Pacific. Now assigned to the Office of Coastal Zone Management, LT Jameson is primarily responsible for managing marine sanctuaries for the Office of Coastal Zone Management.

Eric Powell
Assistant Professor
Oceanography Department

Texas A&M University
College Station, Texas 77843
713/845-7131

Eric Powell received a B.S. degree in 1972 from the University of Washington and his M.S. and Ph.D. degrees in 1976 and 1978 respectively from the University of North Carolina. He came to Texas A&M as an instructor in 1977 and became an assistant professor in 1978. His research has included work on the effects of H2S on marine meiofauna, the ecology of the sulfide system biotope, and the ecology of soft-bottom benthic communities.

Timothy M. Askew
Submersible Pilot
Harbor Branch Foundation, Inc.

RFD 1, Box 194
Fort Pierce, Florida 33450
305/465-2400

Timothy M. Askew is a submersible pilot and a qualified lock-out diver to depths of 300 feet using mixed gas and air. He has logged over 100 missions (300 plus hours) in J-S-L I and J-S-L II. His initial experience at Harbor Branch centered around the constructiion, completion and ultimate operation of J-S-L II, design and construction of propulsion motors, air conditioning and life support systems, and design and construction of a deck decompression chamber. Mr. Askew was with the Eaton Corporation from 1969 through 1973 as a research technician working with high pressure air, nitrogen, and explosive devices. He was with Continental Aviation and Engineering Corporation from 1965 through 1969 as a technician involved in all phases of engine buildup and testing. He graduated from Lawrence Institute of Technology, Southfield, Michigan, in 1972 with a B.S. in Industrial Management. He was Apprentice Airman to Aviation Machinist Mate 2/Class in the U.S. Navy from October 1960 to October 1964.

Nathaniel J. Eiseman
Assistant Research Scientist
Harbor Branch Foundation, Inc.

Link Port
RFD 1, Box 196
Ft. Pierce, Florida 33450

Dr. Nathaniel J. Eiseman was born in Washington, DC in 1943. His research activities have included systematics and ecology of benthic Chlorophyta, Phaeophyta, Rhodophyta and marine vascular plants. Nineteen publications and technical reports have come from this research. He has taught a number of courses, both undergraduate and graduate level.

Dr. Eiseman received a B.S. degree from Randolph-Macon College and a Ph.D from the University of South Florida. He has 13 year's experience in field and laboratory marine science as a student and as a professional.

He is a certified SCUBA diver and a submersible lockout diver.

Dr. Eiseman was awarded two internships by the Smithsonian Institution, Radiation Biology Laboratory, a teaching assistantship at University of South Florida, and research assistantships at Virginia Institute of Marine Science and University of South Florida. He was on the biology Faculty of Maryland State College. He has been a research scientist at Harbor Branch Foundation since 1973 and is also a member of the Graduate Faculty at Florida Institute of Technology.

Roger W. Cook
Operations Director
Harbor Branch Foundation, Inc.

RFD 1, Box 196
Fort Pierce, Florida 33450
305/465-2400

Roger W. Cook's career as an underwater specialist began while in the Navy's underwater demolition team. The use of hand-held sonar and Swimmer Propulsion Units from Navy Fleet Submarines were among his duties. Following his naval service, Mr. Cook worked for the Pacific Missile Range on Kwajelein in the Marshall Islands recovering missile wreckage and components. During this time, he was trained by representatives of Perry Submarine Builders as pilot of the PC3A submarine; a dry, two-man submersible rated to 300 feet. He logged more than 70 dives in this submersible. From 1966 to 1972, Mr. Cook was employed by Ocean Systems, Inc., as Chief Pilot for the Link-designed diver lock-out submersible DEEP DIVER. He logged more than 80 dives at sites ranging from Newfoundland to Europe and the Caribbean. Most of these dives were lock-out, two were saturation dives. DEEP DIVER, depth rated to 1350 feet, was used for work with the U. S. Navy under the Search and Recovery contract. This work also included use of an ADS IV (Advanced Diving System) to recover crashed aircraft and other objects in depths greater than 200 feet. In 1972, Mr. Cook joined Perry Submarine Builders as Project Supervisor for the designing and supervision of construction for the complete outfitting of a one-atmosphere, 5-man personnel transfer bell. He then procured and adapted a support vessel for the PTB. He piloted 41 dives in the PTB. Since January of 1974, he has been with Harbor Branch Foundation, Inc., a not-for-profit corporation engaged in pollution studies, ocean science and engineering research and development. As Operations Director, he is repsonsible for planning and directing the missions of the foundation's research vessels, submersible support ships, and the J-S-L I and II, Harbor Branch's aluminum and acrylic submersibles. Through his supervision and training for the 4-man crafts, these submersibles are used for diver lock-out which serve the marine scientists at Harbor Branch with the capability to observe, collect living samples, photograph, chart and measure features and phenomena of the undersea environment heretofore not possible for surface oceanographic ships. Mr. Cook has directed more than 100 scientific cruises thus far at Harbor Branch, the most recent being a 600' lock-out dive off the coast of Fort Pierce, Florida, the second deepest on record from a submersible. The record lock-out dive, 700 feet, was performed by him from the Perry-Link DEEP DIVER in 1968. He also made the world's deepest salvage dive at 510 feet and deepest aircraft recovery in freshwater at 440 feet. He has personally logged over 100 bell dives.

Robert S. Jones
Director, Johnson Science Laboratory
Harbor Branch Foundation, Inc.
RFD 1, Box 196
Fort Pierce, Florida 33450
305/465-2400

Dr. Robert S. Jones was born in Gatesville, Texas in 1936. He is a marine scientist, educator, and research administrator. His research specialties have included marine ecology and fisheries biology. He has taught a wide range of college level courses, both graduate and undergraduate, and has administered grants and conducted research in marine science resulting in numerous publications and technical reports. His educational credentials include B.A. and M.A. degrees from the University of Texas and Ph.D. from the University of Hawaii. Dr. Jones served in the U. S. Navy as an LTJG aboard a hydrographic survey ship. His duties included assignments as Communications Officer, Operations Officer, and he was qualified Watch Officer underway. He has 24 years of experience in handling power boats and ocean cruising sailboats and has 26 years of experience in diving, including saturation and submersible lock-out diving. Dr. Jones held the rank of full professor and was the first director of the University of Guam Marine Laboratory. He served as research associate and program manager for a research contract between the University of Texas and the U. S. Bureau of Land Management. In this position, he was responsible for management of a four-university consortium study of the Texas outer continental shelf. Dr. Jones first joined Harbor Branch as fisheries biologist in the Indian River Coastal Zone Study. He now serves as director of the Johnson Science Laboratory at Harbor Branch.

Joseph L. Morgan
Master, Vessel R/V JOHNSON
Harbor Branch Foundation, Inc.
RFD 1, Box 194
Fort Pierce, Florida 33450
305/465-2400

Mr. Morgan began his career in boating in the early 1930's as deckhand and operator of water taxis and sport fishing vessels in Southern California. In 1943, he branched into towboat work as Captain, and from March 1945 to March 1946, Tugmaster in the U. S. Navy, San Francisco Area. In 1946, after an Honorable Discharge, he returned to Tugmaster duties in Long Beach, Los Angeles Area harbors, and Coast-wise towing. From 1966 to 1969, he was engaged by Offshore Constructors as Bargemaster and expeditor for offshore drilling operations, Santa Barbara Area, and Cooks Inlet, Alaska. From 1969 to 1974, he was Engineer, Captain and Manager for General Marine Transport Company of Santa Barbara, California. June 15, 1974, to present time, he has been Master of the R/V JOHNSON, Harbor Branch Foundation.

Jeffrey R. Prentice
Submersible Pilot/Diver
Harbor Branch Foundation, Inc.

RFD 1, Box 194
Fort Pierce, Florida 33450
305/465-2400

While at the University of Puerto Rico working on a masters degree in Ichthyology, Jeffrey Prentice was Dive Master under the Diving Supervisor, and Emergency Team Leader in charge of the recompression chamber. Since 1973, Mr. Prentice has worked with Harbor Branch Foundation, Inc., in all phases of submersible operations. His responsibilities have included installation, operation and maintenance of the decompression chamber facility aboard R/V JOHNSON; he is a submersible pilot, group leader and at sea, operations director. He is a lock-out diver with two open water dives at 500 feet. While working with Harbor Branch, Mr. Prentice was temporarily assigned to the Duke Hyperbaric Chamber Facility where he was a diver on mixed gas versus a straight Heliox mixture.

Marshall W. Flake
Submersible Pilot -
JOHNSON-SEA-LINK I, II
Harbor Branch Foundation, Inc.

RFD 1, Box 194
Fort Pierce, Florida 33450
305/465-2400

After four years of U.S. Naval Submarine service, Mr. Flake was Dive Master for Small Hope Bay Lodge, on Andros Island, Bahamas, in charge of all diving, diving instruction, and small boats. In August 1972, Mr. Flake came to Harbor Branch, where he became proficient in pneumatic control systems, hydraulics, high pressure gas systems, man-rated systems, life support and high pressure O2 systems. He participated in the construction, design and installation of components and piping in the initial construction of J-S-L II and retrofit of J-S-L I. He is also a qualified lock-out diver in open and closed circuit mode. He was qualified as pilot in March of 1977 and to date, has over 100 hours in this capacity.

APPENDIX 2

J-S-L- Emergency Procedures,

DDC Facility and Life Support Systems

Communications

1. If voice communications are lost on the underwater telephone for fifteen minutes, the J-S-L pilot should surface with extreme caution as soon as practicable, attempt to communicate on the way up by both voice and C.W., establish communications via FM transceiver when surfaced.

2. In the event that communications are lost on the surface and the support ship is not in sight, turn on the flasher and attempt to communicate on FM transceiver with any station on the emergency Channel F1 (Channel 16). If you suspect that both FM transceivers are out of commission and believe the support ship to be within a two-mile radius, consider diving the J-S-L to 50 feet and attempting contact on the underwater telephone or via C.W.

3. If the J-S-L gets entangled on the bottom, communications between the sphere and the dive compartment should be made on the sound powered phone and communications to the support ship should be held down to a minimum to conserve the battery. The underwater telephone uses power as follows:

	Mode	Current
a.	Receive	1 amp.
b.	Transmit Near	1 amp.
c.	Transmit Medium	8 amp.
d.	Transmit Far	17.5 amp.

4. Transmit time can be held to a minimum using the codes outlined in Appendix "C".

Flooding

1. Uncontrollable - It is highly unlikely that J-S-L could encounter an uncontrollable flooding situation without having a collision with another vessel or submerged object. It is also doubtful that the diver compartment would be penetrated in a collision. One of the main ballast tanks could be pierced and rendered almost useless, but the J-S-L could surface on the other tank and if necessary, the battery pod could be dropped. The most vulnerable part of the J-S-L is the plexiglass sphere that could crack if it comes in contact with another hard object at a combined speed of 1.81 knots on the surface to 4.77 knots at 1000 feet. Evidence to date shows that the hull may crack but would probably stay together and not leak due to external pressure holding it in compression. If this was the case, the J-S-L should not attempt to surface above 100 feet. At that depth divers would rig securing lines to the J-S-L frame to be winched under the handling system for recovery. The action to be taken depends on the situation as follows:

   a. If the diver compartment has a seal and the pilot's sphere has uncontrolled flooding:

      (1) Blow main ballast.

      (2) Release the emergency buoy.

      (3) Thruster up if possible.

      (4) If the crack is in the lower two-thirds of the sphere, and water is coming in, pressurize as necessary.

      (5) Blow all remaining ballast.

      (6) Inform the support ship and diver compartment.

      (7) Secure electrical power as dictated by the flooding.

      (8) Don emergency regulators and face masks as necessary.

      (9) Drop the battery as a last resort.

      (10) When the J-S-L arrives on the surface, stay in the submersible, turn on the flasher, communicate if possible and maintain positive buoyancy until help arrives.

b. If the pilot's sphere has a seal and the diver compartment has uncontrolled flooding:

(1) Blow main ballast (use gas bank not needed for pressurization of diver compartment).

(2) Check selection of correct supply to blow and mask 5-way valves.

(3) If necessary, divers should be on the rebreather or mask system.

(4) Report to surface ship.

(5) If flooding is rapid, pressurizing of the dive compartment may be required.

(6) Prepare to drop the battery (complete flooding of the diver compartment will require dropping the battery and blowing main ballast tank dry to achieve positive buoyancy).

(7) Secure electrical power to the diver compartment. Communicate via the sound-powered phone.

(8) If main ballast tanks are dry and the J-S-L is still negative, dropping the battery will produce a positive buoyancy of at least 700 lb. Switch to emergency battery and inform the surface, then drop the battery. Ascent will be uncontrolled.

c. In the event of surface collision, it is possible that one or both main ballast tanks might be damaged as well as the pilot sphere, and dropping the battery would not provide positive buoyancy. Once the J-S-L was on the bottom, personnel in the pilot's sphere could tranfer to the diver compartment as a last resort. Communication with the surface would almost certainly be out and probably with the dive compartment. The procedure would depend on the pilot's assessment of damage, but would resemble the following:

(1) Blow the emergency buoy.

(2) Establish communications with the divers. (A written message could be held against the back of the sphere and read through the forward viewport in the diver compartment). Inform them of transfer attempt. Prepare for pressurization. Close sphere access line hull stop in diver compartment.

(3) Open air cross-connect.

(4) Open oxygen cross-connect.

(5) Select the desired supply with the pilot's 5-way valve and line up the emergency cross-connect manifold so the divers can pressurize using the sphere access line hull stop.

(6) Pressurize the diver compartment and have a diver stand by pilot's sphere hatch.

(7) Complete flooding sphere as neccesary to allow hatch to be opened.

(8) Send observer back to diver compartment with standby diver. Have diver return when "A" hatch is clear; swim back to diver compartment.

(9) Have diver remove all lead ballast and all unnecessary equipment. At this point, it is conceivable if only one main ballast tank is damaged, the battery is dropped and all other tanks are dry that the J-S-L might become slightly positive. The diver should be prepared to return quickly.

(10) If the J-S-L remains on the bottom, the crew would have to use the diver compartment as an ambient pressure habitat until help arrived. With four persons and no electrical power, CO_2 scrubbing would have to be accomplished by other means. If the inhalation hoses of the rebreather masks were disconnected, two people could at least partially scrub the compartment for four. The other two could take absorbent and fold it up in any piece of cloth and breathe through it. Emergency CO_2 absorbent stored in the diver compartment should last two days.

2. Controlled Flooding (leaks) - the following type leaks might occur anytime at any depth:

a. Minor leaks due to "O" ring failure or corrosion around mechanical, electrical, and pipe hull penetration.

b. External depth gage leaks due to gage failure.

c. Pneumatic lines leaks allowing water to back-up line into J-S-L compartment.

d. Electrical penetrator burn out.

Any one of the above is cause to abort a mission. Surface as soon as possible. Pressurization of the sphere to control these leaks should not be done except when on the surface. The sphere hatch will only hold 60 PSI of internal differential pressure. Electrical equipment should be secured as necessary to eliminate short circuits.

Fire

1. The most probable cause of a fire in the J-S-L will be an overloaded circuit due to a ground or a faulty electronic component. Prior to the fire, the submersible occupants are likely to detect an odor of smoldering insulation and/or possibly see smoke. Just prior to this or maybe simultaneously, the occupants should note the failure of a piece of equipment. The second most probable cause of a fire would be due to auto-ignition in one of the pneumatic systems. Because fire cannot be entirely ruled out, oxygen should be carefully monitored to eliminate concentration above twenty-one percent. The lowest concentration of oxygen capable of supporting life wihout any ill effects is 16 percent.

2. Smoke and/or fire while cruising:

   a. In the sphere

      (1) Turn off circuit breakers.

      (2) Turn off sphere O_2 flow.

      (3) Don emergency regulators and face masks.

      (4) Fight fire with extinguisher and/or water.

      (5) Commence surfacing.

      (6) Inform the support ship and diver compartment.

      (7) Upon reaching the surface, ventilate with HeO_2; through the flare gun barrel as necessary.

   b. In the diver compartment

      (1) Secure the O_2 bleed.

      (2) Inform the sphere.

      (3) Don emergency rebreather or masks, or Kirby Morgan masks.

(4) Fight fire with extinguishers and/or water.

(5) Sphere:

(a) Secure diver power and oxygen to the diver compartment.

(b) Commence surfacing.

(c) Inform the support ship.

(d) When the J-S-L reaches the surface, have the divers ventilate the diver compartment with HeO_2.

3. Smoke and/or fire while a diver is locked-out:

a. In the sphere

(1) Secure the oxygen bleed.

(2) Call the diver back.

(3) Turn off circuit breakers.

(4) Don emergency regulators and face masks.

(5) Fight fire with extinguishers and/or water.

(6) Man the sound-powered phone.

(7) Commence surfacing as soon as the diver compartment is over pressurized.

(8) Inform the support ship if possible.

(9) Upon reaching the surface, ventilate with HeO_2 through the flare gun barrel.

b. In the diver compartment

(1) Inform the sphere.

(2) Don emergency rebreather or spare Kirby Morgan mask and enter the water in the manway.

(3) Fight the fire with water or extinguisher.

(4) Blow down with HeO_2.

(5) Sphere:

(a) Alert the diver in the water.

(b) Secure oxygen to diver compartment.

(c) Inform the support ship.

(d) As soon as the smoke is cleared, get the divers back inside and commence surfacing.

Ruptured Pressure Line

1. Internal - A ruptured pressure line or leaking fitting on any one of the pneumatic systems inside the submersible can easily be detected by the sudden change in the noise level and/or the increase in compartment pressure. A leak in the oxygen system can also be detected by monitoring the PO_2 meters. The faulty system should be isolated immediately by securing the appropriate hull stop valve. In most cases, it will be possible to bypass or repair the malfunction while submerged. A report should be passed to the support ship.

   a. Ballast tank pressurization lines - A ruptured or leaking ballast tank pressurization line would be detected by observing bubbles while pressurizing the ballast tank. Since the variable ballast tanks have a common pressurization line, a break in this line would disable both. All other ballast tanks have separate pressurization lines and a broken line can easily be isolated by securing the appropriate blow valve. The main ballast tanks also can be pressurized from the diver compartment. The mission should normally be aborted and the pilot should request permission to surface as soon as practicable after detecting a faulty ballast tank pressurization line.

   b. Gas supply lines - A rupture in one of the gas supply lines will be detected by loss of pressure on the appropriate gage and/or bubbles in the water. In the event a gas supply line is broken, secure the appropriate hull stop valve and realign valves as necessary to keep the J-S-L operational. Request permission to surface as soon as practicable.

Entrapment

1. Your best insurance for survival in case of entrapment is the pre-mission planning and the thoroughness with which the pre-launch check was made; one item overlooked could make the difference between life and death.

2. Entrapment of J-S-L means that it is being physically held in place, such as getting caught in a crevasse, being stuck in the mud, entangled in plant life, or entangled in submerged debris, such as cables or fishnets. More than likely, the J-S-L could be worked out of all these situations by using the thrusters and blowing all ballast tanks, except entanglement in submerged debris.

3. As long as either the diver compartment or pilot's sphere is dry, the J-S-L has enough positive buoyancy to surface if it is not anchored to the bottom in some way. If, by chance, the diver compartment was flooded, the battery pod would have to be dropped and the main ballast tanks blown to gain enough positive buoyancy to surface.

4. If the J-S-L is entrapped and cannot break loose by normal means, and neither the pilot or divers can clearly determine that a lock-out diver could free the submersible, the J-S-L would blow the buoy, vent its tanks, secure all unnecessary equipment to conserve power, and await rescue. A lock-out dive would be conducted only as a last resort in the event that the divers were unable to clear the obstruction.

5. If the divers are unable to free the J-S-L, bring them back in and shut both "A" and "B" hatches. Do not over pressurize. Keep calm, conserve power, monitor your PO_2 and PCO_2 meters, and maintain communication on the sound-powered phone.

NOTE: Anytime the J-S-L is launched, it has gas onboard for a lock-out to maximum mission depth plus adequate dive gear and rescue tools aboard. There is always at least one qualified J-S-L lock-out diver in the diver compartment.

DDC Facility

The following is a detailed breakdown of the D.D.C. volumes and gas storage capacities:

Entrance Lock = 67.9 S.C.F.
Main Lock =127.9 S.C.F.
Transfer Trunk = 26.0 S.C.F.
Medical Lock = 1.5 S.C.F.

PSI Rating 350 psi = 785 F.S.W.

E.L. at 785 F.S.W. = 1683 S.C.F.
M.L. at 785 F.S.W. = 3170 S.C.F.
T.T. at 785 F.S.W. = 644 S.C.F.

TOTAL 5497 S.C.F. = 53.9% of R/V JOHNSON Heliox Banks or a Reserve Capacity of 4703 S.C.F.

H_e/H_eO_2 Bank	Cu. Ft.	
1	1200	
2	1200	
3	900	
4	900	
5	1200	
6	1200	
7	1500	
8	1200	
*9	900	(H_e for Fire System Pressure in D.D.C.)
10	900	
	10,200	cu. ft. (*not counting #9)

Oxygen = 2100 cu. ft.
Air = 2400 cu. ft.

.8 ATM O_2 = 3.23% mix at 785 F.S.W.

3.23% of 5497 S.C.F. required to blow M.L., E.L., and T.T. to 785 F.S.W. = 177.5 S.C.F. O_2. 177.5 S.C.F. O_2 = 8.45% of R/V JOHNSON O_2 capacity.

If J-S-L is filled to capacity with proper mix for diver and R/V JOHNSON is also filled to capacity we would theoretically have 46.1% of ships HeO_2 capacity as reserve gas available for the entire D.D.C. complex. Oxygen does not present a problem until oxygen decompression is needed.

For example:

at 60 ft. with two divers breathing 3/4 cu. ft./min. of O_2 (each) = 1.5 cu. ft./min. x 2.8181 ATM = 4.23 cu. ft./min. or 253.6 cu. ft. O_2/hr.

For example:

At 30 ft. O_2 consumption would be 171.8 cu. ft./hr.

Total O_2 capacity of R/V J = 2100 cu. ft. O_2

The D.D.C. facility aboard R/V JOHNSON is a closed circuit system with full instrumentation to monitor and control life support. Environmental control equipment include the following:

1. Beckman CO_2 Analyzer
2. Lindbergh Hammar CO_2 Scrubber
3. Bio Marine O_2 Analyzer Recorder
4. Pyrotector Automated Fire Suppression System
5. Helle Communications
6. Lighting via External Source
7. Remote Temperature Proble
8. Scott Oxygen Breathing Regulators with Overboard Dump

Other equipment which enhance the safety of the entire complex or which are back-up equipment are the following:

1. Bio Marine Hand O_2 Analyzers (3)
2. Bio Marine Explosive Gas Monitor
3. Remote O_2 Emergency Shut-off
4. 12, 24 and 36 V.D.C. Electrical System
5. Open-mike land phone (when in Link Port)

PRIMARY LIFE SUPPORT EQUIPMENT

1. Beckman CO_2 Analyzer (see Reference 1)
2. Lindbergh Hammar Scrubber
   Sodasorb is used in these units and can either be filled within the chamber or a fresh canister can be sent in via the medical lock. See Reference 2 for further information on the performance.
3. Bio Marine O_2 Analyzer Recorder
   This unit will simultaneously measure the PO_2 in the main lock and entrance lock as well as the ship's lazarette and control console. Rustrak recorders continuously operate for the main lock and entrance lock only. The chamber stations read from 0 - 2.0 ATM of O_2 and the lazarette and control console stations read from 0 - 0.4 ATM of O_2. For further information, see Reference 3.
4. Pyrotector Automated Fire Suppression System
   This integral system utilizes Helon 1301 in the control console and lazarette and water with a helium pressure head for the main lock and entrance lock. Operation of the system is either manual or automatic utilizing numerous infra-red sensors to activate the system. For further information on this system, see Reference 4.

5. Helle Communications
   This system provides communication via speakers to the main lock and entrance lock. To date no provisions have been made for helium voice unscrambling. Communications are continuously open from the chambers to the control console.
6. Lighting via External Source
   Light to the main lock and entrance lock is provided via J. M. Canty Associates rheostated lights mounted externally. Light enters the chambers via plexiglass penetrators.
7. Remote Temperature Probe
   Continuous monitoring of the temperature in the main lock in degrees F is shown in the control console on a Weksler Instrument Gauge.
8. Scott Breathing Regulators with Overboard Dump
   There are two regulators in the main lock and one regulator in the entrance lock. All regulators have a first stage regulator mounted internally to provide 125 psi over ambient to the divers. All masks are also equipped with a vacuum regulator so that divers may use them as emergency breathing regulators at any depth. These same masks provide either air, mix-gas or oxygen to the divers upon demand.

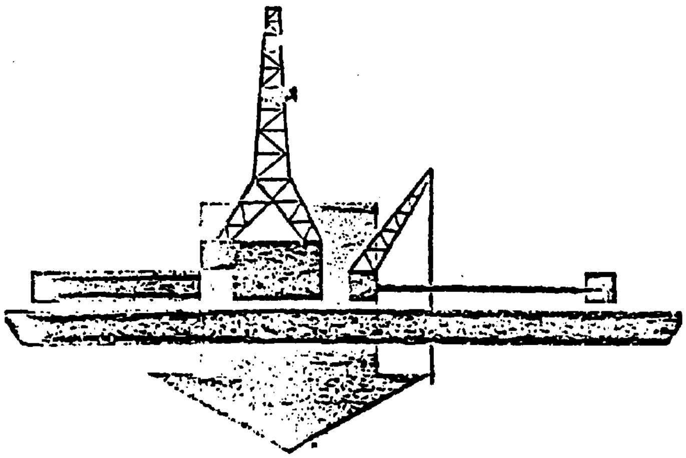
BACK-UP EQUIPMENT

1. Bio Marine Hand-Held O_2 Analyzers
   Three model 255 Bio Marine O_2 Analyzers are available in the control console with the following scales: 0 - 100%, 0 - 25%, 0 - 10% and 0 - 5%. One unit is semi-permanently attached to the sample line from the main lock and entrance lock. For further information on this unit, see Reference 5.
2. Bio Marine Explosive Gas Monitor
   This unit continuously monitors for the presence of any flammable or explosive gas in the lazarette. For further information, see Reference 6.
3. Remote O_2 Emergency Shut-off
   In the event of fire or catastrophic leak in the oxygen system the O_2 bottles can be secured at the bottles via a remote valve in the control console area. This is done utilizing pneumatic shut-off valves. These valves must be turned on topside prior to each operation.
4. 12, 24, and 36 V.D.C. Electrical System
   Every essential life support system is run on D.C. current so that in the event of malfunction or temporary shut-down of the ship's 110 and 220 V.A.C. system, all functions will continue normally. The only equipment which will not run on A.C. is the internal lighting in the chambers and the Rustrak recorders in the O_2 monitoring station.
5. Open-mike Land Phone
   When the ship is in Link Port there is a telephone in the control console area which can be operated "no hands".

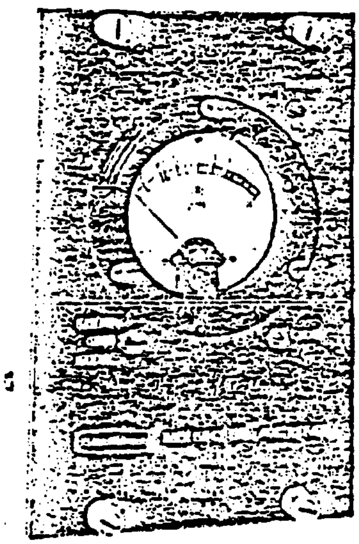
REFERENCE I

PRIMARY LIFE SUPPORT EQUIPMENT

BECKMAN CO_2 ANALYZER



Beckman MINOS®
Atmospheric
Carbon Dioxide Monitor



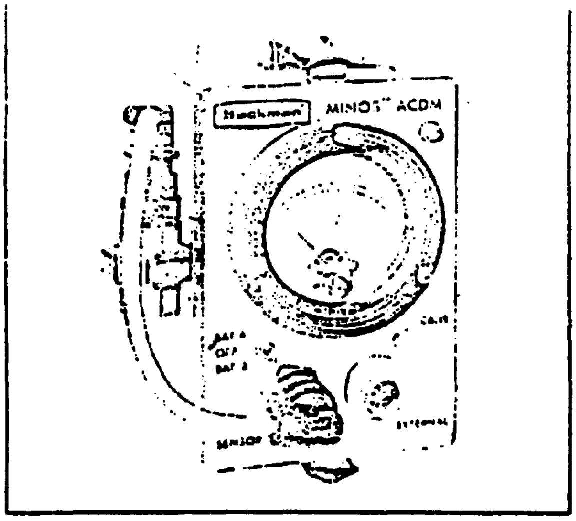
General Description
Designed for the rugged hyperbaric environments of diving, clinical, and research chambers, the MINOS ACDM (Atmospheric Carbon Dioxide Monitor) will faithfully safeguard your breathing environment by measuring carbon dioxide content from 0.1 through 30 millimeters of mercury partial pressure. Although the availability of oxygen at safe levels in a sealed chamber is critical, the build-up of carbon dioxide must also be monitored carefully. The MINOS ACDM helps to make certain that personnel inside chambers are not exposed to dangerous levels of carbon dioxide. The MINOS ACDM—together with its companion MINOS AOM (Atmospheric Oxygen Monitor)—offers you a *complete* atmospheric monitoring system.

Superior Design Sensing System
This self-contained system responds directly to the partial pressure of carbon dioxide, independent of total sample pressure. Operating electro-chemically, the sensor contains a pH electrode and a reference electrode. Separated from the atmosphere by a membrane permeable to carbon dioxide, the electrolyte pH will change as a function of exposure to carbon dioxide. Electrode potential is proportional to a logarithm of the partial pressure of carbon dioxide in the sample. The partial pressure of carbon dioxide is displayed on a logarithmic meter scale on the instrument. The ACDM may be ordered for either panel or bulkhead mounting.

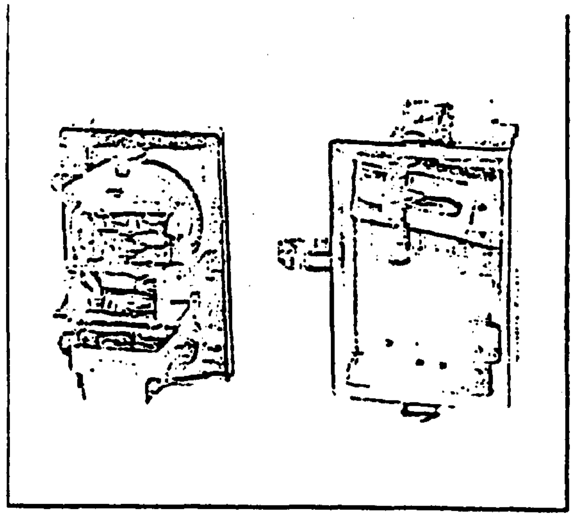
The rechargeable sensor will operate up to 30 days before recharging is necessary. Since the sensor receptacle contains a preamplifier, the sensor can be used at considerable distances from the meter, with no signal degradation from cable noise; or, if desired, the sensor-receptacle assembly is easily mounted directly on the face of the instrument. The ACDM functions in operating pressures as high as 35 absolute atmospheres, making it ideal for almost any application from ambient to hyperbaric pressure.

Features
- Uses alkaline batteries or 12 to 32 VDC external power (some options require 14 to 32 VDC external power).
- External outputs available for remote alarms, meters, recorders, or an analog-to-digital converter.

Complete Monitoring Systems
By using the MINOS ACDM in conjunction with the MINOS AOM (Atmospheric Oxygen Monitor), a complete atmosphere monitoring system is established. Ask for Bulletin 0-2016 for information on the MINOS AOM.



Bulkhead Model mounts easily on any vertical surface.



Compact and self-contained, ACDM is all-solid-state.

Specifications

Operating Range:	0.1 to 30 millimeters of mercury, P_{CO_2}.
Accuracy:	±4 percent of full scale, 60 to 90°F ±8 percent of full scale, 40 to 110°F ±10 percent of full scale, 35 to 130°F
Stability:	±3 percent of full scale, 30 days, at 80 percent relative humidity.
Absolute Pressure Range:	0.5 to 35 absolute atmospheres.
Response Time:	63 percent response to step function increase in sample partial pressure to 25 mmHg, P_{CO_2}, or more within one minute.
Relative Humidity:	To 100 percent.
Outputs:	0 to 2.5 Vdc with 25K minimum load; 0 to 50 mVdc at 500 ohms; 0 to 100 μA; all outputs double-ended.
Options:	For alarm and control options, see price list for Bulletin 0-2018.
Power:	12 to 32 Vdc external source or internal batteries (Mallory MN 1604 alkaline cell); 14 to 32 Vdc external power for alarm and control options.
Size:	Bulkhead Mount, 6¼ x 4¼ x 3½ inches; Panel Mount, 7½ x 5 x 5 inches.
Weight:	Bulkhead Mount, 5¾ pounds; Panel Mount 4½ pounds.

Beckman INSTRUMENTS, INC.
OCEANIC EQUIPMENT ACTIVITY
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2500 HARBOR BOULEVARD, FULLERTON, CALIFORNIA 92634
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REFERENCE 2

PRIMARY LIFE SUPPORT EQUIPMENT

LINDBERGH HAMMER SCRUBBER

LINDBERGH-HAMMAR ASSOCIATES
~~559 Maple Avenue, Carpinteria, California 93013~~
~~Telephone: (805) 684-4319~~
5511-A EKWILL 87
SANTA BARBARA, CALIF 93111
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2329

JON M. LINDBERGH
Consultant
JAMES H. HAMMAR
Development & Engineering
ROBERT A. BAKER
Administrative

THEORY OF OPERATION
PURA 787M CARBON DIOXIDE REMOVAL SYSTEMS

Units in this series are assembled from three main components; an outer sealed case, a refillable dessicant canister, and a power unit. The canister and power unit are mounted in tandem within the exterior case. In operation the turbine end of the power unit exhausts air from inside the case, forcing it out through coaxial ducting surrounding the power unit. As the gas within the case is exhausted, a pressure differential is established, causing external air to flow through the intake end of the dessicant canister. This air is scrubbed or purified by chemical compounds which retrieve and retain carbon dioxide, and pass other gases in the breathing mixture to be reused indefinitely.

Operating electric motors of any type in environments with high partial pressures of oxygen or flammable gases is extremely hazardous. Commutator-type motors with sparking brushes are obviously dangerous. Induction motors, though brushless, are also dangerous since short circuits can develop in field and rotor coils to trigger an explosion. Inverter-type motors share the same deficiencies.

The PURA 787M completely isolates the motor, wiring system and other electrical components from contact with the environmental atmosphere by installing these inside a heavy walled pressure vessel. To eliminate the danger of seal wear on a rotating motor shaft, a magnetic coupling connects the motor with the external dual turbine. There is no direct mechanical connection between motor and turbine; magnetic lines of force pass through solid stainless steel, establishing a high torque interlock. All dynamic sealing is eliminated. Other static sealed closures are dual sealed with two types of O-ring glands for safety. Each unit is environmentally leak checked at pressure stages from 1 to 1500 PSIG and certified.

Motor heat is dissipated through a heat sink system. There is no direct air flow through the motor

All bearings in contact with high pressure environmental oxygen are specially treated and compatible with any breathing mixtures.

ELECTRICAL CONNECTIONS - 787M9 Series scrubbers operate on 24 to 60 volts, AC or DC. The motor is a universal type and is uni-directional; it cannot be externally reversed by interchanging leads. Connect two wires from hull penetrator to a suitable power source. Make certain that all connections are mechanically tight. Tie down all loose cable with suitable straps or clamps to guard against accidental snagging. Use only approved explosion-proof switches in pressurized environments. DO NOT make or break pressure-exposed connections in oxygen atmospheres.

GROUND TERMINAL - Secure a heavy gauge wire to the ground terminal (located at the exhaust end of the unit next to the hull penetrator) and connect it to an adequate ground; (metal sidewall of a hyperbaric chamber). CONNECT GROUND CABLE BEFORE OPERATING UNIT.

MOUNTING- Scrubbers will operate in any attitude. Preferred mounting position is vertical, against a sidewall near floor level. (See Loading) Any holes drilled and tapped into the scrubber end plates for mounting purposes should be sealed gas-tight with RTV Silicone Cement. (See Punctures) Special mounting brackets are available from the factory.

SNAP-LOCKS - The quick-release hooks securing the loading cover penetrate the case through O-ring gland fittings and are gas-tight. Apply a drop of APPROVED SILICONE OIL to each rod to keep it operating smoothly. (See Lubrication and Loading)

FITTINGS and HARDWARE - All stock fittings have been tested and certified. Do not endanger safety and certification by changing or altering installed fittings. If modifications are required, return to factory for refitting, testing and certification. (See Maintenance). DO NOT DRILL, TAP WELD, OR IN ANY WAY ALTER THE PRESSURE HOUSING.

ABSORBENT - Any approved carbon dioxide absorbent may be used, including plastic prepacks (disposable type). Prepacks are NOT recommended in high partial-pressure oxygen atmospheres because of their flammability. Gas flow through prepacks is not as efficient as through stock stainless steel refillable canister. (See Loading and Baralyme/Sodasorb : pH)

CO_2 REMOVAL - Gas exchange rate is controlled directly by varying input voltage. Unit can be ideally matched to any system by monitoring CO_2 level and altering the supplied voltage. In large hyperbaric installations, multiple scrubbers may be used to hold CO_2 concentration at the required level. (See excerpts - test reports)

PAINT - Use only fire-resistant, oxygen-compatible epoxy coatings when retouching any surface.

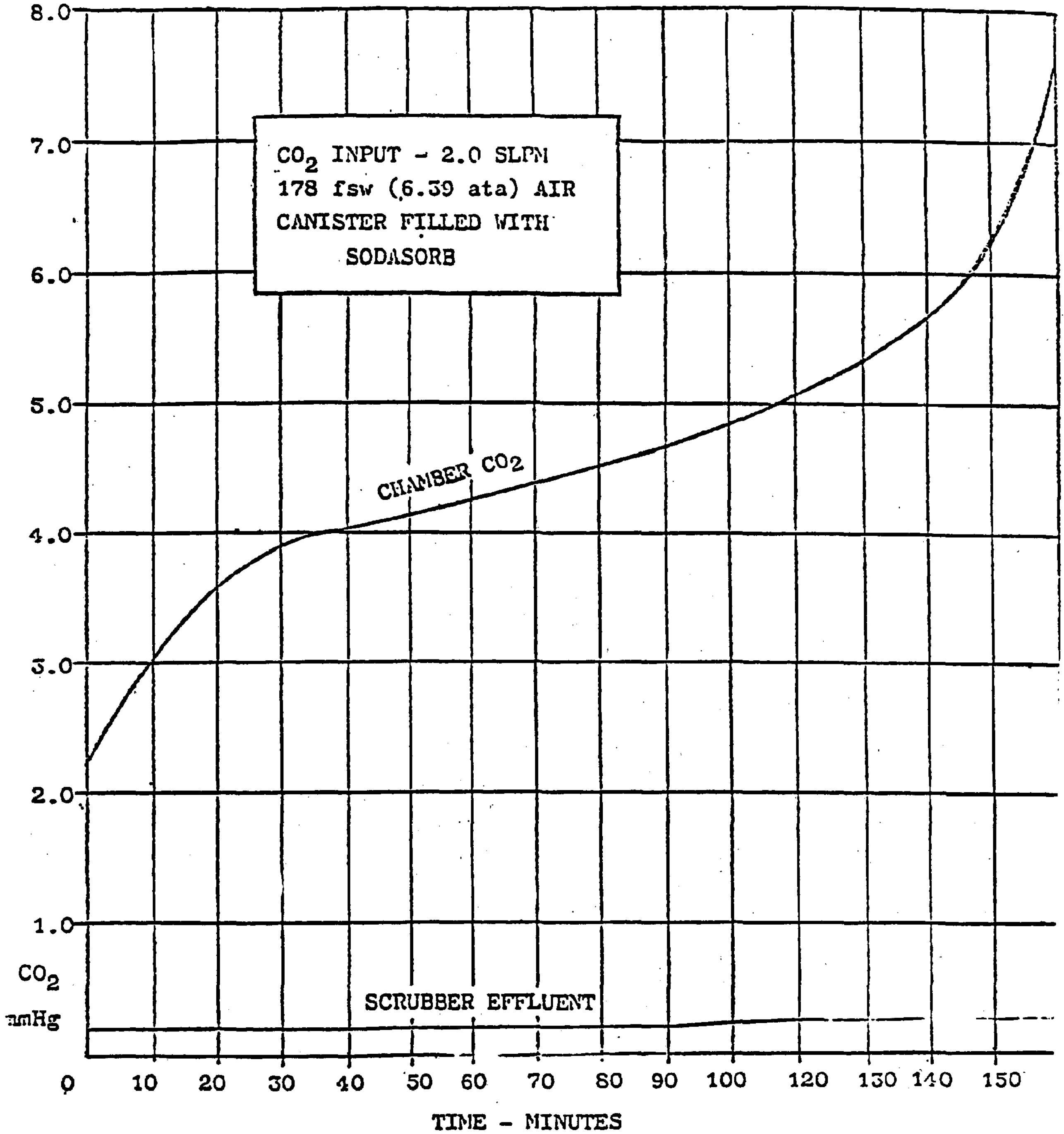
LOADING - The unit is prepared for use by filling the desiccant canister with a carbon dioxide absorbent chemical. Fill prior to each use with fresh, dry desiccant. DO NOT OMIT this procedure. Sodasorb is recommended, although the canister may be charged with any approved desiccant.

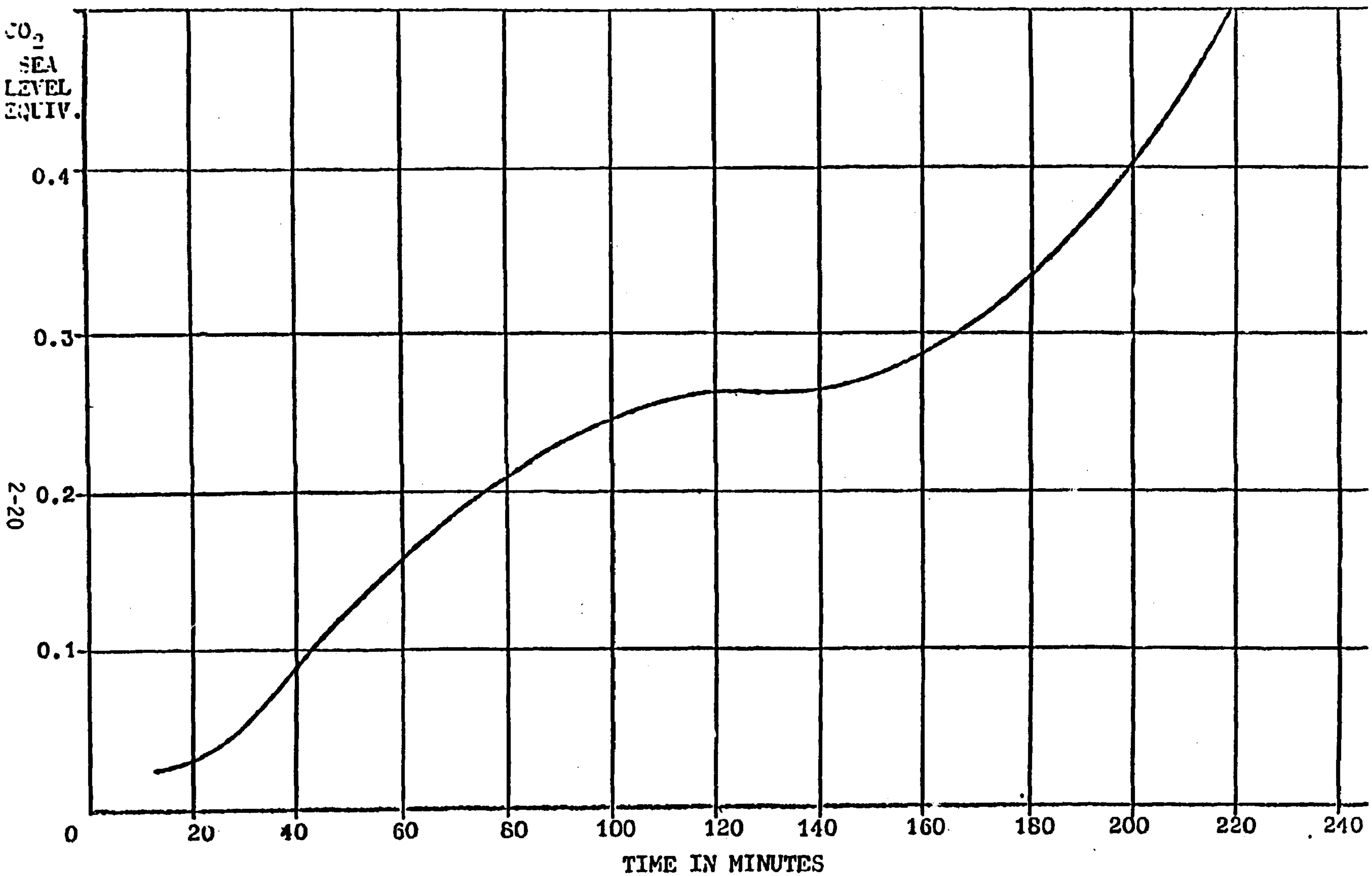
Remove the canister from within the case by twisting the five securing snap-locks to release the loading cover. Remove the cover, exposing the canister. Lift the canister straight out with the wire bail and then free the canister top from the three locking bayonet pins. Fill the cylinder carefully with desiccant. While filling, tap the canister firmly on the bottom with the palm of the hand to settle the granular chemical. If the unit is operated in a vertical position, the desiccant will settle firmly without "channeling." If operated in a horizontal attitude, the canister must be packed tightly with great care to avoid settling which might cause a void along the side of the cylinder through which intake gas would flow freely without passing through the desiccant. Such channeling is extremely dangerous since the carbon dioxide is not retained.

Inspect the bottom gasket (intake end) on which the canister seats for dirt or dust and clean carefully. Clean the mating machined bronze surface of the canister. Replace the top screen canister cover, locking it in place on the bayonet pins. Lower the canister into position within the unit.

Clean the top machined surface of the exterior case around the five snap-locks. Check the loading cover gasket for dust and wipe clean. Position the loading cover over the snap-locks, and push it straight down, forcing the attached bronze compression ring against the canister. Pull up on the snap-locks with a slight outward force and twist them into position to lock the cover securely in place.

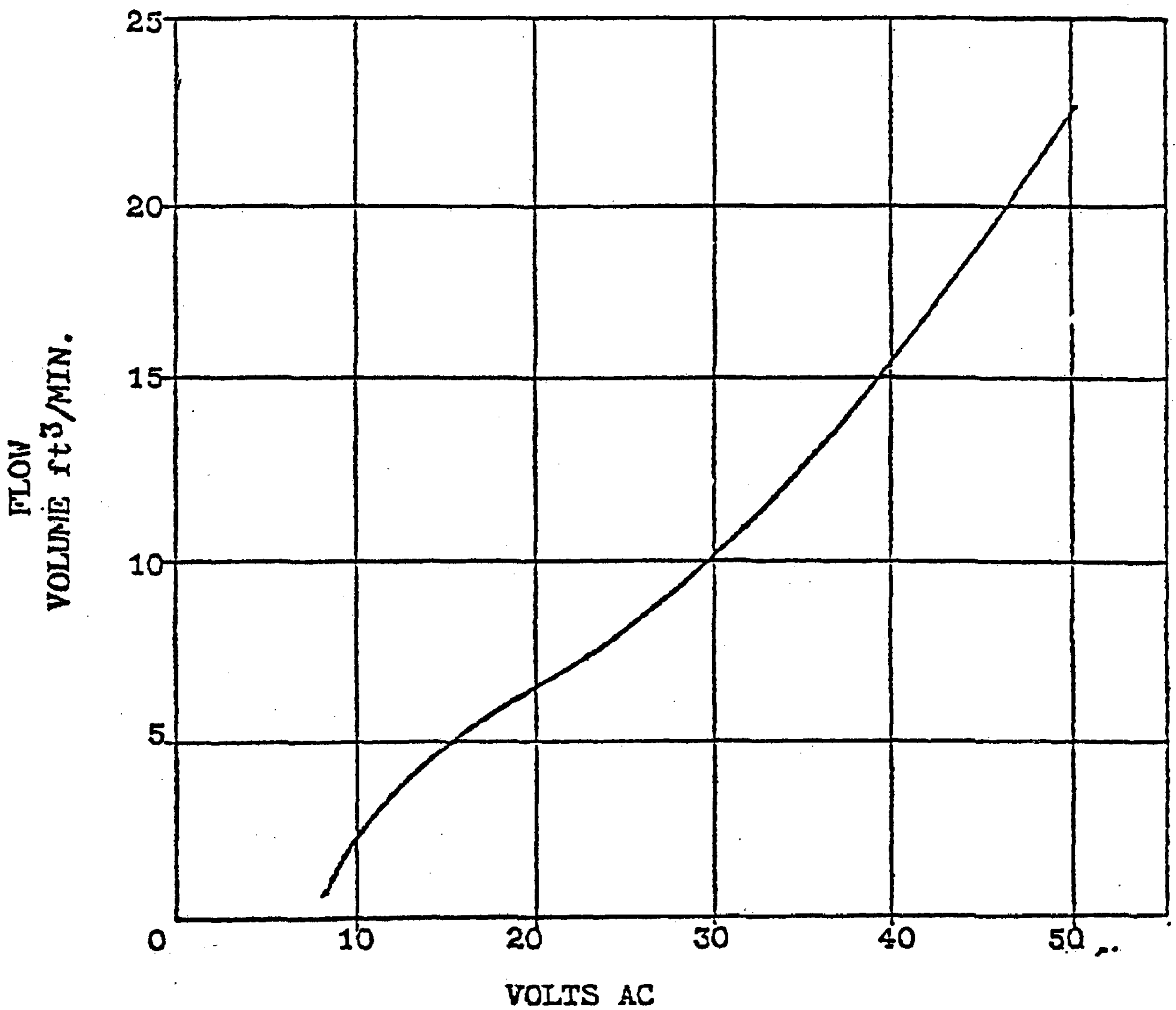
Check the loading cover gasket carefully for proper positioning, especially along its straight edge where the actual sealing area is narrow. It is important that the exterior case is maintained gas tight, so that the air flow is through the desiccant canister only. If the case is punctured, patch immediately or carbon dioxide removal will be severely impaired (See Maintenance).


CO2 INPUT - 2.0 SLPM
178 fsw (6.39 ata) AIR
CANISTER FILLED WITH
SODASORB
CHAMBER CO2
SCRUBBER EFFLUENT
CO2
mmHg
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
10
20
30
40
50
60
70
80
90
100
120
130
140
150
TIME - MINUTES

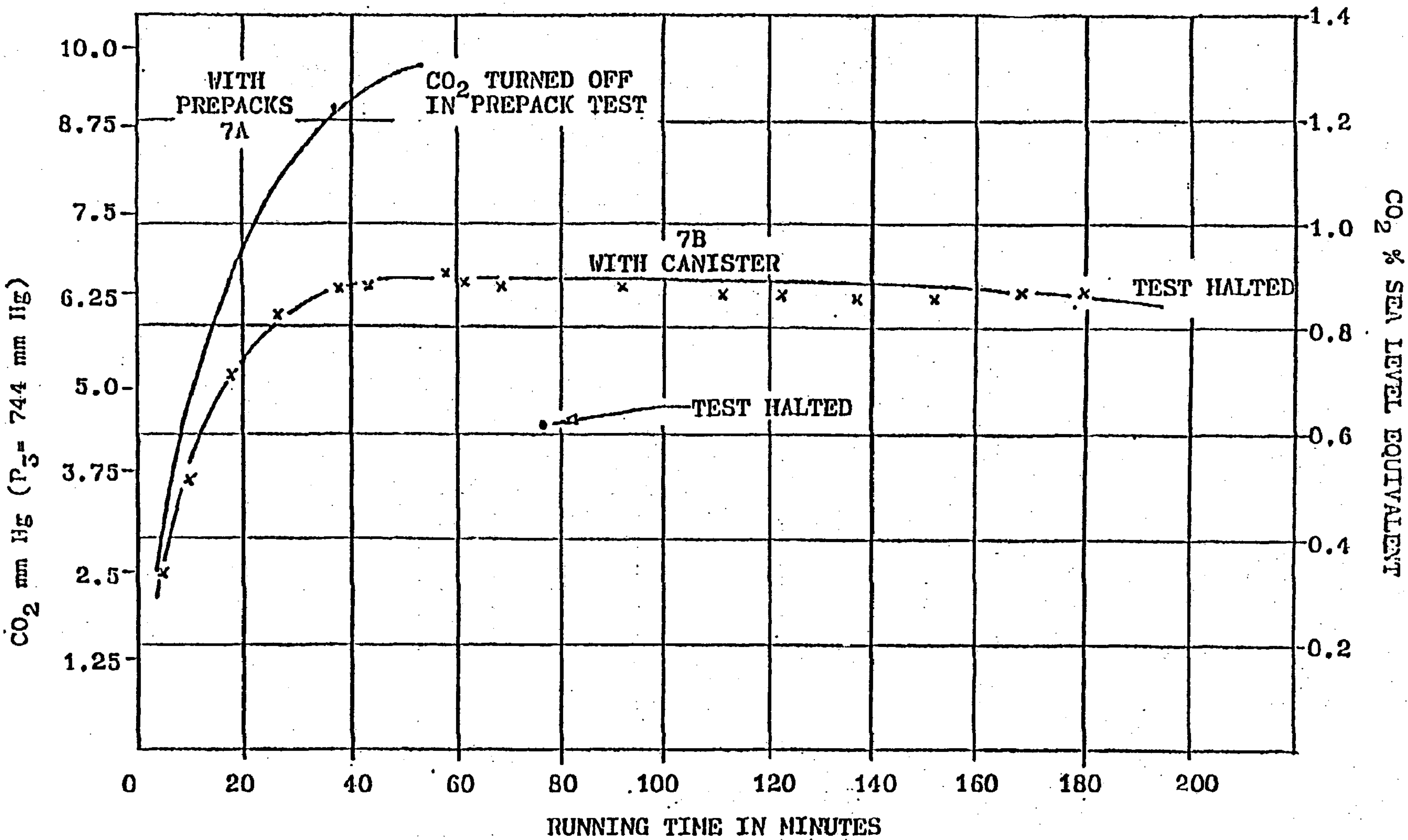


Scrubber test 178 fsw air

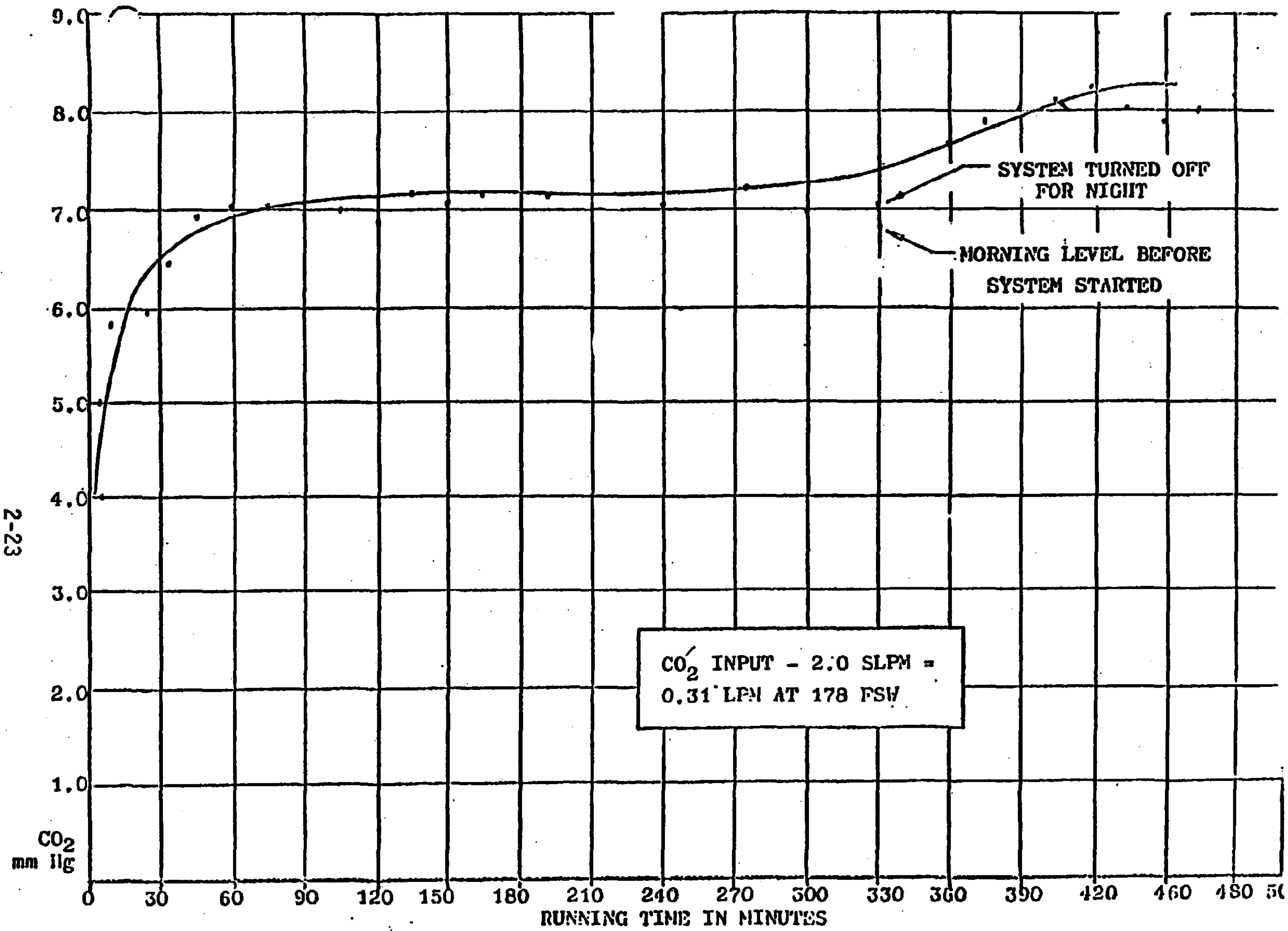
CO_2 input 2.0 L/min S.L. equivalent



Design Calculations
Lindbergh-Hammar Drytype Scrubber
Sodasorb Prepacks



Chamber CO_2 in mmHg and in % sea level equivalent
Lindbergh-Hammar Scrubber, 24 VAC prepacks of Sodasorb vs. canister of Baralyme; CO_2 input : 2.0 SLPM at 178 fsw air



Chamber CO_2 Using Lindbergh-Hammar Scrubber at 24VAC with Sodasorb packed in a cartridge at 178 fsw on air

REFERENCE 3

PRIMARY LIFE SUPPORT EQUIPMENT

BIO MARINE 0_2 ANALYZER RECORDER

DRAWING #10A556
DATE: 8/14/74
BY: Bill Mac Bride

OPERATION INSTRUCTIONS

FOR

REMOTE OXYGEN MONITOR AND RECORDER

(DEVELOPED FOR THE HARBOR BRANCH FOUNDATION)

GENERAL

This monitor was developed to fill a need for a four (4) station hyperbaric oxygen analyzer with adjustable high and low alarms. Integrated circuit techniques have been employed in its construction, insuring many years of reliable service, while enabling a complexity impossible just a few years ago. The unit will operate over a wide temperature range (32° F to 105° F) and will enable the operator to maintain precise control over the oxygen partial pressure in the diver decompression chamber.

DESCRIPTION AND CONTROLS

This monitor consists of a four (4) station oxygen monitor with adjustable high and low alarms in a brushed aluminum rack configuration. In addition, stations #1 & #2 are backed up by Rustrak type recorders; these recorders produce a permanent record of the oxygen level for later evaluation. Stations #1 & #2 have a full scale sensitivity of 2 Atm. Abs. Stations #3 & #4 have a full scale sensitivity of .4 Atm. Abs. Each station has a sensor select switch, sensor calibrate controls, alarm adjust switch, high and low alarm set controls, recessed taut band suspension display and an alarm light emiting diode. In addition, common to all stations, the front panel contains a power disconnect switch, an audio alarm disconnect switch, a sonalert type audio alarm and push to reset circuit breakers for batteries and line. All stations share a common power supply with a battery back up.

REFERENCE 4

PRIMARY LIFE SUPPORT EQUIPMENT

PYROTECTOR AUTOMATED FIRE SUPPRESSION SYSTEM

SECTION 1

DESCRIPTION

1.1 INTRODUCTION

This technical manual provides information on the Optical Fire Detection and Extinguishing System Components manufactured by Pyrotector, Incorporated, Hingham, Massachusetts for installation in HBF's shipboard decompression facility.

1.2 GENERAL DESCRIPTION

The Fire Detection and Extinguishing System is an integrated automatic detection, warning and extinguishing system utilizing high speed optical detectors, signal conditioning amplifiers, control panel and Halon 1301 extinguisher assemblies which can be activated at the control panel by operation of electrical switches or manually at the site of the solenoid valve assembly. Remote manual operation may be incorporated by the addition of pull cables connected to the manual override lever on the solenoid valve assembly.

Independent detection and extinguishing is provided for the lazarette, control console area and D.D.C. A separate control amplifier is mounted in or adjacent to each compartment to accept detector signal inputs and to relay alarm output to the control panel.

Pressure Switches are installed in each Compartment. They turn on an amber light on the control panel and are activated by the pressure rise in the extinguishing agent distribution piping when the system is discharged.

Audible alarms (Horns) are located in the D.D.C. control console to warn of a fire in any compartment and in the control console to warn of a fire in that compartment.

A test switch is provided on the electrical control panel for verifying system integrity and operation of the detection components. Components of the system are designed to operate from a nominal 28 VDC. Compartments protected by the system and allocation of components are listed in Tabele 1-1. Descriptions and illustrations of components are provided in Figures 1-1 through 1-10.

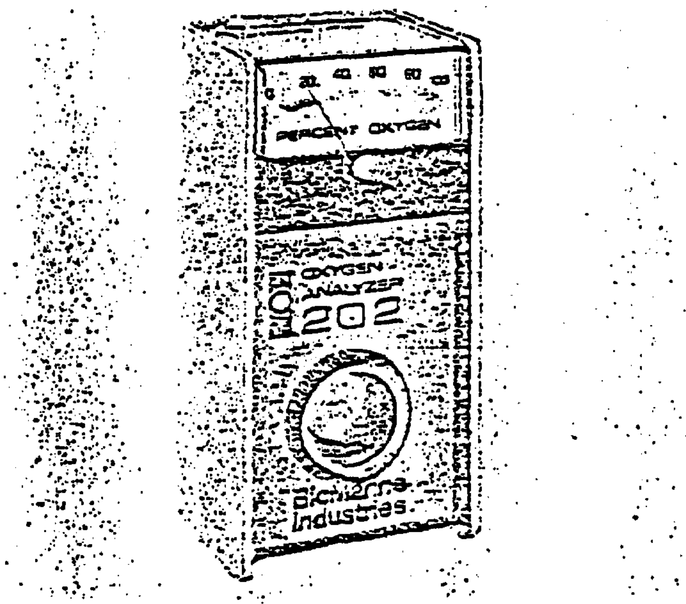
REFERENCE 5

BACK-UP EQUIPMENT

BIO MARINE HAND HELD O_2 ANALYZERS

BioMarine Industries

[illegible]



OA 200 SERIES operating instructions

Oxygen Analyzers

GENERAL

BioMarine analyzers provide continuous direct reading of the oxygen concentration in any given environment. Easily portable and simple to operate, the analyzers are automatically temperature compensated over their full operating range of 32°F to 104°F (Model OA222, 45°F to 104°F) require single point calibration and perform accurately in high humidity environments.

REFERENCE 6

BACK-UP EQUIPMENT

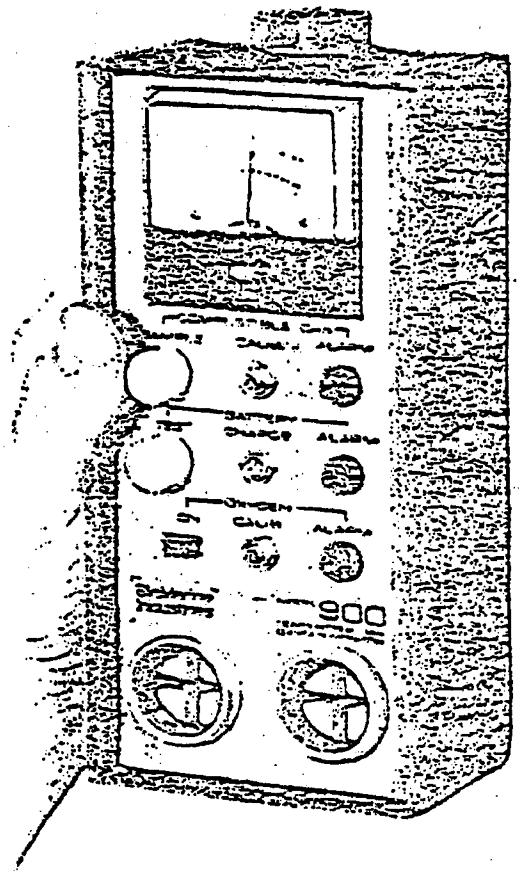
BIO MARINE EXPLOSIVE GAS MONITOR

MODEL 900

BioMarine Industries

COMBINATION COMBUSTIBLE GAS/OXYGEN DETECTOR WITH ALARMS . . . . .40 HOURS CONTINUOUS USE BETWEEN RECHARGES

- HAND HELD - TRULY PORTABLE
- BUILT-IN ALARM FOR COMBUSTIBLE GAS & OXYGEN
- LIGHTWEIGHT - WEIGHT ONLY 3 LBS.
- 0 - 100 LEL COMBUSTIBLE GAS,
  0 - 40% OXYGEN SCALE
  0 - 5% METHANE
- IMMEDIATE READING - NO WARM UP
- DIFFUSION AND REMOTE DETECTING CAPABILITY
- INTRINSICALLY SAFE
- COMPLETE WITH CARRYING CASE AND SAMPLING KIT



The Model 900 provides continuous monitoring of both combustible gas and oxygen in any environment for a full week (40 hours) between battery recharges. Audible and visual alarms automatically warn of the presence of combustible gas, oxygen deficiency or low battery voltage.

The combustible gas sensor employs an advanced ceramatized gas sensing element insuring long life. The proven BMI galvanic oxygen sensor is self-powered and never requires rebuilding or recharging. The 900 is fully temperature compensated from 5°F to 110°F and meets U.S. Bureau of Mines intrinsic safety requirements.

The 900 may also be used in spot checking for both oxygen and combustible gas at the press of a button.

Each unit comes with a remote sampling kit. The unit is housed in a rugged leather carrying case and may be worn on the belt or on the shoulder. The 900 is completely solid state with no moving parts to wear out. A loud, penetrating remote alarm is available to provide additional warning of alarm con-ditions to outside or "topside" personnel.

.ne 900 is particularly useful in mines, tunnels, silos, tanks, ship holds, railroad tank cars, manholes, sewers and other locations in the chemical, petroleum, mining, utilities and shipping industries where combustible gases and oxygen deficiencies may be found.

DIMENSION - 4 x 8 x 3

WEIGHT - 3 lbs.

SCALE - 0 - 100% LEL Combustible gas
0 - 40% Oxygen
0 - 5% Methane

RESPONSE TIME - Oxygen - 10 sec.
Combustible gas - 5 sec.

RECHARGE TIME - Less than 16 hours

BioMarine Industries
303 West Lancaster Avenue
Devon, Pennsylvania, 19333
215:687-2800 • Cable: BIOMAR

MODEL 900 COMBUSTIBLE GAS/OXYGEN MONITOR

OPERATING AND MAINTENANCE INSTRUCTIONS

WARNING: These instructions must be read and understood by all individuals who will have the responsibility of operating and servicing the Combustible Gas/Oxygen Monitor. The actions taken as a result of the measured oxygen and combustible gas levels must be in strict accordance with Company and Government regulations. The instrument should not be used to measure combustible gas in atmospheres either oxygen deficient or containing more than 25% oxygen by volume.

GENERAL

The BioMarine Combustible Gas/Oxygen Monitor provides a simple method of determining oxygen concentrations and combustible gas levels in any environment. The instrument may be used for both spot checks and continuous monitoring with alarms. When used as a monitor, oxygen level and battery voltage are monitored continuously and Combustible Gas level is checked automatically every three minutes. This "sampled data" approach allows forty hours continuous operation before battery recharging. Easily portable and simple to operate, the Monitor is automatically temperature compensated over its full operating range of 5°F to 110°F. The Monitor requires infrequent calibration and performs accurately in high humidity environments. While methane is the calibration standard for the combustible gas monitor, other combustible gases will be detected. If desired, combustible gases other than methane may be used for calibration.

CAUTIONS

1. The battery must be tested before the monitor is used.
2. In combustible gas concentrations above 100% LEL, the instrument will give incorrect readings. If it is suspected that concentrations higher

APPENDIX 3

Notification of Coast Guard

and

Navy Rescue Organizations

Notification of Coast Guard and Navy Rescue Organizations

Prior to commencement of the at-sea portion of the project, Harbor Branch Foundation, Inc. shall notify the Coast Guard in accordance with Coast Guard Notice 3130, by completing and submitting USCG Form 4790 (8-71), "Summary of Planned Submersible Operations." This form will be sent to Commander, 8th Coast Guard District, New Orleans. The Commander of the 8th Coast Guard District will notify appropriate Navy authorities of the impending operation, and will issue a warning to mariners giving location and time of operations in order to minimize interferences during the operations.

If the submersible should be unable to surface, the support ship shall radio a MAYDAY message to the Coast Guard on 2182 KHZ, and other emergency circuits as may be available. The Coast Guard Rescue Coordination Center (New Orleans) may be reached using a telephone call via the marine operator 504/589-6225.

Upon receipt of the MAYDAY message, the Coast Guard will proceed in accordance with Commandant Instruction 3130.7A of 5 December 1975. If Navy assistance is appropriate, the Coast Guard will so request by calling the Navy Department Duty Captain at 202/695-0231. The Navy Duty Captain will take action in accordance with OPNAV Instruction 3130.4A of 29 October 1973. Applicable portions of Coast Guard Instruction 3130.7D and OPNAV Instruction 3130.4A are presented hereinafter:

G-M-2/82

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (G-M-2/USP/83)
400 SEVENTH STREET SW.
WASHINGTON, D.C. 20590
PHONE (202) 426-2307

PLANNING & SPECIAL PROJECTS STAFF

COMDTINST 3130.7D
5 DEC 1975

DEC 17 1975

COMMANDANT INSTRUCTION 3130.7D

Subj: Operations Involving Civilian Submersibles

1. Purpose. This Instruction provides procedures to be followed by the Coast Guard with respect to operations involving civilian submersibles.

2. Cancellation. Commandant Instruction 3130.7C CH-1 is cancelled.

3. Discussion.

a. The Coast Guard's search and rescue responsibilities extend to vessels operating under, as well as on, the surface of the sea. These responsibilities therefore include the small number of civilian submersibles which operate in or near U.S. waters on scientific, industrial or other missions. The safety record of these submersibles has been good, but the few accidents have demonstrated both the difficulty of rescue and the potential for public interest. The Coast Guard has no special undersea search and rescue equipment to assist a submersible unable to surface and must discharge its responsibility by requesting suitable equipment be brought to the scene. Equipment is available which could effect a rescue in most situations, but frequently information on the location and status of the equipment is not available. The primary source of expertise and equipment is the U.S. Navy, and procedures have been established to permit utilization of Navy resources in the event of a civilian submersible SAR incident. A single point of contact has been established, as the Navy can provide not only fleet resources but specialized experimental equipment located at laboratories, and also civilian specialists retained on contract for undersea salvage. The point of contact is the Navy Department Duty Captain at the Pentagon, as described in OPNAVINST 3130.4, enclosure (1). When the Navy has responded and assumed the role of SAR Mission Coordinator, the Coast Guard role becomes one of support. Until that time the Coast Guard must respond with its own resources and whatever local civilian or government help is available.

b. Submersible operations present another problem. This is one of interference with Navy operations. To enable the Navy to reduce this possibility, to reduce the chance of classifying a civilian submersible as an unknown submerged vessel necessitating investigation, and to aid in prompt SAR assistance the Commandant has established a voluntary reporting system through which pertinent information can be relayed to concerned parties. The Commandant (G-M-2/USP/83) monitors submersible activity and advises known submersible operators of the reporting system and the procedure for requesting assistance if needed.

c. There is no mutual assistance plan, formal or informal, in effect among the submersible operators. Most operators, however, could be expected to be willing to assist in the rescue of a distressed submersible.

4. Action.

a. Commandant (G-M-2/USP/83)

(1) Inform all known submersible operators and owners in the United States of the voluntary reporting system. Enclosure (2) is a copy of the notice used for this purpose.

(2) Maintain liaison with the Navy and other organizations to provide coordinated planning for submersible emergencies.

(3) Distribute periodic reports on the status of U.S. submersibles to all District Commanders. Coordinate the distribution of appropriate informational material to District Commanders (RCC's). The following publications are currently distributed automatically:

Deep Submergence Systems Summary and Characteristics Manual: Published and revised annually by Commander Submarine Development Group One as COMSUBDEVGRU ONE INSTRUCTION 5450.1 and contains characteristics of U.S. military and civilian submersibles, unmanned undersea systems, and habitats.

An Inventory of Navy Laboratory R&D Equipment Available for Emergency Undersea Operations: Published by and revised annually by Naval Undersea Center, San Diego as NUC AP-2.

b. District Commanders

(1) On receipt of information on planned submersible operations disseminate this information by message as described in enclosure (3). Issue a Notice to Mariners as appropriate giving the location and time(s) of operations to minimize interference during the operations.

(2) In the event that a specific request for assistance to a civilian submersible is received:

(a) Obtain Navy assistance, if appropriate, by calling the Navy Department Duty Captain in the Pentagon at the following phone number, notifying him of the situation:

COMMERCIAL (202) 695-0231

AUTOVON 22-50231

If appropriate request implementation of SUBMISS/SUBSUNK for civilian submersibles in accordance with OPNAV INSTRUCTION 3130.4, and the USN ADDENDUM to NWP 37(B). Send a follow-up message in the format of enclosure (4) to confirm the request.

(b) Respond with appropriate Coast Guard resources, such as On-Scene Commander rescue platform (buoy tender), traffic control, communications, and logistics.

(c) Ascertain if there are any other civilian submersibles available; request that they assist the distressed sub.

(d) Coordinate the response as SAR Mission Coordinator (SMC) until the Navy assumes this responsibility. Continue to provide any assistance requested after the Navy assumes SMC. Ensure that the AREA COMMANDER and the COMMANDANT are kept informed of the progress of the rescue both before and after the Navy assumes SMC.

(e) Until the Navy assumes SMC (and in case the Navy is unable to assume SMC) obtain advice from Headquarters Flag Plot and make use of best available military and civilian resources. A brief guide to RCC controllers in handling submersible SAR incidents is printed by and available from the National Search and Rescue School, Governors Island, New York.

(f) Prepare a SAR Case Study in addition to the normal assistance report.

5. Availability of Forms.

a. Commandant (G-M-2/USP/83) shall distribute the SUMMARY OF PLANNED SUBMERSIBLE OPERATIONS (CG-4790) to all known owners, operators, and manufacturers of civilian submersibles in the United States and to all RCC's.

b. Additional copies of Form (CG-4790) may be obtained from Commandant (G-M-2/USP/83).

R. H. SCARBOROUGH
Chief of Staff

Encl:
(1) OPNAVINST 3130.4B
(2) Notice to all owners, operators, and manfacturers of civilian submersibles
(3) Message format for planned submersible operations
(4) Message format for requesting Navy to implement EVENT SUBMISS/SUBSUNK

List CG-10
Dist: (SDL No. 101)
A: acde (3);gfhmv (2); ijnou (1)
B: n (45); c (20); f (15); g (11); e (10); r (7); h (6); bm (3); dpq (1); j(2)
C: a (5); bdn (3); go (2); q (1)
D: a (2); dsu (1)
E: do (1)
None

CNO OP-23 (5)
CNO OP-943 (5)
SUPSALV (5)
CINCLANTFLT (5)
CINCPACFLT (5)
COMSECONDFLT (5)
COMTHIRDFLT (5)
COMSUBLANT (5)
COMSUBPAC (5)
NAVOCEANO (5)
COMSUBFLOT 1 (2)
COMSUBFLOT 2 (2)
COMSUBFLOT 5 (2)
COMSUBFLOT 6 (2)
COMSUBFLOT 7 (2)
COMSUBRON 6 (2)
COMSUBRON 12 (2)
COMSUBDEVGRU 1 (2)

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. 20350

IN REPLY REFER TO
OPNAVINST 3130.4A
Op-232
29 OCT 1973

OPNAV INSTRUCTION 3130.4A

Subj: OPNAV Manned Non-Combatant Submersible SUBMISS/SUBSUNK Bill (R

Encl: (1) Washington Area Notification List (A
(2) Information regarding action to be taken in the Washington area
(3) General information regarding manned non-combatant submersibles (R

1. Purpose. The purpose of this bill is to ensure that the Navy Department is alerted to provide assistance whenever a SUBMISS/SUBSUNK is executed for a manned non-combatant submersible.

2. Cancellation. OPNAV Instruction 3130.4 dated 18 July 1969 is hereby superseded. (A

3. Scope. This bill serves to advise the Navy Department duty captain, Navy Command and Support Center (NCSC) of the following: (R

a. Action to be taken by him to alert the Navy Department or initiate appropriate U. S. Navy action if required.

b. Action to be taken by other activities in the Washington area.

4. Discussion (A

a. In the event of loss of a manned non-combatant submersible operated by the U. S. Navy or operating under a Navy lease, "Event SUBMISS/SUBSUNK" will be placed in effect by the Submarine Operating Authority in whose area the submersible is operating.

b. In the event of the loss of a civilian submersible not operated by or under lease to the U. S. Navy, the U. S. Coast Guard may request Navy assistance in accordance with the National Search and Rescue Plan, 1969. Under federal law, the Coast Guard is responsible for developing, establishing, maintaining and operating, with due regard to the requirements of national defense, rescue facilities for the promotion of safety on, under and over the high seas and waters subject to the jurisdiction of the United States. The Coast Guard has issued an instruction on civilian submersible operations, Commandant Instruction 3130.7 series. The Navy is assigned no direct responsibility in the Natior SAR Plan for the rescue of personnel or salvage of civiliar owned and operated submersibles. However, provision is mac for the use of Navy facilities to meet civil needs on a bas of non-interference with higher priority military missions If Navy assistance is requested by the Coast Guard, "Event SUBMISS/SUBSUNK" may be placed in effect by the duty capta: after consultation with the appropriate fleet commander anc the Deputy Chief of Naval Operations (Submarine Warfare). If "Event SUBMISS/SUBSUNK" is declared, the Navy will respc to the fullest extent possible within its existing capabil: When Navy assistance is provided, the cognizant Coast Guarc area or district commander will designate the senior U. S. Navy officer on scene as the on-scene commander. That off shall be qualified for succession to command at sea, and i: practicable, will be a submarine officer serving in a submarine billet.

c. The provisions of this instruction will cease to apply should the operation become simply one of a salvage nature. Appropriate salvage instructions will then apply. This could occur should:

(1) The personnel in the disabled vehicle escape o be rescued and the submersible or parts thereof remain on the bottom.

(2) The personnel entrapped have exhausted their life support and rescue is no longer possible.

R) 5. Action. When a manned non-combatant submersible emerg arises, the Navy Department duty captain shall:

a. Call those listed in enclosure (1) and inform ther of the situation.

b. Coordinate as necessary any actions or assistance that may be required from assets not under the command of the search and rescue mission coordinator.

c. Declare SUBMISS/SUBSUNK, if appropriate, upon receipt of a request for assistance from the Coast Guard and after consultation with the proper fleet commander and the DCNO (Submarine Warfare)

E. P. WILKINSON
Deputy Chief of Naval Operations
(Submarine Warfare)

Distribution:

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A5	Bureaus	(R
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B3	Colleges	(A
B5	U.S. Coast Guard (Commandant, only)	(A
21A	Fleet Commanders in Chief	
22	Fleet Commanders	(A
23	Force Commanders	(A
24	Type Commanders	(R
26VV	Submarine Force Representatives	(A
26WW	Deep Submergence Rescue Vehicle and Deep Submergence Vehicle	(A
26YY	Fleet Ocean Surveillance Information Facility and Center	(A
27	Administrative Commands and Units	(R
28K	Submarine Groups and Squadrons	(R
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31	Amphibious Warfare Ships	(A
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50A	Unified Commands (less CINCONAD and USCINCRED)	(A
50C	Subordinate Unified Command	(A
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C2	To Naval Officers at Air Force Activities	(A
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(Continued on Page 4)

Distribution (Continued)

A)	SNDL C4L	Director of Naval Laboratories
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A)	FKL9B	Experimental Diving Unit
A)	FKN1	Facilities Engineering Command Division
A)	FKP1E	Torpedo Station
A)	FT38	Submarine Training Center
A)	FT44	School of Diving and Salvage
A)	FT54	Scol Submarine
A)	FT69	Scol Academy
A)	FT73	Scol Postgraduate
A)	FT75	Naval War College
A)	FW	Shore Activities under the Command of the Commander Naval Weather Service Command

`) Ops 00, 09, 09B, 09C, 09D, 09F, 090, 90, 91, 96, 097, 094, 941, 943, 945, 947, 948, 095, 951, 952, 098, 981, 982, 983, 985, 987, 008, 009, 01, 02, 21, 22, 23, 29, 03, 32, 04, 40, 41, 43, 45, 05, 50, 06, 60, 61 and 62

Stocked:

CO, NAVPUBFORMCEN
5801 Tabor Avenue
Philadelphia, Pa 19120

WASHINGTON AREA NOTIFICATION LIST

CNO (Op-00)
VCNO (Op-09)
DCNO (Submarine Warfare) (Op-02)
DepSubProgCoord (Op-23)
SECNAV
UNSECNAV
President's Naval Aide
*NMCC
DIRCMDSUPROG (Op-094)
DIRFLTOPSREANAVCOMSUPDIV (Op-943)
DCNO (Air Warfare) (Op-05)
DCNO (Surface Warfare) (Op-03)
Head, Submarine Branch (Op-951E)
Assistant for Surveillance Operations (Op-951F3)
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NAVDIST Washington Duty Officer
OIC NAVXDIVINGU
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Naval Oceanographic Office Duty Officer
****DIR ATOMIC ENERGY DIV (Op-985)

* To further alert ASTSECDEF (PA) & ASTSECDEF (Atomic Energy) if nuclear vessel involved
** To further notify Codes 04, 425, 395 & OOC. Code 08 if nuclear vessel involved
*** To further alert Director, Personal Services Division and Casualty Branch
**** If nuclear vessel involved

INFORMATION REGARDING ACTION TO BE TAKEN IN THE WASHINGTON AREA

1. Upon receipt of information that a manned non-combatant submersible SUBMISS/SUBSUNK event has been executed, the duty captain will notify the persons and activities listed on the notification list (enclosure (1)) using the most expeditious means available. (R

2. Upon receipt of a request for Naval assistance from a cognizant Coast Guard area or district commander in the event of the loss of a civilian submersible, the duty captain initiates event SUBMISS/SUBSUNK, designating the appropriate fleet commander in chief to take the necessary action and authorizing direct liaison with the cognizant Coast Guard commander. He will notify the persons and activities listed in the notification list that SUBMISS/SUBSUNK has been placed in effect. (R

3. The Director, Fleet Operations, Readiness, Navy Command Support Division (Op-943) with the assistance of the Director, Deep Submergence Systems Division (Op-23) and the Supervisor of Salvage, will coordinate CNO's action. (R

4. Commander Submarine Development Group One will be alerted to provide staff assistance to the on-scene commander, if requested, and to make ready his search, recovery and rescue assets.

5. The Naval Ship Systems Command Headquarters duty officer will alert the Submarine Division (Code 425), the Deep Submergence Project Office (PMS-395) and the Supervisor of Salvage (Code 00C) so that any requirements for material can be furnished expeditiously. The NAVSHIPSYSCOMHQ duty officer shall also alert the Nuclear Power Directorate (Code 08) if a nuclear submarine is involved. (R

6. The Experimental Diving Unit will be ready to furnish a qualified diving officer, diving medical officer, additional divers, and diving and rescue gear depending on the nature of the casualty.

7. The Chief of Naval Personnel is responsible for the notification of next of kin in the event of the presence of naval personnel aboard the submersible. Therefore, the (R

Loss of Power

During a mission the main circuit breakers may trip due to an overload. When this happens all equipment should be de-energized and the breakers reset. Then energize the equipment again, one piece at a time, to attempt to establish the cause. If the breakers continue to trip and the cause cannot be isolated, surface with caution as soon as practicable.

GENERAL INFORMATION REGARDING MANNED NON-COMBATANT SUBMERSIBLES

1. Deep submersibles are generally designed to perform specific ocean engineering tasks. As a result, the size, hull form and equipment arrangements are usually quite different.

2. Deep submersibles have the following common characteristics: (R

a. Life support systems capacity varies and is generally less than 24 hours. Some exceptions are the Submarine NR-1 and USS DOLPHIN.

b. The hatches on the deep submersibles are normally not compatible with the Deep Submergence Rescue Vehicles (DSRVs) and Submarine Rescue Chambers (SRCs) used for submarine rescue.

c. Deep submersibles are usually not designed for escape using buoyant ascent. Again the deep diving submarines USS DOLPHIN and Submarine NR-1 are exceptions.

d. At the present time the only feasible method of saving the lives of an untethered manned non-combatant deep submersible crew would be to salvage the vessel.

4. If the J-S-L I is entrapped and cannot gain it's freedom by blowing all ballast and thrustering, time should not be wasted waiting on help from the surface. Turn off all unnecessary electrical equipment to conserve power for your scrubbers and communications. Vent off ballast tank, blow down and diver compartment and lock-out a diver to survey the situation. Once you know what your problem is you can figure a way out. This information will be invaluable to the people on the surface preparing for your rescue. Be sure to keep accurate records on the divers' depth and time. Keep the support ship informed of all measures taken.

5. In the event that J-S-L I divers are unable to free the J-S-L I, bring them back in and shut both "A" and "B" hatches. Do not over pressurize. Release your emergency location buoy, keep calm, conserve power, monitor your PO_2 and PCO_2 meters, and maintain communication on the sound powered phone.

<u>NOTE</u>: Anytime the J-S-L I is launched it has gas onboard for a lock-out to maximum mission depth plus adequate dive gear and rescue tools aboard. There is always at least one qualified J-S-L I lock-out diver in the diver compartment.

Form Approved
OMB No. 04-R3030

DEPARTMENT OF TRANSPORTATION U. S. COAST GUARD CG-4790 (8-71)	SUMMARY OF PLANNED SUBMERSIBLE OPERATIONS

NOTE: The following information is voluntarily submitted to the Coast Guard for dissemination to minimize operational interference and to facilitate emergency action if needed.

NAME OF SUBMERSIBLE	CALL SIGN
NAME OF COMPANY (OWNER)	FREQUENCIES GUARDED
NAME OF SUPPORT SHIP	RADIO WATCH SCHEDULE
PORT OF DEPARTURE	TIME AND DATE OF DEPARTURE

DATE	ESTIMATED TIME OF DIVE	ESTIMATED TIME OF SURFACE	LOCATION OF OPERATING AREA	WATER DEPTH

NEXT PORT OF CALL	TIME AND DATE OF ARRIVAL

During the next inport period, it is anticipated that the submersible will be maintained in a state of readiness such that it would require about ________ hours to make it ready to dive.

COMMENTS

DATE	SIGNATURE AND TITLE

ENCLOSURE (1)

that contains a quart of mineral oil as a lubricant and has been deflated with a vacuum pump, rolled up and tied into the aluminum funnel. This funnel also acts as a receptacle for the surface rescue drop-lock. The float is equipped with a 2 PSI relief valve. High pressure air is piped up from the pilot's sphere to a special adaptor that is attached to the funnel and the float. When the float is pressurized from the sphere it expands and breaks away from the funnel and air connection. Fully inflated, the buoy has 281 pounds of positive buoyancy which overcomes the tension on the reel of the cable and streams it to the surface.

E. Rescue

Submersible rescue can be accomplished by dropping a specially designed drop-lock down the buoy line. The drop-lock is grooved on one side so the unit fits around the buoy line. The end is attached to 1500 ft. of rescue cable. The rescue winch is located on the submersible's support vessel.

Commander
1st Coast Guard District
Boston SAR Coordinator
Rescue Coordination Center
150 Causeway St.
Boston, MA 02114
Phone No. (617) 223-3645

Commander
2nd Coast Guard District
St. Louis SAR Coordinator
Rescue Coordination Center
Federal Building
1520 Market St.
St. Louis, MO 63103
Phone (314) 425-4614

Commander
3rd Coast Guard District
New York SAR Coordinator
Rescue Coordination Center
Governors Island
New York, NY 10004
Phone No. (212) 264-4800

Commander
5th Coast Guard District
Portsmouth SAR Coordinator
Rescue Coordination Center
Federal Building
431 Crawford St.
Portsmouth, VA 23705
Phone No. (804) 393-9231

Commander
7th Coast Guard District
Miami SAR Coordinator
Rescue Coordination Center
Federal Bldg., Room 1018
51 S.W. 1st Ave.
Miami, FL 33130
Phone No, (305) 350-5611

Commander
8th Coast Guard District
New Orleans SAR Coordinator
Rescue Coordination Center
Customhouse
New Orleans, LA 70130
Phone No. (504) 589-6225

Commander
9th Coast Guard District
Cleveland SAR Coordinator
Rescue Coordination Center
1240 East 9th St.
Cleveland, OH 44199
Phone No. (216) 522-3984

Commander
11th Coast Guard District
Long Beach SAR Coordinator
Rescue Coordination Center
Heartwell Bldg.
19 Pine Ave.
Long Beach, CA 90802
Phone No. (213) 590-2225

Commander
12th Coast Guard District
San Francisco SAR Coordinator
Rescue Coordination Center
630 Sansome St.
San Francisco, CA 94126
Phone No. (415) 556-5500

Commander
13th Coast Guard District
Seattle SAR Coordinator
Rescue Coordination Center
915 2nd Ave.
Seattle, WA 98174
Phone No. (206) 442-5886

Commander
14th Coast Guard District
Honolulu SAR Coordinator
Rescue Coordination Center
P.O. Box 48
FPO San Francisco, 96610
Phone No. (415) 556-0220
Ask for 808-546-7109

Commander
17th Coast Guard District
Juneau SAR Coordinator
Rescue Coordination Center
FPO Seattle, 98771
Phone No. (206) 442-0150
Ask for 907-586-7340

From: CCGD_____ (COAST GUARD DISTRICT)

Pacific-East of 145°W

Action: COMSUBGRU FIVE
COMTHIRDFLT

Info: CINCPACFLT
COMSUBPAC
COMSUBDEVGRU ONE
CNO
COMDT COGARD
COMPACAREA COGARD

Pacific-Between 145°W and 160°E

Action: COMSUBPAC
COMTHIRDFLT

Info: CINCPACFLT
COMSUBDEVGRU ONE
CNO
COMDT COGARD
COMPACAREA COGARD

Pacific-West of 160°E

Action: COMSUBGRU SEVEN
COMTHIRDFLT

Info: CINCPACFLT
COMSUBPAC
COMSUBDEVGRU ONE
CNO
COMDT COGARD
COMPACAREA COGARD

Atlantic, Gulf of Mexico, and Caribbean Sea

Action: COMSUBLANT
COMSECONDFLT

Info: CINCLANTFLT
COMSUBDEVGRU ONE
CNO
COMDT COGARD
COMLANTAREA COGARD

BT

REPORT OF PLANNED SUBMERSIBLE OPERATIONS

A. COMDT COGARD INST 3130.7D

1. SUBMERSIBLE________ WILL CONDUCT DIVING OPERATIONS________(LOCATION) ________ DURING THE PERIOD________ TIME (DAYS).

2. DESCRIBE (IF POSSIBLE) MISSION (e.g. CABLE BURIAL, OCEANOGRAPHY, PIPELINE INSPECTION) AND DEPTH OF WATER.

3. MOTHER VESSEL WITH DESCRIPTION, CALL SIGN, AND FREQUENCIES GUARDED.

4. LIFE SUPPORT ENDURANCE, NUMBER OF CREW (IF POSSIBLE).

5. RESCUE CAPABILITY ON SCENE, SPECIAL RESCUE FITTINGS.

BT

(NOTE THAT EXACT TIMES AND LOCATIONS OF DIVES ARE USUALLY NOT AVAILABLE AND NEED NOT BE REQUIRED)

FM: CCGD________ (COAST GUARD DISTRICT)

ACTION: CNO (CHIEF OF NAVAL OPERATIONS)

INFO: COM________ AREA (COMMANDANT AND AREA OFFICES, U.S. COAST GUARD)

BT

UNCLAS

DISTRESS CIVILIAN SUBMERSIBLE________

A. OPNAVINST 3130.4A (SUBJ: CHIEF OF NAVAL OPERATIONS MANNED NON-COMBATANT SUBMERSIBLE SUBMISS/SUBSUNK BILL; PROMULGATION OF)

B. USN ADDENDUM TO NWP 37 (B)

1. REQUEST IMPLEMENT EVENT SUBMISS/SUBSUNK FOR SUBJECT VESSEL.

2. SITUATION (DESCRIBE SITUATION INCLUDING AS MUCH AS POSSIBLE OF THE FOLLOWING INFORMATION)

   (a) LOCATION

   (b) MOTHER VESSEL, CALL SIGN, FREQUENCIES

   (c) DEPTH OF WATER

   (d) WEATHER ON SCENE

   (e) LIFE SUPPORT TYPE AND DURATION

   (f) RESCUE CAPABILITY ON SCENE

   (g) RESCUE FITTINGS

3. ACTION TAKEN (INCLUDE DESIGNATION OF ON SCENE COMMANDER AND SAR MISSION COORDINATOR)

BT

DISTRIBUTION LIST

Commander, 3rd Coast Guard District
New York SAR Coordinator
Rescue Coordination Center
Governors Island, NY 10004

Commander, U.S. Coast Guard
(GM-2/USP/83)
Washington, D. C. 20054

Commander, Submarine Force
U.S. Atlantic Fleet
Norfolk, VA 23521
ATTN: Code N-311B

U.S. Navy Supervisor of Salvage
NAVSHIPS OOC
2531 Jefferson Davis Highway
Arlington, VA 20362

Commander, Submarine Development
Group One
Building 139, Syslvester Road
San Diego, CA 92106

Commander, 5th Coast Guard District
Portsmouth SAR Coordinator
Rescue Coordination Center
Federal Building
431 Crawford Street
Portsmouth, VA 23705

U.S. Coast Guard 7th District
ATTN: OSR
51 SW 1st Avenue
Miami, FL 33130

NOAA Safety Engineer
c/o Edwin McCann
Code AD-1
6010 Executive Blvd.
Rockville, MD 20852

Department of the Navy
Office of the Chief of Naval Operations
ATTN: Capt. E. E. Henifin (OP-23)
Washington, D.C. 20350

Commander, Submarine Group 2
Box 52, Naval Submarine Base
Groton, CT 06340