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MEMORANDUM

From: Chairman, Task Group 68-1
To: Vice Commander, Naval Facilities Engineering Command

Subj: Study Topic 68-1, Facilities Engineering Command Role Plan for Definition NAVFAC/Naval Construction Forces Role in Ocean Engineering

Ref: (a) Memorandum from Vice Commander NAVFAC to Captain E. M. Saunders dtd 24 May 1968 same subject

Encl: (1) Report "Study Topic 68-1, Plan for NAVFAC/NCF Role in Ocean Engineering" September 1968

1. In accordance with reference (a), enclosure (1) is submitted herewith.

2. Section II presents a summary of the report. Section VI presents actions which are recommended for achieving the goals of the plan.

3. Approval of Section VI is recommended.

Very respectfully,

E. M. Saunders
Chairman

CDR J. F. DOBSON

LT N. T. MONNEY

CDR D. B. WILE

DR. M. YACHNIS

CDR W. J. EAGER

MR. M. E. ESSOGLOU

LCDR J. M. F. KAU

MR. P. H. CAVE

LCDR R. D. SMART

MR. W. D. BASS

MEMORANDUM

From: Vice Commander, Naval Facilities Engineering Command
To: Captain E. M. Saunders, CEC, USN

MAY 24 1968

Subj: Study Topic 68-I, Facilities Engineering Command Role; plan for definition of NAVFAC/Naval Construction Forces role in ocean engineering

Ref: (a) NAVMATNOTE 5460 of 3 May 1966
(b) OPNAVNOTE 5450 of 21 Nov 1967
(c) GOR #41 of 5 Jun 1967
(d) ADO 46-36X Deep Ocean Technology of 4 Jan 1968 (CONF)
(e) TDP 46-36X (Draft) of 20 Mar 1968

1. You are hereby appointed senior member of a task group to define the complete role of NAVFAC and the Naval Construction Forces in ocean engineering.

2. The task group shall consist of the senior member and:

CDR D. B. Wile, CEC, USN - Code 062	Member
CDR J. F. Dobson, CEC, USN - Code 042	Member
CDR W. J. Eager, CEC, USN - Code PM 1121	Member
LCDR J. M. F. Kau, CEC, USN - Code 06112	Member
LT N. T. Monney, CEC, USN - MAT 0327E	Member
Mr. M. Yachnis - Code 041G	Member
Mr. M. Essoglou - Code 031	Member
Mr. P. H. Cave - Code 0321C	Member
Dr. L. W. Hallanger, NCEL	Member

3. A statement of the background, topic objective and tasks to be performed is attached. NAVFAC Code 011 will serve as study control point, will provide further guidance, and will arrange for such staff support as may be required.

4. Report. The completed study shall be presented by 1 August 1968 as a written report to the Commander, Naval Facilities Engineering Command.

R. E. SEUFER
Rear Admiral, CEC, USN
Acting Vice Commander
Naval Facilities Engineering Command

Copy to:
(See next page)

Subj: Study Topic 68-I, Facilities Engineering Command Role; plan for definition of NAVFAC/Naval Construction Forces role in ocean engineering

Copy to:

CDR Wile - 062
CDR Dobson - 042
CDR Eager - PM 1121 (CNM)
LCDR Kau - 06112
LT Monney - MAT 0327E
Mr. Yachnis - 041G
Mr. Essoglou - 031
Mr. Cave - 0321C
Dr. Hallanger - NCEL

CO NCEL

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STUDY TOPIC 68-I

PLAN FOR DEFINITION OF NAVFAC/NCF ROLE IN OCEAN ENGINEERING

BACKGROUND

By reference (a) the Naval Facilities Engineering Command was assigned the responsibility to support the Operating Forces of the Navy, the Marine Corps, components of the Naval Material Command, and other Navy bureaus and offices in the area of shore facilities and related material and equipment. These duties included providing engineering and support for "fixed surface and sub-surface ocean structures." By reference (b) the Chief of Naval Operations informed naval command elements of the responsibilities and capabilities of the Naval Construction Forces in support of oceanographic and deep ocean engineering projects and programs. It stressed the prime importance of the refinement of existing and development of new construction techniques within the aquaspace to facilitate the successful implacement, operation and maintenance of sub-surface ocean structures envisioned and under development within the entire spectrum of oceanography and ocean engineering. This document directed the use of the NCF in the development of aquaspace programs to which their expertise and talents could be profitably applied in response to Fleet operational requirements. It further advised of the responsibility of the Commander, Naval Facilities Engineering Command to plan for and develop the resource capabilities, readiness, and material support of fixed surface/sub-surface ocean structures for the Operating Forces of the Navy and Marine Corps and associated activities. Naval commands and project offices engaged in oceanographic and deep sea development and/or operational activities were required to consult COMNAVFACENGCOM on facility construction requirements which may be generated or required.

DISCUSSION

References (c), (d), and (e) further define the importance of the deep ocean to the Navy and establish the future role of NAVFAC, the CEC and the Naval Construction Forces in new programs and limited explorations preparatory to the launching of large scale, scientific studies of the aquaspace. The ocean is the natural environment of the Navy; the deep ocean is at the moment a military vacuum. Control of the seas in the future will depend upon national leadership in ocean technology. Complete military exploitation of the deep ocean

will require a sea floor construction capability and that, in turn, a deep ocean engineering capability. As a logical extension of waterfront and shallow water construction capabilities, it is considered to be the responsibility of the Naval Facilities Engineering Command and the Naval Construction Forces to take the lead in sea floor engineering and construction for the Navy.

For the past five years NAVFAC has taken some preliminary steps toward the development of deep ocean technology. During this same period the SEABEEs have demonstrated a capability of limited construction at scuba depths and are developing wider capabilities. We are now at a point in time where aggressive, fully coordinated effort is required.

PURPOSE AND OBJECTIVE

a. The purpose of this study is to define the complete role of the Naval Facilities Engineering Command/Naval Construction Forces in ocean engineering as it relates to RDT&E, design, engineering, and construction.

b. The objective of the study is to develop an overall time-phased plan to discharge these responsibilities and attain the level of competence required to undertake major undersea construction assignments within the next decade. Within this context, specific attention shall be given to developing a SEABEE/civilian capability to provide engineering support for underwater construction.

c. In fulfilling this objective it is desired that a systems approach to deep ocean construction be developed with the basic elements identified and defined; i.e., underwater facilities planning, site selection, site preparation, facilities components development assembly, placement and maintenance. Specific short, mid and long range actions should be developed by elements to meet the objective and to facilitate identification of required construction techniques and equipment, personnel skills and training, construction materials, facilities components and utilities. This plan should be devised to provide a firm, justified basis for price-out and submission of a request for resources. Additionally, system coordination responsibility within NAVFAC should be addressed for this multiple element program.

REPORT

ON

STUDY TOPIC 68-1

PLAN FOR DEFINITION OF NAVFAC/NCF ROLE

IN

OCEAN ENGINEERING

NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D. C.

SEPTEMBER 1968

PREFACE

The Vice Commander, Naval Facilities Engineering Command on 24 May 1968 established a task group for the purpose of defining the complete role of NAVFAC and the Naval Construction Forces in ocean engineering. The task group was to prepare a time-phased plan for the development of engineering and military (SEABEES) capability to enable NAVFAC to perform assigned responsibilities and to acquire the capability to undertake major undersea construction assignments within the next decade.

The study group consisted of the following:

Name	Organization
Captain E. M. Saunders	NAVFAC 03
Commander J. F. Dobson	NAVFAC 042
Commander D. B. Wile	NAVFAC 062
Commander W. J. Eager	DSSP
LCDR J. M. F. Kau	NAVFAC
LCDR Robert D. Smart	DSSP
LT N. T. Monney	CNM 0327
Dr. M. Yachnis	NAVFAC 041G
Mr. M. Essoglou	NAVFAC 031
Mr. P. H. Cave	NAVFAC 0321C
Mr. W. Bass	NAVFAC 0621
Mr. J. Quirk	NCEL
Ens. S. Stevenson	NCEL L02A

The firm Systems Design Incorporated assisted the workshop both technically and administratively. Messrs. E. Joseph Wheeler and Scott E. Terrill, Jr. were principal participants and contributors.

Presentations were made to the workshop on various pertinent subjects by personnel as listed below:

Name	Organization	Subject
Capt. L. E. Zeni	CNO OP-960SG7	Blue Waters Report
Capt. J. W. Boller	CNM MAT-0327	Remarks as to the Role of NAVFAC in the Navy's DOT Program
Mr. L. D. Cathers	DSSP PM 11-242	General Remarks on the Role of the Marine Commission
Mr. H. Arnold	National Council on Marine Resources and Ocean Engineering	" " " " "

Capt. V. F. Anderson	ASWSP ASW-205	ASW Surveillance
Capt. W. F. Searle	NAVSHIPS 00C	Divers in Underwater Construction
Mr. W. J. Bobisch	NAVFAC 041	The Future for Waterfront Construction and other Remarks
Major C. D. Blackwell	USMC A04S	Marine Corps 1985 and Other Remarks
Major G. H. Douse	USMC AX-5D	" " " "
Capt. C. M. Esler	CNO OP-71B	The Navy Deep Submergence Ocean Engineering Planning Group Report and Related Remarks
Mr. W. M. Spodak	DSSP PM 11-100	" " " "
Capt. R. J. Dzikowski	NAVSHIPS PMS-81	Certification of Submarine and Pressure Hulls
Capt. W. M. Nicholson	DSSP PM-11	DSSP'S Programs and General Remarks
Mr. H. A. O'Neal	ONR 480	Remarks of ONR's Activities in Ocean Technologies
Capt. E. C. White	NAVORD 03	NAVORD's Role and Activities in Ocean Engineering
Mr. John Ropek	NAVORD 03C	" " " "
Dr. C. C. Bates	NAVOCEANO 02	NAVOCEANO Activities Bearing on the Subject
LCDR R. E. Jacobs	CNO OP-321C	Sound Surveillance Systems

The last 3 days of the workshop week were devoted to the preparation of the following 3 sub areas which form the nucleus of this report: (a) identification of operational and research requirements and the formulation of design concepts to satisfy these requirements, (b) the development of a time phased plan identifying personnel, facilities, material, data, and assets to be required, and (c) a time phased plan for the development of a Naval construction force capability for seafloor construction.

This report is intended to inform the Commander, NAVFAC as to the resources required for NAVFAC to assemble the necessary assets which will yield the capability to achieve eminence in Ocean Engineering analogous to that it enjoys in Shore Facilities and to recommend actions designed to acquire those resources.

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I. NATIONAL AND NAVY NEEDS

A. Background

The Navy's role in ocean engineering and technology has been stated recently in three authoritative reports. First, the President's Science Advisory Committee on Oceanography in its report to the President in June 1966 established: "The utilization of the sea to enhance national security" as one of four national goals. In discussing this specific goal the report indicated that the Navy presently has primary responsibility for development of the capability for using man at depths in the ocean, and the report recommended expansion of those activities which will permit operation at any location and time within the oceans. The report pointed out that the bulk of the Navy's oceanographic efforts are primarily military, involving specialized requirements for both research and surveys, as well as engineering developments. The panel recommended that the program remain solely under Navy direction.

Second, the National Council on Marine Resources and Engineering Development reported to the President in February 1968 that "The Navy must expand knowledge and understanding of the sea and its characteristics; provide the ability to examine even the most remote depths of the sea; construct and improve ships, structures, and equipment which will perform in the marine environment; and to transport men and material quickly wherever they are needed."

Third, the Navy Deep Submergence/Ocean Engineering Program Planning Group (NDS/OEPPG) report of 2 July 1968 recognized that the systems and equipment being developed by the Navy to fulfill military missions could be of value in the National Oceanographic Program. The wide range of technological developments pursued by the Navy in fulfillment of its own needs will support the peaceful exploration of the oceans.

Thus, the Navy's leading posture in ocean engineering and technology is recognized at the National level. The continuance and intensification of the Navy's ocean programs is recommended because of the potential military threats described in ADO 46-36X and other documents. They are summarized as follows:

(a) The existing submarine force of the Soviets and the possibility of future developments in this area pose a threat. To meet this threat, the sea-based forces provide for strategic deterrance by deployment of Polaris submarines,

anti-submarine systems, support of amphibious operations, mine warfare and limited ground action, surveillance of the oceans, and operations to conduct and protect essential shipping.

(b) Protection of developed natural resources in the ocean is a national military requirement.

(c) The presence of effective military power in the oceans will exert influence of any future negotiations for changes in present laws or conventions pertaining to the oceans.

(d) Several other nations may develop the capability to exploit the oceans for military and commercial purposes posing an economic and military threat to the United States.

To counteract these threats the Navy has established and is planning a number of underwater systems in the areas of ASW surveillance, inshore warfare, shallow water facilities, mine warfare, amphibious warfare, underwater storage, surface logistics, and sea-based strategic deterrance. As vehicles for the development of technology, RDT&E projects, and other focal projects have been recommended. These warfare and support systems require "construction" sub-system efforts including design, test and certification, underwater construction equipment, trained personnel for underwater construction, life support, power, ocean bottom site engineering, and component development to provide the required operational undersea facilities and systems. The construction sub-systems effort requires the development of the technologies of materials, structures, energy generation and conversion, sensors, navigation control and communications, seafloor earth mechanics, environmental prediction and ocean survey, diver support, saturated diving, and acoustic oceanography.

CNM Organizational Manual, NAVMAT Notice 5460 of 3 May 1966 assigns to COMNAVFACENGCOM the life cycle responsibility for fixed surface and subsurface ocean facilities. NAVFAC has been assigned a significant role in the Deep Ocean Technology (DOT) Project, Technical Development Plan 46-36X. Its principal objective is to develop a broad technological base through the DOT focal projects, which are designed as test beds for the experimental evaluation of new construction, propulsion, hull, communication, and weapon sub-systems and components. Under Technical Development Plan Y41-02, NAVFAC has been assigned total Navy responsibility for the development of nuclear power systems in the range of 2-10KW(e) and 100-500KW(e) for ocean engineering applications.

B. Requirements

1. General

To assess NAVFAC underwater construction capabilities, ocean systems, required to meet the threats in the previous section, were compiled and examined. This compilation of system requirements, Figure II.C.1, was derived from authoritative sources such as program managers (see Appendix B), Navy studies and Navy requirement documents (Figure II.C.1). Requirements were translated as outlined in Section III.B into generalized NAVFAC/SEABEE capability requirements, Figures II.C.2 and II.C.3. The NAVFAC/SEABEE task listing of Appendix A including Figure A.1 are summarized for each system requirement in Figure II.C.1. It provides a total overview of system requirements and the NAVFAC/SEABEE capabilities required to support those systems.

2. Specific

It is not considered necessary or appropriate to discuss in detail each system requirement with its applicable references, mission requirement, possible design concepts, and thus derive the underwater construction requirements and NAVFAC/SEABEE support capability requirements as are summarized in Appendix A and Figure II.C.1. However, to emphasize the extreme importance of the NAVFAC/SEABEE development of a total "construction system" effort as related to required operational undersea military defense missions, one such system requirement will be discussed. ASW Surveillance now and in the 5 to 10 year time period is appropriate.

A detailed analysis of the potential enemy submarine types and total threat estimate is contained in R&D Planning Objective No. 20, Antisubmarine Warfare. Advanced Development Objective 46-36X, Deep Ocean Technology, provides a summary of the threat to CONUS from the undersea Soviet strategic force as follows: Near or on-bottom operations by Soviet submarines are potentially attainable with advanced designs employing available materials and design concepts. Near term improvements in the delivery accuracy of Soviet sea-based ballistic missiles against the U. S. land-based fixed ICBM sites may be achieved through the use of methods utilizing techniques based on data obtained from satellite obserations. The lack of U. S. undersea surveillance capability against such near or on-bottom forces may therefore compromise present U.S. counter force advantages.

Advanced Development Objective 24-07X, ASW Surveillance, states in part: The Sound Surveillance System (SOSUS)

is the only system in being with the capability for large ocean-area undersea surveillance. ..... SOSUS is a passive system its detection performance is dependent upon the radiated noise level, operating depth and speed of the target, and its classification capability is dependent on the characteristics of the targets' radiated noise level within the 10-300 cps range. It is technically feasible to reduce the radiated noise of potential targets to a degree that the detection capability of the SOSUS may be seriously degraded. ..... The overall, integrated Undersea Surveillance System to be developed must provide an undersea surveillance capability against submarines in all modes of operation under all environmental conditions in all areas of strategic or tactical interest. ..... Conduct the necessary research and experimentation for the development of active and/or passive undersea surveillance techniques leading to the design of an operationally useful and economically acceptable system capable of coping with submarines which in the future may be too quiet to be detected reliably by any realistic extrapolation of current passive techniques. System concepts to meet this objective include deep and shallow water fixed, mobile and deployable subsystems, and/or combinations thereof.

The effectiveness of the existing U. S. undersea surveillance system, the Sound Surveillance System (SOSUS), is limited by the present inability of contractors or the Navy to perform basic underwater construction tasks. An average of two failures occur each year in the SOSUS cables, and each failure usually results in a down time of 4 to 6 months of a hydrophone array before the cable can be repaired. The cost of each repair operation averages approximately $300,000. These failures are usually caused by submarine landslides or trawler operations, and could be virtually eliminated by protective construction in areas of landslides and by burial in areas of trawler operations. Burial of the SOSUS cables would also alleviate the present danger of intentional cutting by potential enemies.

TDP A 2407X, ASW Surveillance, supporting ADO 24-07X provides for the investigation of a number of conceptual systems. One concept for a medium range sub-system (25-150 nautical miles) provides for the suspension of a 200 foot diameter 30 foot height array from a floating stable platform. The fabrication of such a structure is considered to be within the limits of present technology, but the problems of transporting, lowering and suspending the structure have not been forced before. There are also basic problems in handling through the air-water interface and implaced stability during high sea state conditions. A concept for a long range sub-system (100-2000 n.m.) envisions a vertical array as

shown in Appendix A Concept 3 - Pole Grid, but with an active sound source as shown in Appendix A Horizontal Array. Other concepts shown in Appendix A were derived from project manager briefings. The long range sub-systems will require techniques for installing a sound source supporting structure and a source weighing up to 500 tons on an ocean bottom or sub-surface slope, and will require the building and installing of the receiving arrays. NAVFAC responsibilities for these described concepts include: design of array structure, design of array mountings, design of housing for sound source, provide system power (nuclear power required), provide bottom survey and soil exploration, develop implantment procedures, design of power and sound source foundations along with attachments, and provide necessary design and technology of subcomponents including such items as pressure vessels, cables, cable connections, anti-corrosion protection, implantment and weight handling systems. In view of the clandestine installation of these systems, their military priority and construction requirements, the SEABEES will be required to provide for operation of a stable platform, weight handling and installation, prefabrication of structural and foundation components, obtain bottom soil samples, provide jetting, augar and/or pile driving for foundation implacement, and accomplish the system installation.

The NAVFAC/SEABEE team does not possess all of the capabilities necessary for the above "construction system" effort. But the requirements for such an effort are real requirements in order to meet essential Navy operational missions.

Ocean Engineering is defined as specific technical capabilities for meeting operational requirements in underwater search, rescue, salvage, and construction.

II. SUMMARY

A. Narrative Brief

1. Background

The Naval Facilities Engineering Command is at a crossroads. To now, activities have been principally research and development in ocean bottom construction and engineering. In recent years weapons and support systems development engineers and scientists have planned and executed an increasing number of ocean bottom projects, which had they been on land, would have been NAVFAC projects. Industry, commercial laboratories and educational institutions are planning, designing and building habitats and underwater structures, manned and unmanned, at depths of hundreds of feet. Others in the Navy are installing a deep-diving capability using exotic atmosphere and saturated diving techniques. National goals, defense public statements to industry, and intuition tell us that the ocean is the next new environment man will conquer. NAVFAC expressions of assurances that NAVFAC is covering the underwater construction and seafloor engineering area, whether expressed to OPNAV, the Secretary, White House, or the public, are met with enthusiastic positive response. If resources are plentiful, the way to proceed would be clear. Realistic recognition must be taken of the fact that funds and ceiling are scarce.

Competition is keen between agencies, between services, between Navy organization, and within NAVFAC itself. Competition for resources takes several forms: The successful agency finds an important requirement, identifies it to the agency mission, determines that the agency is or will be capable of fulfilling the requirement, and aggressively follows through on convincing others that his requirement, mission, and capability package deserves resource support from higher authority. He can, and often does, accentuate the worth of his package, and privately and publicly minimizes that of his competitor.

2. Purpose of Report

This report is intended to:

a. Convince the Commander, NAVFAC that there are important missions for which underwater construction and related work will materialize within the next few years.

b. Review and express the established mission of NAVFAC to provide life cycle support to undersea facilities.

c. Present the plan for establishing the necessary NAVFAC/SEABEE capabilities in a timely manner.

d. Suggest approaches for providing the follow-through necessary to justify the expenditure of resources for accomplishment of items of work, and to illuminate the positive value to the Navy of NAVFAC capability to perform underwater construction.

3. Scope of Report

This report addresses all pertinent aspects of NAVFAC's role in ocean engineering: Navy requirements, present experience and capability, needed capability, time-phased resources requirements and immediate actions. The aim is to give credibility to the description of the future posture NAVFAC should achieve, and to recommend a reasonable course of action to achieve that posture.

4. Nature of the Management Problem to be Solved

The CNM representative briefing the task group posed five deliberately provocative questions. The questions are quoted and answered in paragraph II.A.6. Clearly, the questions can be summarized: Why should NAVFAC provide a capability for ocean construction? If it should, what is being done about it? The answers carry the note that action to improve our capability is needed. The need for improving capability is further evidenced by the observation that R&D funds decisions made in the recent past by the Chief of Naval Material apparently have been influenced by evidence of lack of NAVFAC involvement in and in-depth capability for ocean engineering in the NAVFAC ocean engineering mission area. A shift in emphasis on NAVFAC effort is needed to the extent that planning, engineering and construction will become a larger percentage of the total NAVFAC involvement compared to research and development which, up to now, has dominated the NAVFAC ocean engineering effort. An initial shift in staffing and funds from other functional areas is also required in order to accelerate the process of establishing NAVFAC capability.

Following a model of the discourse between CNO, NAVMAT and SYSCOMS (Figure II.A.1) on introducing new capability, it is observed that, at present, preliminary Navy requirements exist. The mission of NAVFAC is stated, and the tasks are defined as satisfactorily as the preliminary nature of the requirements allows. The NAVFAC submission of technical concepts in the form of proposals must now go forward to OPNAV. Present NAVFAC capability inventory to start this procedure includes:

The Process of Introducing
New Concepts into the Navy

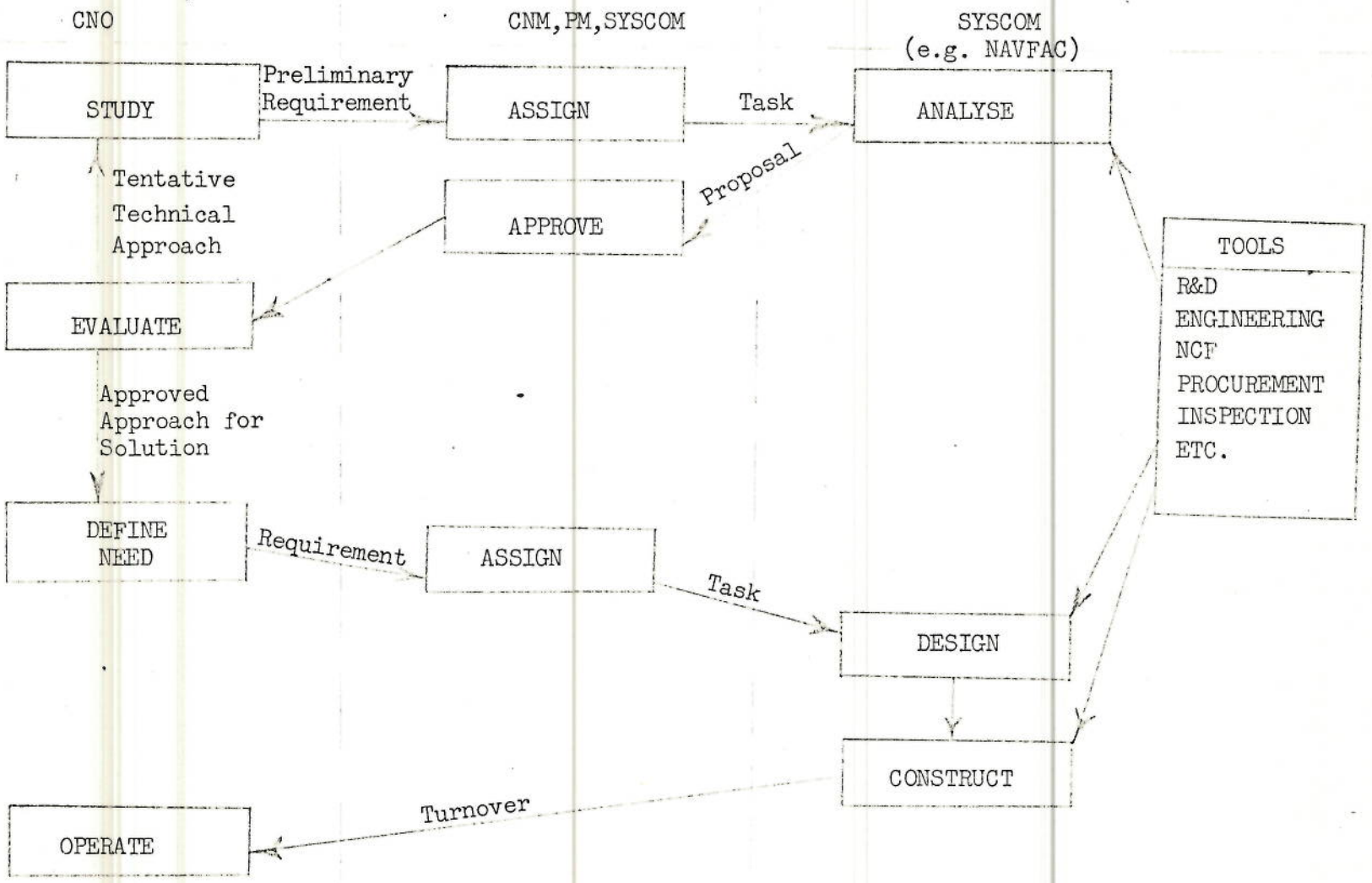


Figure II.A.1

a. R&D results from ten years of exploratory development are available but need to be integrated into usable packages.

b. A nucleus of ocean engineering capability exists in NAVFAC but requires expansion.

c. Procurement and inspection in ocean engineering is probably in hand, but trials of our capability are almost non-existent.

d. The Naval Construction Forces have a basic capability of limited scope.

NAVFAC efforts in analysis of requirements, formulation and submission of proposed technical approaches to operational problems ought to increase appreciably. This will precipitate more definite requirement statements, and NAVFAC's posture as the Navy's underwater construction agent will increase--design and construction assignments will then follow. The resources planned in FY 1970 (in part), FY 1971 and subsequent years assume success in the "pump priming" actions of FY 1969 and 1970, in that new, established, funded ocean engineering projects will be forthcoming.

5. Means of Solution of the Problem

At the onset, the means available to the Commander to move NAVFAC into its assigned ocean engineering role may be limited to the following management tools:

a. Policy and goals.

b. Funds available to NAVFAC.

c. NAVFAC personnel and personnel ceilings.

d. Training.

e. Facilities.

f. Organizational responsibility assignments.

g. Planning, programming, budgeting for additional resources.

h. Appraisal and correction.

i. Information transfer.

j. Technical data gathering and dissemination.

The actions recommended in this report employ these management tools in the following significant ways:

a. Management Goals

A set of management goals toward which NAVFAC should move are expressed thoroughly in the report in Paragraphs IV.A(2) and IV.B(2), and Figures IV.A.3 and IV.B.2. In summary:

(1) Three SEABEE underwater construction units in operation by 1972.

(2) Several large undersea construction projects designed and underway by 1972.

b. Staffing

The urgent needs for additional staffing are as follows:

(1) Provide two military billets and three civilian billets to the Director, Ocean Engineers Programs in FY 1969.

(2) Increase R&D staffing from one man in ocean engineering to two in FY 1969. FY 1970 needs will be for 3 or 4.

c. Funds

(1) In-house effort.

There will be a gradual shift in effort towards engineering, specifications, and construction battalion engineering support. As need for additional effort arises in connection with specific projects, it is assumed that funds will be available from the benefited programs as in Program IV today.

(2) R&D program.

A many fold increase in R&D funds is visualized. The amounts ascribed to NCEL in this report are within the amounts which are possible for NAVFAC future spending in the ocean engineering field.

d. Organization

Each program manager and assistant commander will continue to function in the established program and

functional areas, but their activities (i.e. building up their own ocean capabilities, providing technical assistance to the rest of the Navy, and developing hardware and force capabilities) will be integrated into a cohesive NAVFAC program by the proposed Director, Ocean Engineering Programs. He and his small staff will provide the planning, appraisal, and impetus for the program. This approach is recommended because of the relative lack of environmental pressure on NAVFAC in this field. Command attention should be intensified to substitute for outside pressure. Section V of the report presents a detailed discussion of the rationale and resulting recommendations.

6. Answers to Certain Questions

The CNM representative briefing the study group posed five deliberately provocative questions to NAVFAC. These questions and NAVFAC's reply are as follows:

a. Why has NAVFAC not been tasked for more active participation in major seafloor engineering projects such as Sealab, Seaspider, and SOSUS?

The personnel associated directly with such projects desire to keep relationships simple and handle as many support areas themselves as they feel are economical. As such projects increase in number complexity and cost, no longer can a do-it-yourself approach be used. Often in the past, such persons have been too busy to even discuss their problems with NAVFAC personnel. Authoritative action by the Chief of Naval Material will probably be required to correct this trend. It is essential that NAVFAC capability grow to meet needs as they become more demanding in the future.

b. Why, after about ten years of effort in this area, is NAVFAC having difficulty identifying a clearly defined R&D program in ocean engineering?

(1) A defined national or Navy program in ocean engineering for the ocean bottom has begun to emerge only recently. Requirements for vehicles development clearly exist but for ocean bottom structures and other aspects of seafloor engineering, we are dealing in a set of solutions for problems whose definition requires vision and imagination.

(2) The remainder of the DOT program, besides serving real existing problems associated with vehicles, is more closely associated with the weapons system engineering problems well familiar to those who are in the chain of review. It is therefore inherently better understood.

(3) We have, after some difficult effort, established a defined R&D program in ocean engineering. The program is as yet incomplete. Additional R&D funds and headquarters staffing would return immediate benefits in this area.

c. What do we have to show for the moneys already invested in this area? What additional operational capability can be attributed to this effort?

(1) Industry (not DOD) is about to build manned underwater stations to be placed on the ocean floor. Navy/NAVFAC exploratory development has provided a technological base.

(2) A basic literature is available for behavior of materials on or near the ocean floor. Materials problems associated with underwater communications, vehicles and structures have been solved through experimental work performed at NCEL.

(3) NCEL/NAVFAC developed acrylic windows which are usable for deep submergence vehicles.

(4) A Navy capability for handling technical problems associated with multi-conductor and tube umbilicals exists at NCEL.

(5) A 5000 psi 72 inch pressure vessel is presently testing deep submergence components.

(6) A shallow water Navy construction capability is presently emerging.

(7) Indirect benefits from this program have given rise to improvements in Navy salvage methods, particularly in air and water handling and weight handling.

(8) For others, see the NCEL report on Ocean Engineering 1967-1968.

d. From a pure economic base, might it not be wise not to develop an in-house capability but to continue our reliance on the ever increasing number of ocean engineering vendors for turn-key types of operations?

(1) The costs for maintaining in-house competence capable of assuring the safety of men and system availability would undoubtedly be many times smaller than the costs resulting from a failure.

(2) While NAVFAC policy has always been the maximum utilization of industry, such utilization cannot be assured unless NAVFAC is technically competent; furthermore just as in the past so in the future there will always be occasions where contractors simply cannot be used.

(3) Results of industry R&D, unless paid for by government, cannot be obtained generally except by buying the products embodying the R&D. Reliance cannot be placed on industry claims for performance of untried and not understood concepts. Rather, the government must be able to evaluate and correct suppliers' engineering at all points in the life cycle.

(4) In this new field, industry must be handed the results of R&D in order to provide hardware to the government, just as we develop sea surface antennas, guns, weight handling, propulsion and environmental prediction techniques to be incorporated in ship and weapons systems by industry as a system supplier.

(5) Industry cannot provide a fleet operational capability for underwater construction.

(6) Where certification for safety, i.e. "man rating", is required in-house expertise is an absolute requisite for certification.

e. We have noticed in the past that NAVFAC has ocean engineering representatives in only two groups--NAVFAC 03 and NCEL (with the exception of nuclear engineering); whereas other commands gain major assistance from their engineering division. Why doesn't NAVFAC utilize their engineering division in a similar manner?

The NAVFAC engineering group has inadequate resources. What is needed is a capability in a field office, as recommended in this report.

B. Summary Assessment of Existing Capability

An inventory of existing NAVFAC capabilities in ocean engineering are presented in Appendix C and summarized in Table II.B.1. These capabilities represent expertise in engineering materials; power systems; site preparation; and assembly and construction. Some expertise in life support and shallow water construction execution is in evidence. There is no organized capability indicated for contractor surveillance, maintenance, inspection, and safety certification for deep ocean structures. There are a limited number of SEABEE divers available and expertly trained in underwater construction. Our expertise exists

EXISTING PERSONNEL ASSETS*

LOCATIONS	EFFECTIVE NUMBERS OF PERSONNEL
NAVFACENGCOMHQ	
Technical Management	3
Technical Consultants	2
Specialists	6
Non-Specialists	0
NAVFAC EFD'S	
Technical Management	1
Technical	9
NCF (SEABEES)	
Officers	2**
Men	6**-63***
Immed. Support Civilian	4.5
NCEL	
Technical Management	2
Technical (Eng. and Sci.)	20
Support (Technicians)	4

* This is a tabulation of the effective NAVFAC and SEABEE personnel assets constituting the total NAVFAC capability profile in ocean engineering. Derived from Appendix C.

** Qualified saturation divers.

*** Authorized diver billets in NCF at present.

TABLE II.B.1

in what might be termed "pockets of excellence". However, the degrees of expertise within these "pockets" vary substantially, such that the total NAVFAC capability is less that satisfactory for today's ocean engineering problems, let alone those to be encountered in the future.

There exist library, technical data and computer facilities available in NAVFAC and NCEL sufficient to support most but not all of the anticipated workload. Equipment for certification testing is lacking.

NCEL's facilities and equipment for ocean and waterfront technology development is adequate for most but not all of the expected effort. Programmed is a pressure test facility, and resources are programmed for RDT&E support equipment or will be programmed as soon as requirements become more definite.

Appendix C is a detailed summary of existing personnel, equipment, facility and data assets in NAVFAC and NCEL.

C. Summary Plan

The NAVFAC technical end product capabilities required by the various construction requirements, derived from existing and foreseeable missions, are shown in Figure II.C.1. Appendix A contains 44 design concepts which are the basis for this Figure. The missions, for which the construction requirements were inferred, were obtained from Navy planning documents and with the benefit of the speakers whose briefs appear in Appendix B. The capabilities are fully discussed in Sections IV.A and IV.B covering the NAVFAC-NCEL life cycle management and engineering capability and the SEABEE military force capability respectively. Figure II.C.2 relates end product capabilities to the additional required assets of personnel, equipment, facilities, data, and contract services. Finally, Figure II.C.3 shows the resources needed for acquisition of the various categories of assets. The resources are arranged by appropriation classes and fiscal years.

CONFIDENTIAL

NAVFAC/NCF OCEAN ENGINEERING DEVELOPMENT PLAN

REQUIREMENTS — CAPABILITIES

ANTICIPATED OR ESTABLISHED SYSTEM REQUIREMENTS \ CAPABILITIES	a. SITE SELECTION & ENVIR. ENGRG	1. HYDROSPACE	2. SEAFLOOR		b. SIR SUBSYS	1. MAT'L'S & STRUCT'S	2. FDN'S, ANCRS & SITE PREP	3. ASSY & CONSTR		c. POWER		d. LIFE SPT & HUMAN ENGR		e. COMMAND & CONTROL		f. MANAGEM'T		REQUIREMENT REFERENCES MRO	GOR	SOR	ADO	EDG
I ASW SURVEILLANCE																						
A. ANTI-NEUTRINO DET SYS		X	X			X	X	X			X		X		X		X	78	24,35,12		24-07X	133,134,175,176
B. OCEAN BOT ACOUSTIC TEL		X	X			X	X	X			X		X		X		X	78	24,35,12		24-07X	133,134,175,176
C. VERTICAL ARRAYS		X	X			X	X	X			X		X		X		X	78	24,35,12		24-07X	133,134,175,176
D. HORIZONTAL ARRAYS		X	X			X	X	X			X		X		X		X	78	24,35,12		24-07X	133,134,175,176
II SHALLOW WATER																						
A. HARBOR & PORT FACILITIES		X	X			X	X	X			X		X		X		X	78	14,41			542
B. INSTANT PORT		X	X			X	X	X			X		X		X		X	78	14,41			542
C. RIVERINE WARFARE		X	X			X	X	X			X		X		X		X	78				447
III MINE WARFARE																						
A. WEAPONS SYS (CAPTOR)		X	X			X	X	X			X		X		X		X	78	14,26,27		46-36X	343
IV AMPHIBIOUS WARFARE																						
A. LOG & RECON SPT STA		X	X			X	X				X		X		X		X	78	14,41			542
B. FUEL STATION (U/W)		X	X			X	X				X				X		X	78	14,41			542,543
C. FUEL FARM		X	X			X	X				X				X		X	78	14,41			542,543
D. LOG. MODULES (U/W)		X	X			X	X	X			X		X		X		X	78	14,41			234,261
E. LOG. BASE		X	X			X	X	X			X		X		X		X	78	14,41			
F. SUP. DELIV'RY SYS (DECNE)		X	X			X	X	X			X		X		X		X	78	14,41			542,543
V UNDERWATER CACHE																						
A. POL		X	X			X	X	X			X		X		X		X	78	14,41			
B. SUPPLIES		X	X			X	X	X			X		X		X		X	78	14,41			
VI SURF. LOG. & WORK PLATF		X	X			X	X	X			X		X		X		X	78	14,41			
VII SEABASED STRAT DETER'NT SYS																						
A. PLATFORM						X	X	X			X		X		X		X	78	15		46-36X	231,341
B. IN BOTTOM		X	X			X	X	X			X		X		X		X	78	15		46-36X	231,341
C. ON BOTTOM		X	X			X	X	X			X		X		X		X	78	15		46-36X	231,341
VIII RDT & E SUPPORT PROJECTS																						
A. TEKTITE		X	X			X	X	X			X		X		X		X	78				179
B. SEALAB		X	X			X	X	X			X		X		X		X	78				
C. HYDROG'PHIC DATA COLL															X		X	78	37	534-05	46-20X, 46-36X	179, 534
D. OCEANOG'PHIC DATA COLL						X	X	X			X		X		X		X	78	37		46-36X	179, 534
E. COMM-NAV INTERFACE DATA COLL		X	X			X	X	X			X		X		X		X	78	37		46-36X	179
F. WEATHER DATA COLL			X					X			X		X		X		X				46-36X	179
G. GEOLOGICAL DATA COLL		X	X			X	X	X			X		X		X		X	78	37,48			179
H. PRESSURE TEST FACILITY		X	X			X	X	X			X		X		X		X				46-18X	549
IX FOCAL PROJECTS																						
A. DS/OE-PPG																						
1. PROTYPE U/W WORK UNIT		X	X			X	X	X			X		X		X		X	78	15,37		46-07X, 46-20X	179,493,534,547
a. AQUANAUT EQUIP.		X	X			X	X	X			X		X		X		X	78	15,37		46-07X, 46-20X	179,493,534,547
b. MOVABLE HABITAT		X	X			X	X	X			X		X		X		X	78	15,43,37,41		46-07X, 46-20X	179,493,534,547
2. MANNED U/W LAB		X	X			X	X	X			X		X		X		X	78	15,43,37		46-07X, 46-20X	179,493,534,547
B. MARINE COMMISSION																						
1. FIXED CONT SHELF LAB		X	X			X	X	X			X		X		X		X	78	15,37			179,493,534,547
2. MOVABLE HABITAT		X	X			X	X	X			X		X		X		X	78	15,41			179,493,534,547
3. OCEAN PLATFORMS		X	X			X	X	X			X		X		X		X	78	37			179,493,534,547
4. NATL OCEANOG'PHIC BUOY SYS			X			X	X	X			X		X		X		X	78	37			179,493,534,547
C. DEEP OCEAN TECHNOLOGY																						
1. TEST-BED MANNED BOT INSTL		X	X			X	X	X			X		X		X		X	78	15,37,41		46-36X	179,493,534,547
2. TEST-BED MANNED SSM		X	X			X	X	X			X		X		X		X	78	15,41		46-36X	179,493,534,547
3. ANCILLARY DEVELOPMENT													X		X		X	78	15,37		46-36X	179,493,534,547
4. WPNS SPT INTERFACE DEVELMT		X	X			X	X	X			X		X		X		X	78	15		46-36X	179,493,534,547

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

FIGURE II.C.1

NAVFAC OCEAN ENGINE[illegible]G DEVELOPMENT PLAN

CAPABILITI[illegible]S ASSETS

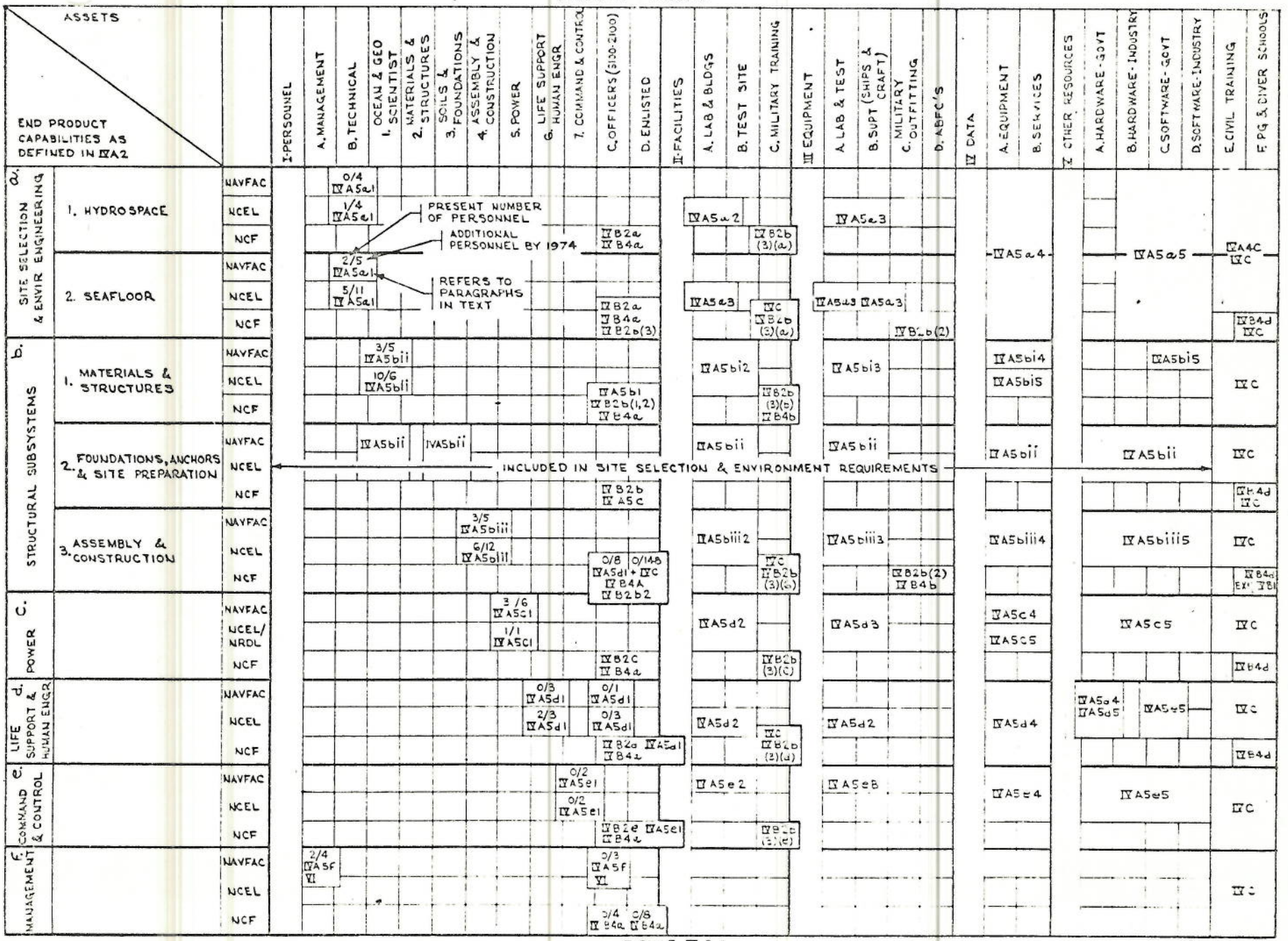


FIGURE II C.2.

NAVFAC OCEAN ENGINEERING DEVELOPMENT PLAN

REQUIRED ASSETS

LEGEND: PERSONNEL —•/•— DOLLARS

△ NCF FORCE DEVELOPMENT ITEMS
0810, 2, 2100 DESIGNATORS RESPECTIVELY
O OFFICERS: 5100, ENLISTED: GRP VIII
□ INCLUDES MN PERSONNEL

		FY 69					FY 70					FY 71					FY 72					FY 73					FY 74				
		RDT&E	O&MN	OPN	MILCON	MPN	RDT&E	O&MN	OPN	MILCON	MPN	RDT&E	O&MN	OPN	MILCON	MPN	RDT&E	O&MN	OPN	MILCON	MPN	RDT&E	O&MN	OPN	MILCON	MPN	RDT&E	O&MN	OPN	MILCON	MPN
I PERSONNEL	A. MANAGEMENT		1/70					1/20					2/50				2/50						2/50					2/50			
	B. TECHNICAL																														
	1. OCEAN/GEO SCIENTIST	1/20	1/20				2/40	2/40				3/60	3/60				4/80	4/80				4/80	4/80				4/80	4/80			
	2. SOILS & FOUNDATIONS	4/50	1/20				6/120	4/40				5/100	3/60				5/100	4/80				10/200	5/100				10/200	6/100			
	3. MATERIALS & STRUCTURES	1/20					3/60	1/20				6/120	2/40				6/120	5/100				6/120	5/100				6/120	5/100			
	4. ASSEMBLY & CONST						3/60	1/20				6/120	2/40				5/100	3/60				10/200	4/80				12/250	5/100			
	5. POWER											2/40	1/20				4/80	3/60				6/120	5/100				7/140	6/120			
	6. LIFE SUP & HUMAN ENGR	1/20					2/40	1/20				3/	2/40				3/60	3/60				3/60	3/60				3/60	3/60			
	7. COMMAND & CONTROL						1/20					1/20	1/20				2/40	1/20				2/40	2/40				2/40	2/40			
	C. OFFICERS O					2/24					7/84					13□/156					13□/156					13□/156					23□/274
	D. ENLISTED O										28□/140					93□/465					98□/490					141□/705					141□/705
II FACILITIES	A. LABS & BUILDINGS									10,000																					
	B. TEST SITES																								50						
	C. MILITARY TRAINING		△100					△300	△250				△500	△1500				△500	△250				△500					△500			
III EQUIPMENT	A. LAB & TEST						400					500					950					800					500				
	B. SUPT (SHIPS, CRAFT)						100					650		1000			1200		2000			700		2000			200		500		
	C. SBARGE OP'NS & OUTFIT							△200	△500				△800	△1000				△600					△600					△600			
IV DATA	A. EQUIPMENT SERVICES						100	100				100	100				100	100				100	100				100	100			
V OTHER RESOURCES	A. HARDWARE, GOVT						500					500					△500					500					500				
	B. HARDWARE, INDUSTRY						150/5850					700/△10,000	△100	4000			1200/△9,650	△100	5000			1050/△13,300	△100	1000			2050/△6800	△100	14,000		
	C. SOFTWARE, GOVT						100					100					100					100					100				
	D. SOFTWARE, INDUSTRY & AE	10					420					710					610					610					360				
	E. CIVILIAN TRAINING		10				"	20					30					10					10					10			
	F. DIVER & PG SCHOOL					△6					△260					△800					△270					△250					△270

ALL $ FIGURES IN THOUSANDS OF DOLLARS

III. MISSIONS AND CAPABILITIES

A. Rationale for Expanding NAVFAC Capability

A study of the NAVFAC and SEABEE missions indicates that there are functions and responsibilities to which ocean engineering capability must be identified, measured and improved. This section relates NAVFAC and SEABEE mission requirements to their respective capabilities and identifies deficiencies to be overcome. The baseline of current capability and the nature of ocean facilities lead to a rationale for the required NAVFAC and SEABEE expertise in ocean engineering and the formulation of a plan to develop that capability.

1. NAVFAC Missions and Roles in Ocean Engineering

a. NAVFAC Mission

NAVFAC expertise in research, planning, design, construction, maintenance, (i.e. acquisition through disposal) of Naval shore facilities, utilities, fleet moorings, waterfront structures, as well as transportation, construction and weight handling equipment and shore nuclear power must be extended to ocean bottom structures. The NAVFAC mission in ocean engineering is broadly defined in the NAVMAT Organization Manual. NAVMATNOTE 5460 of 3 May 1966 assigns NAVFAC the responsibility for planning, designing, constructing, inspecting and maintaining facilities with respect to fixed surface and subsurface ocean structures.

Closely related is the effective utilization of Man-In-The-Sea for construction tasks. The salvage mission assigned to NAVSHIPS has many common elements of technology and operations with construction.

b. Capability and Responsibility

In-house engineering expertise relating to ocean technologies is a function which must be maintained and improved. Detailed analysis of the facility sub-system component requirements vis a vis capabilities (Figure II.C.1) indicates that NAVFAC must have total ocean engineering and management capability which includes:

(1) Prefabrication and assembly ashore.

(2) Handling and transportation on the sea surface, in the ocean, and on the bottom.

(3) Structures including platforms, towers and other components necessary to handle, operate and service functional equipment.

(4) Methods of applying adjustable buoyancy to permit control and precise placement of facility elements.

(5) Survey of the ocean bottom.

(6) Underwater site preparation.

(7) Soils investigations and construction of foundations and supports.

(8) Construction and/or erection of facilities.

(9) Provisions for servicing and maintenance.

(10) Protection and surveillance of facilities and complexes.

(11) Mechanics of placing and recovering heavy loads in deep water.

NAVFAC ocean engineering responsibility is further demonstrated by its involvement in the Navy's Deep Ocean Technology Program (DOT) which makes specific assignments to NAVFAC for the development of technologies pertinent to fixed surface and subsurface ocean structures. The DOT Program responsibility matrix shows that NAVFAC is responsible for the "Test Bed Manned Bottom Installation" as follows:

(1) Site selection.

(2) Site preparation and construction.

(3) Diver support.

(4) Structural systems.

(5) Utilities, safety and habitability (in part).

(6) Navigation assistance, surveillance, communication, command and control (in part).

The Naval Civil Engineering Laboratory is the principal in-house laboratory engaged in the development of

ocean technology required for the NAVFAC mission. Although Naval Civil Engineering Laboratory (NCEL) is NAVFAC's principal support laboratory, it conducts also research and development for Supervisor of Salvage NAVSHIPS, the Man-In-The-Sea (MITS) project of the Deep Submergence Systems Project Office (DSSPO) and others.

NAVFAC, as the Navy's construction agent, plans, programs and administers contracts for all MILCON construction projects calling for underwater facilities. For non-MILCON projects, assignment to NAVFAC is made on an individual basis by the project director concerned with the construction requirement.

Work accomplished to date has been generally limited to shallow depths, including tower installation (Argus Island), Polaris pop-up facilities, and undersea range equipments. Operations in the sea are conducted routinely as a part of the NCEL R&D program.

2. SEABEE Missions and Roles in Ocean Engineering

a. SEABEE Mission

Mission definition--SEABEES are those Naval Mobile and Amphibious Construction Battalions (NMCBs and ACBs) comprising the Naval Construction Forces (NCF). The SEABEES provide combat construction for Naval, Marine Corps and other military forces including tactical and logistic bases, underwater construction, ship-to-shore facility systems, maintenance and operation. SEABEES also engage in cold war operations and, in peacetime, undertake construction projects for the training needed to maintain their wartime readiness.

b. NAVFAC Relationship to the SEABEES

The Naval Facilities Engineering Command has the responsibility of ensuring that the Naval Construction Forces are capable of meeting all missions assigned by the Chief of Naval Operations (CNO). NAVFAC supports the NCF in three major areas: financial, personnel and technical. Financial support includes initial outfitting, and allowance replacement. In personnel support, the number, grades, specialties and training of the CEC officers and Group VIII personnel are recommended to BUPERS. Technical support provides for the total integration of personnel and equipment into a capable military construction force.

c. Capability Requirements

As a result of recent developments, the Navy's requirements and the SEABEE capabilities for performing inshore underwater construction have been reviewed. This review considered terminal logistics and ship-to-shore transfer, anti-submarine warfare, riverine warfare, counter insurgency, amphibious operations, and inshore undersea warfare; and the rapidly expanding needs for oceanographic intelligence. These Navy missions will undoubtedly require tactical diver-constructor expertise capable to function in a tactical mode and militarily responsive to the Fleet or Theater Commander. It follows that, since SEABEES are commissioned units of the Naval Operating Forces and have already demonstrated their shallow water construction capability they should be further developed and utilized in expected ocean construction missions.

As a consequence of the above, the CNO issued OPNAV Notice 5450 on 21 November 1967, which:

(1) assigns responsibility to NAVFAC to plan for and develop the resource capabilities, readiness, and material support of pontoon equipment, fleet moorings, and fixed surface/subsurface ocean structures for the operating forces of the Navy and Marine Corps and associated activities;

(2) specifies that COMNAVFACENGCOM is to be kept advised on all facility construction requirements generated from Oceanographic and Deep Sea projects or operational activities on a continuing basis; and

(3) urges Naval commands and offices to utilize the services of the Naval Construction Forces in the conduct of RDT&E and operational programs requiring ocean engineering capabilities.

3. NAVFAC Impact in Ocean Engineering Today

As is pointed out in the NDS/OEPPG Report (the Esler Report) of 2 July 1968, many Navy activities are developing and employing deep submergence technologies to satisfy their particular mission responsibilities. There is less than satisfactory communication and coordination among the several agents engaged in the deep ocean studies and development work related to facilities and underwater construction. This fragmentation of facilities development is expensive in terms of time, money, and personnel resources. This fragmentation stems partially from the tendency of laboratories and contractors to undertake facility support

sub-system development integrally with the primary systems. Part of the fragmentation is due to the commonalty of the involved technologies.

NAVFAC experience and technical know-how has not always been recognized and utilized to the best advantage to the Navy. NAVFAC's involvement in ocean engineering thus far has been mainly through RDT&E in the development of technological know-how of wide scope and depth in materials, soils, systems, power, etc.--approximately $11,000,000 in 10 years. SEALAB is an example of non-recognition by other Navy activities of NAVFAC's capabilities. From its inception, SEALAB was considered a fixed (non-mobile) underwater facility as opposed to a propelled (mobile) structure. Consequently, just as with other fixed Navy facilities NAVFAC participation in planning, engineering, site selection, testing, and support should have been included. These functions were required for most of the sub-systems which now comprise the DSSP SEALAB project. In retrospect, it appears that NAVFAC should have participated in the SEALAB series. Indeed, this observation is also made in the NDS/OEPPG (Esler) Report. To have taken on this task in 1962-63 would have required then, just as now, the assembly of a staff capable of developing and promoting system concepts and providing visibility of the NAVFAC capability.

4. Conclusion

There is a sufficient basis to conclude that undersea construction will take place within the next decade (Appendixes A and B) and that this construction will relate to ocean surveillance, weapons and logistics systems.

The Navy has the opportunity to assume national leadership in ocean technology engineering and construction. If NAVFAC and the SEABEES do not respond to this opportunity for leadership and contribution to the national needs, other agencies or elements of the Services may. Additionally, there is the need to make available a military construction force in being, backed by NAVFAC ocean engineering know-how, and ready to meet military needs for underwater construction.

NAVFAC is now assigned the task of developing construction techniques and hardware. Lack of tangible return to the Navy has resulted in budget cuts in development funds being placed on NAVFAC. Demonstration that NAVFAC can in fact undertake and do ocean jobs is needed. The high cost of undersea operations dictates that a production oriented in-house organization, with strong motivations to decrease cost and increase effectiveness, be developed in the Naval Construction Forces in particular and NAVFAC in general. Such capability will increase

our strategic and tactical options through the flexible use of the ocean bottom. With sufficient determination and attention to advanced technology (a function of proper funding, staffing and policy) NAVFAC can successfully develop the construction systems, and with proper training and equipment the SEABEES can carry out the construction operations.

B. Capability Plan Approach

The task group proceeded to develop the proposed capability plan as follows (Figure III B-1):

1. Assimilation of pertinent information bearing on the subject: national policy, Navy missions, state of technology, level of effort, management of Ocean Engineering Program--nationally and Navy wide.

2. Briefings from key people representing the organizations participating in the shaping of the ocean engineering policy, programs and technology (Appendix B).

3. A workshop week of informal briefings, discussions, and work sessions as outlined in Figure III B-2.

In formulating the capability plan two basic ingredients were considered: (1) Operational Requirements and (2) Resource Capabilities. For each RDT&E focal project and operational system i.e. the requirements, a conceptual design was developed which represents probable seafloor facility sub-system. Forty-four such designs are included in Appendix A. A work breakdown structure (WBS) was then developed for each project design concept. The WBS was used to identify end product technical capabilities necessary to construct the concept. Time frames were established for attainment of required operational capability. These time frames are: the current period (1-2 years); near-time-frame (3-5 years), mid-range period (5-10 years) and long range (10-20 years). The capability plan addresses three major organizational and functional entities: Engineering and Program Management (NAVFAC), The Combat Construction Force (SEABEES) and RDT&E (NCEL and NRDL).

The resources needed to acquire the personnel, equipment, facility, and contractor service assets for the technical and operational capability were estimated by appropriation class and fiscal year. Finally, a set of recommended FY 69 actions, to initiate the necessary changes in the policy, organization, funding, training, management and engineering of NAVFAC, and the SEABEES, were formulated.

Major Phases of Task Force 68-1 Efforts

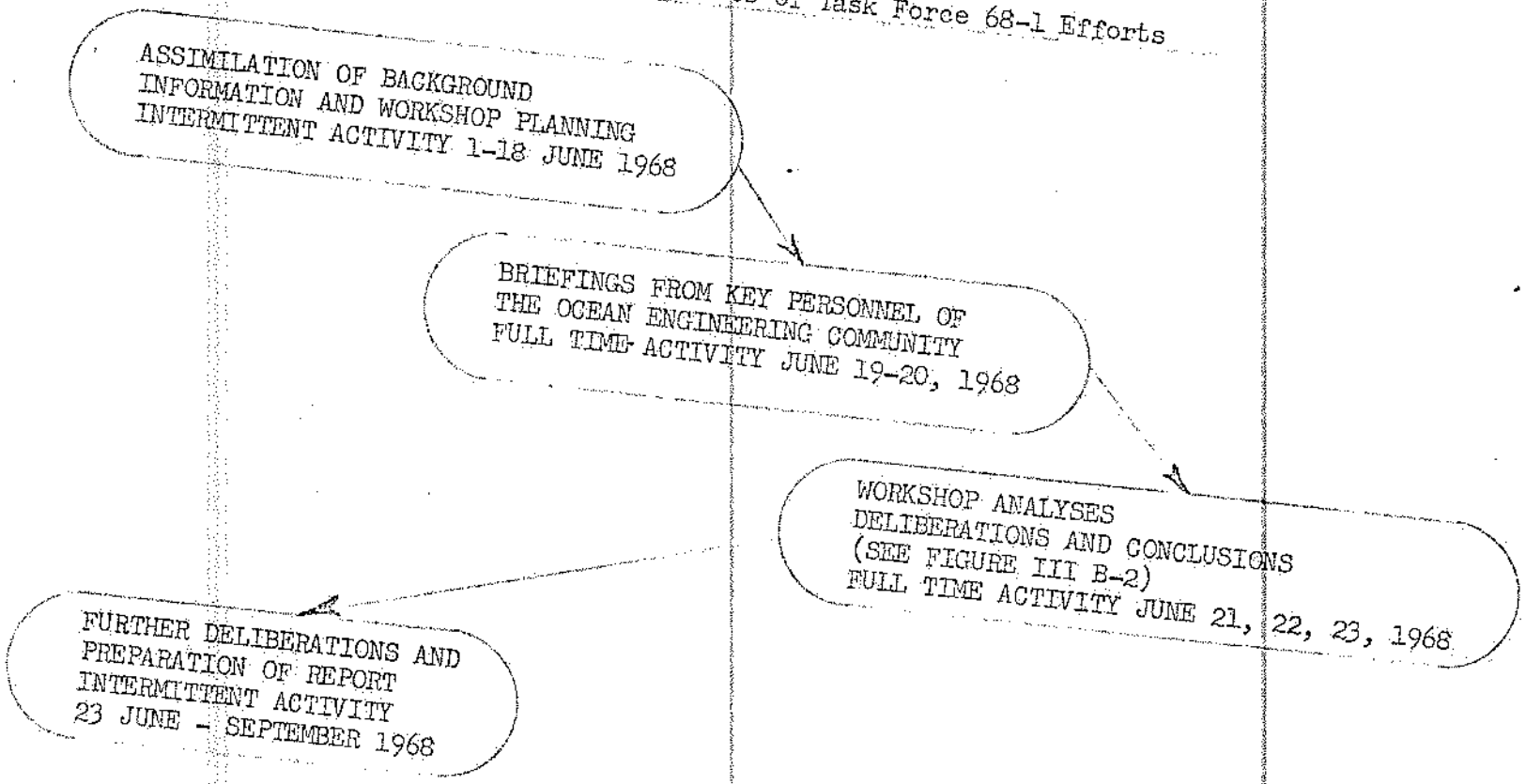


Figure III.B.1

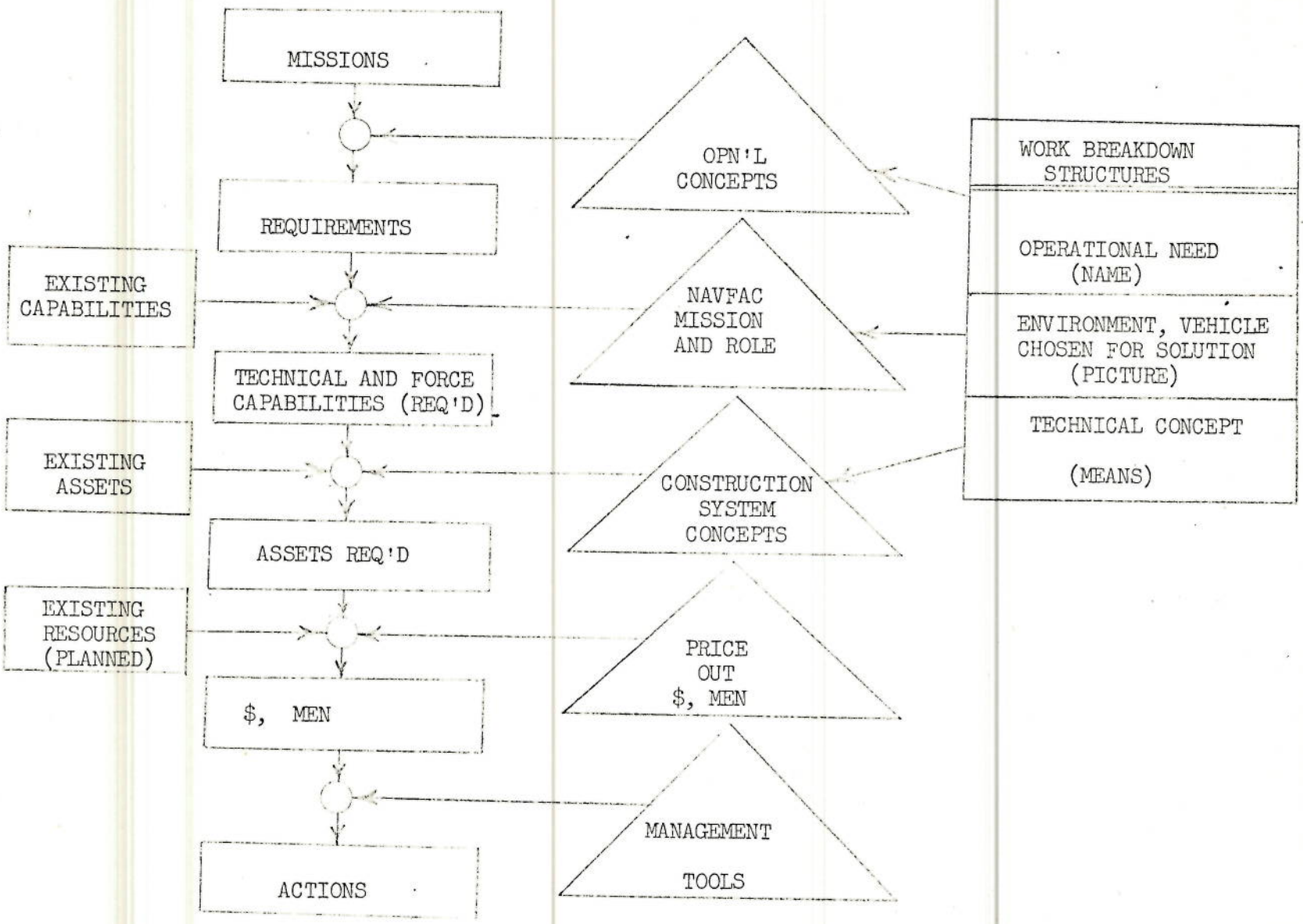


Figure III.B.2

IV. CAPABILITY PLAN

A. NAVFAC

This section does not include the development of a military force capability (this is addressed in Part B); rather, it addresses the development of an engineering capability applicable to many projects at all stages of the life cycle consisting mainly of officers, professionsl engineers and technicians competent to apply a broad spectrum of engineering expertise to underwater construction missions.

1. Background

The synergistic effects of technological progress in several interacting and complementing fields will bring about the creation of warfare and support systems making extensive and intensive use of the ocean bottom environment. Within the confines of todays technological and operational concepts, the following warfare/mission groups are identified:

ASW Surveillance
Shallow Water Warefare/Support
Mine Warfare
Amphibious Warfare
U/W Storage
Surface Logistics and Work Platform
Sea-Based Strategic Deterence

For the efficient channeling of resources to develop the appropriate know-how, several R&D focal projects have been proposed on the premise that if they can be done, most foreseeable operational projects can also be done. Operational and focal projects that were identified by the task force are summarized in Figure IIC.1. They serve as points of departure for the development of probable facility sub-system configurations and their associated work breakdown structures, i.e. their constituent parts of sub-assemblies and components. (See Appendix A and Figure A-1). These design concepts then constituted the basis for preparing Figure IIC.1. Figure A-1 is in more detail and shows the occurrence frequency and spectrum of technological capabilities as they relate to the foreseeable mission requirements.

The time phasing of these requirements depends upon the development of systems as a result of interactions between advances in technology and military necessity. Projections of the military necessity when compiled with projections of technology into the future introduce considerable uncertainty. However, to plan for the timely acquisition of the necessary assets, the best possible projection of requirements must generally be made. The requirements were assessed as to their time phasing (a) by

considering implicitly depth of water, clandestine/concealment and speed of accomplishment, and (b) by considering military necessity as expressed in Navy planning documents. The resulting "probable" time phasing is shown in Figure IVA.1 and constitutes the basis for this plan.

2. Capability Discussion

Capability is defined for purposes of this study to mean "The organic ability to perform, build or conduct a technical end function or product." Specifically for the mission and roles of NAVFAC in ocean civil engineering; these technical end functions are as follows:

a. Site Surveying and Environmental Engineering.

b. Underwater Structural Sub-systems (includes: structures, foundations, assembly and construction).

c. Power.

d. Life Support and Human Factors Engineering.

e. Command and Control Interface Engineering.

While there are other ways of defining capability this was selected because of its generality. It implies: (a) a "life cycle" aspect (i.e. R&D, planning, design, construction, maintenance and operations), (b) it is independent of all organizational implications, namely, who does it, i.e. industry, civil service, or military, and (c) it includes both engineering knowledge and data or "software" and physical products or "hardware".

Figure IV.A.2 shows then that a particular technological capability implies many possible combinations through which it is exercised depending upon the circumstances surrounding each specific requirement. The selected capability profile essentially parallels that of the Deep Ocean Technology (DOT) Program.

The major broad capability areas are outlined as follows:

Site Selection and Environmental Engineering. The ability to conduct the spectrum of observations and analyses necessary to converge on the most appropriate site for a given mission and provide for the engineering necessary for total environmental compatibility. The detailed distribution and level of expertise will be determined as requirements materialized. However, broadly speaking

Time Phasing of Requirements

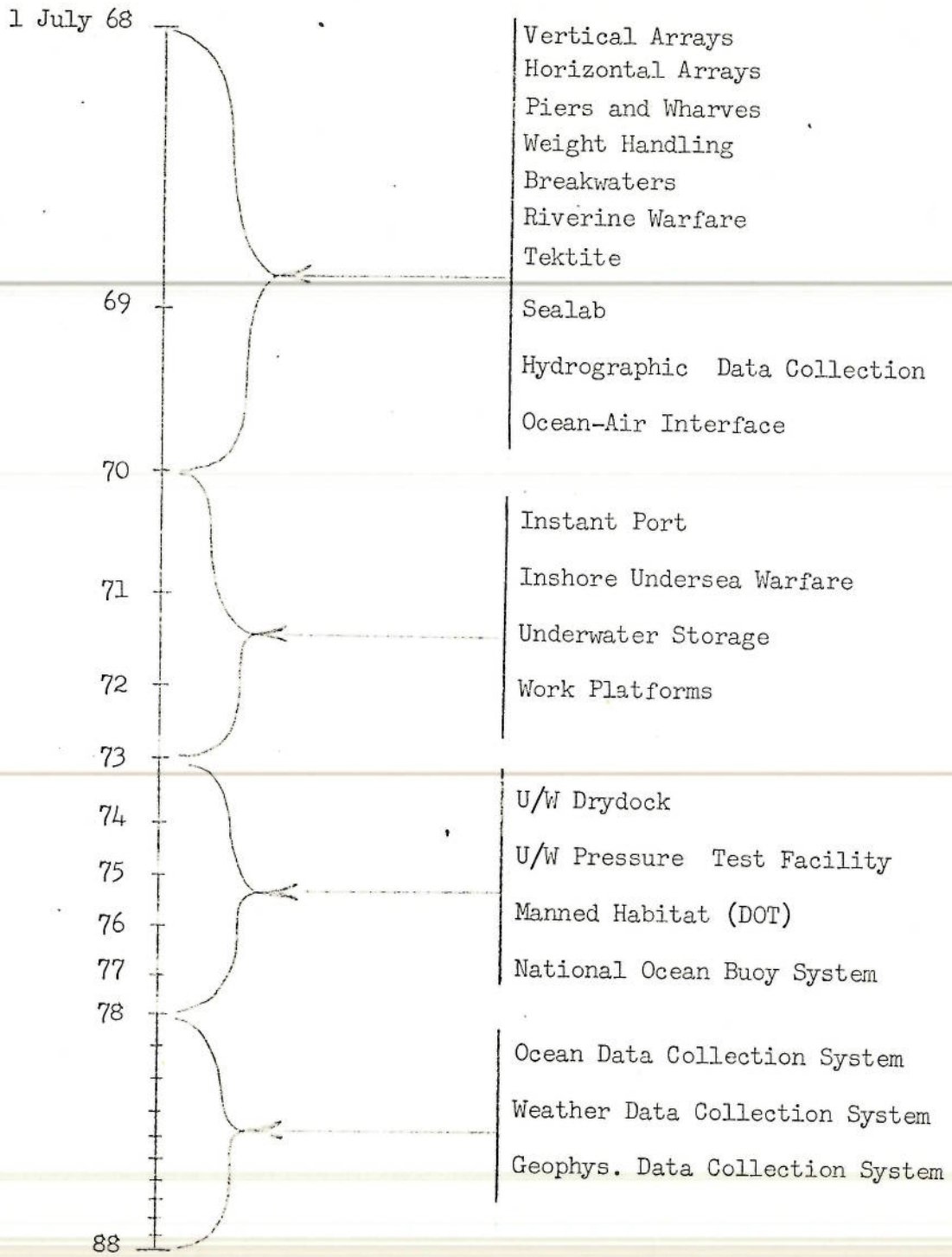


Figure IV.A.1

TYPICAL TECHNOLOGICAL CAPABILITY PROFILE

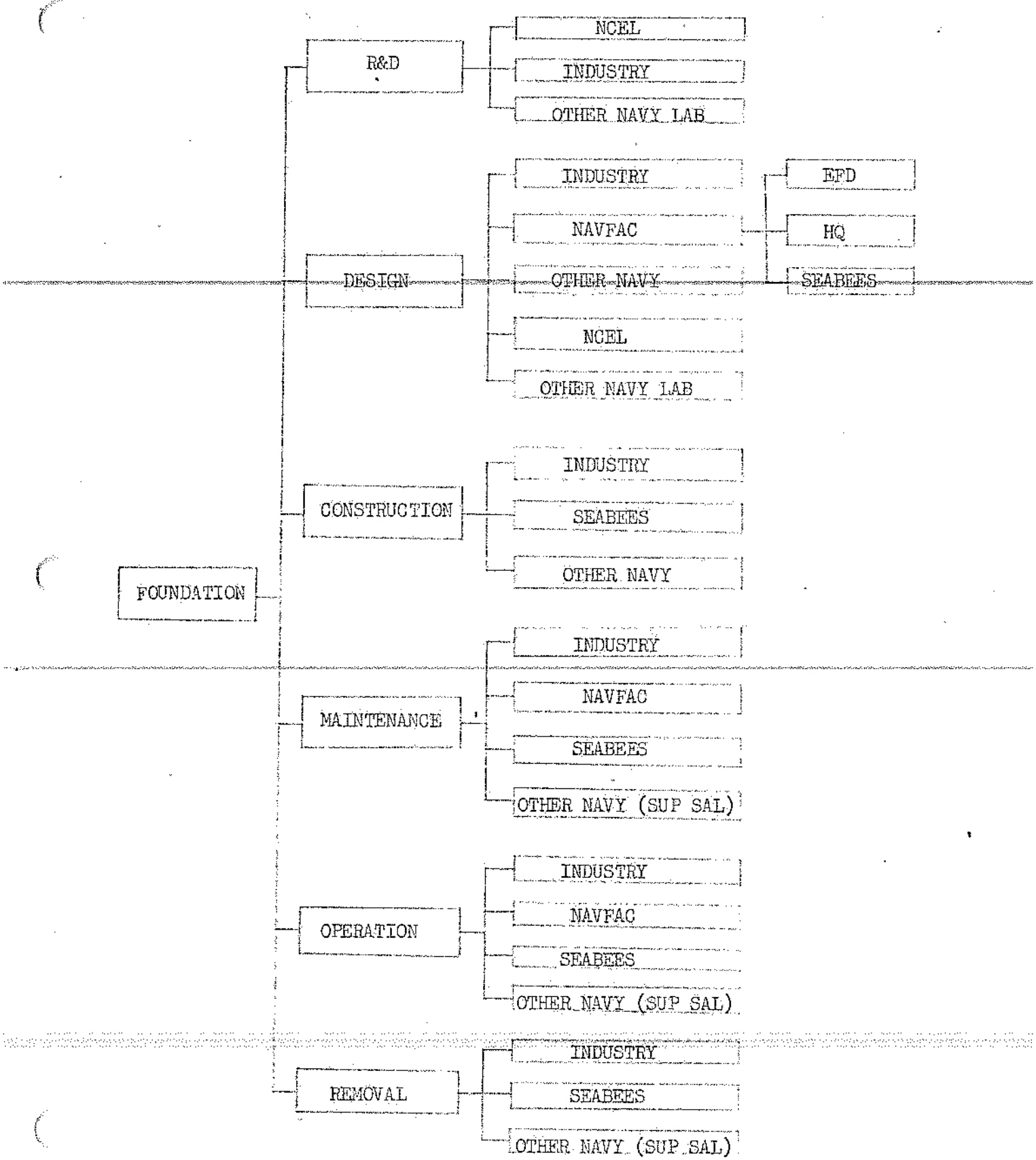


Figure IV.A.2

NAVFAC should lead in the development and application of those techniques that measure the engineering characteristics of a site. The level of confidence must be consistent with the life cycle structural and functional integrity requirements of the facilities complex. This is mainly direct physical exploration and analysis but it does include the technical specification and application of chemical, biological and geophysical methods of measuring the earth and water environment. Geophysical and oceanographic methods and knowledge will not be developed by NAVFAC except insofar as is necessary to plan, engineer and administer contractual efforts for the services of industry and other government agencies. Use of geophysical and oceanographic techniques can be planned and even performed by NAVFAC personnel. Support equipment and facilities for site selection in general follow a similar rational. Specifically, development of support ships sub-assemblies and airplanes will probably be those of others. Planning for their use and operational control can be done by NAVFAC personnel.

Underwater Structural Sub-Systems.

Materials and Structural Engineering. This includes total life cycle expertise in the engineering use of materials for facility complexes. In this area NAVFAC will perform new technology developments, engineering, planning, design and specification, and will have the ability to contract for construction, maintenance and operation. In structural engineering the emphasis will be in efficient application and extension of know-how recognizing related and pertinent efforts by others such as NAVSHIPS. Criteria for the design and certification of pressure test facilities is included.

Foundations. This includes fixed foundations, anchors, deadmen, trenching earth moving, drilling, pile driving, soil stabilization and surfacing. In foundations, anchors and earthwork NAVFAC will lead in the development of the state-of-the-art, as well as engineering and applications. The entire spectrum of soil and rock mechanics (hardware and software) shall be the technical backbone with expertise in depth and breadth.

The general support equipment for carrying out work such as foundations and structures will be contracted from industry or provided by elements of the operating forces such as SEABEES, Salvage, NAVOCEANO, etc. Principal technical equipment may be that developed and operated by Navy Laboratories such as Naval Civil Engineering Laboratory (NCEL) and Naval Undersea Warfare Center (NUWC). Support fleet will be that of contractor or the Navy.

Site Assembly and Construction. This includes capability for the engineering specification and construction surveillance of the following classes of activities: (a) cutting, welding, and riveting, (b) utility connections, (c) weight and bulk handling and transporting, (d) tools and equipment for divers, and (e) nets, cables, and platform operation. Expertise to plan, engineer, contract for and inspect these activities shall rest within NAVFAC. The development of new techniques shall be one of the primary technical leadership objectives of NAVFAC through RDT&E. Reliable know-how for the efficient specification and surveillance for moving, assembling and constructing structural complexes shall be central to the basic capability of the NAVFAC engineering team. Actual work may be contracted. Surveillance shall be by military and civilian personnel, augmented by contractor services as requirements and circumstances necessitate.

Power. This includes the total engineering know-how to develop, specify and contract for power systems and associated conversion and distribution sub-systems. It includes, surface umbilical, reactor, petroleum fueled, radioisotope, fuel cell, battery and related sub-systems.

Life Support and Human Factors. This includes the total environmental and human factors engineering necessary to primarily monitor and secondarily conduct development and specify man-machine sub-systems and create proper life support environments within and without any habitats or other facilities. Capability as to life support of divers shall be shared with the assembly and construction group. It encompasses saturated and non-saturated diving, ingress and egress, hyperbaric and one atmosphere environments.

Command and Control. This capability is required to obtain the timely services of other expertise in communications, navigation, surveillance (ascoustics), instrumentation and data processing. This capability will provide liaison for effective system integration. Accordingly, operational as contrasted to professional engineering talent will suffice in general.

3. Goals

The attainment of the proposed capability can be visualized in terms of specific goals as follows:

a. Assemble required staff and manage the anticipated DOT RDT&E program by 1969; maintain and strengthen contacts in R&D and operational communities.

b. Provide limited ocean facilities with substantial reliance on NCEL expertise by 1970.

c. Provide planning, design, and contracting services by 1971.

d. Provide, in addition to the above, construction, maintenance and operation capability by 1972 (through contractors in industry and SEABEES (part IV-B of this report)).

e. Total life cycle engineering, acquisition, management and operation by 1973.

f. Nuclear reactor power underwater prototype in operation by 1974.

The above capabilities shall be available to the Navy through the Commander NAVFAC within depth, operational, sea-state and other constraints imposed by the state of technology. All would develop simultaneously and would be considered to be established as routine activities at the times indicated.

While these are the primary visible goals, NAVFAC together with NCEL should proceed immediately to develop an Ad Hoc capability for total engineering and acquisition until the specific personnel capability is staffed. This is to be achieved through collateral duty designation of certain personnel. Supplemental accelerated training should be afforded to these people on a crash basis early in 1969. (See next section IV.C for discussion of training and section VI for interim FY 69 action).

4. General Considerations

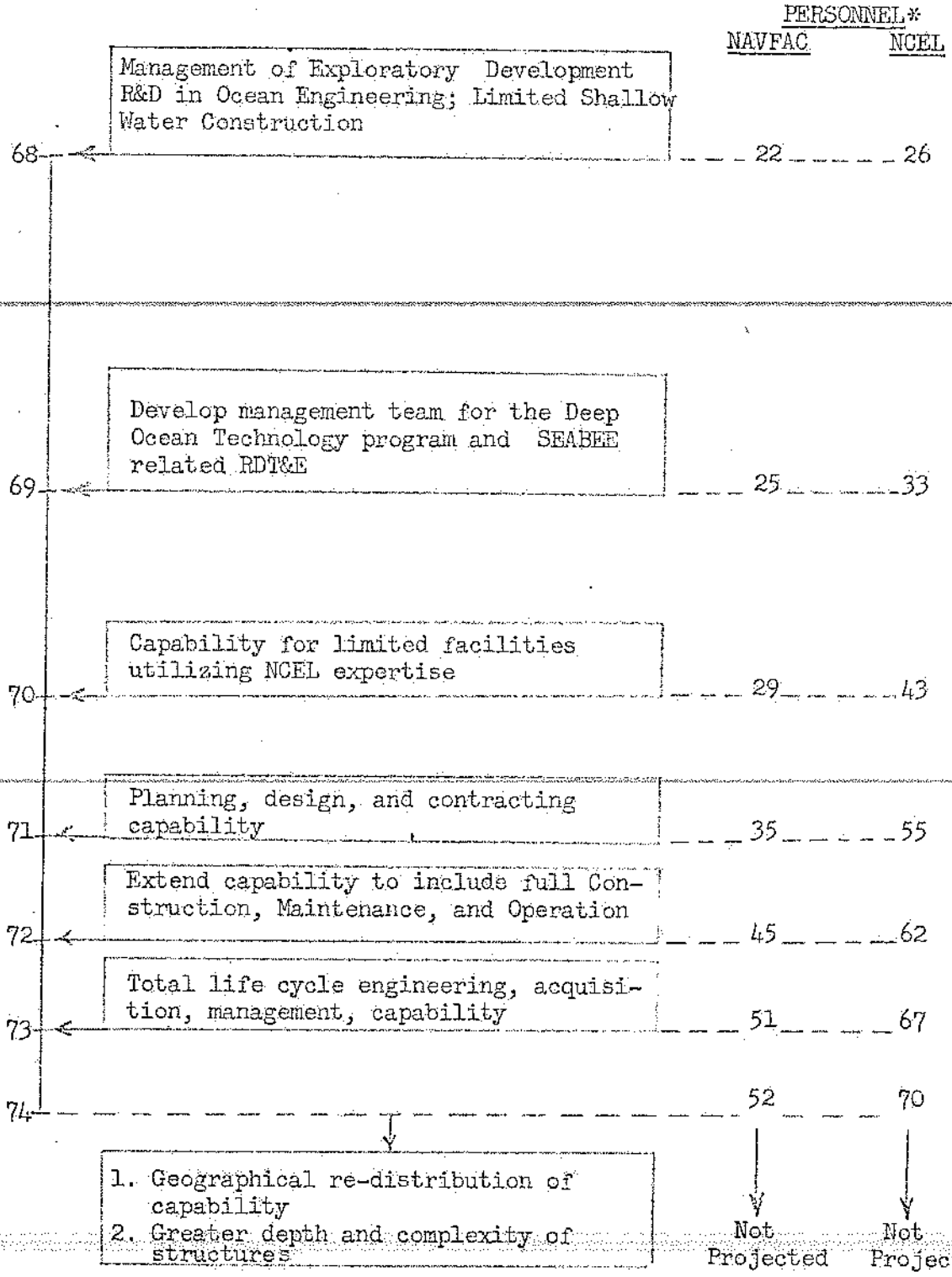
a. NAVFAC/NCEL Relationship.

The capability outlined in the subsequent paragraphs is in terms of NAVFAC and NCEL professional and technical personnel assets, facilities, equipment, data and resources for contracting. It is recognized, however, that NCEL ceilings are controlled by the Director of Naval Laboratories and not by NAVFAC.

b. Location of Field Activity.

Location of most NAVFAC billets will have to be at the field level ultimately. Proximity to Washington will be required for a nucleus of engineers for planning and programming and appraisal purposes and for liaison with CNM, CNO and the SYSCOMS.

Capability Goals and Personnel Projections
for NAVFAC and NCEL +



+ less SEABEES

* Cumulative figures

Figure IV.A.3

The field activity can be located in one of five locations listed below with their advantages and disadvantages.

Location	Advantage	Disadvantage
Port Hueneme	Proximity to NUWC, NCEL, CBC	Furthering West Coast Concentration. Distance from Washington
Boston	Proximity to Wash. Bolster local EFD. Boston Area is a center of ocean technology and science.	Distance from NCEL
Southeast Div. and/or Southwest Div.	Previous ocean related experience. Proximity to emerging ocean industry centers of Florida and Southern Calif.	EFD heavily involved in other activities because of Navy concentration.
Chesapeake Div.	Proximity to D. C.	Distance from NCEL and NUWC

As NAVFAC's capability and the Navy's demands evolve it will become clearer as to where field centers of excellence should be established. Because of proximity to Washington and the East Coast centers of ocean engineering, it appears that CHESDIV should be the first such field center.

As noted in Sections II and III present capability of NAVFAC lacks appropriate specialization and specific ocean bottom experience, in general. Structural engineers from the Waterfront Structures Section of NAVFAC and EFD's have accumulated considerable knowledge of the surface ocean environment and shallow water bottoms. They, in the aggregate, constitute a substantial backbone of expertise that can quickly adapt to accomplish possible designs for near time missions complemented by NCEL and guided by the Deep Ocean Facilities Consultant.

c. NAVFAC Training.

An agressive and ambitious training effort needs to be undertaken in a three fold manner:

(1) A crash basis re-training program of the Ad Hoc ocean engineering capability group discussed in paragraph IVA3,

(2) Establish an evolving 2 week intensive course in Seafloor Engineering through the collaboration of CECOS, NCEL, NUWC and NAVOCEANO. (See IV.C). This course shall be for CEC officers, Senior Petty Officers and civilians.

(3) The promotion of a liberal policy and a suitable compensation plan to encourage personnel to undertake Ocean Engineering studies leading to advanced degrees.

The Director Ocean Engineering Programs (Part V) shall formulate and implement a detailed plan for the above and as further discussed in Section IV.C.

d. Policy Towards Institutions.

To further the capability of the Command, it is necessary to establish and maintain close constructive and cordial interchanges with institutional establishments relating to ocean engineering, i.e. trade associations, industrial associations, professional societies, labor unions, regional promotional organizations, specific interest groups (e.g. conservationists, bird watchers, etc.) and, most of all, the academic community. To this end all officers and professional personnel shall endeavor to participate in the activities of such other groups and through their contribution promote the Command's image.

e. NAVFAC Initiative

NAVFAC must agressively seek out specific projects such as Seaspider, Tektite, Argos Island and demonstrate capability to carry total technical management as well as quality engineering. NAVFAC should initiate concept formulation activities for facility subsystems by proposing technical concepts, to weapons and support system planners and managers and by assisting OPNAV in preparing requirement documents. To accomplish this it is necessary to achieve an organizational staffing structure that can maintain contact with the Ocean Engineering Community both Navy and industry and with OPNAV as discussed in Section V.

In particular NAVFAC should assume the initiative to secure the new Man-In-The-Sea (MITS) Program. The NDS/OEPPG (Esler) Report recommended cancellation of the present MITS Program and the establishment of a new MITS Program of expanded scope. One of the three recommended alternatives for managing the NDS/OEPPG recommended MITS Program is the establishment of a Project Manager in NAVFAC. The NDS/OEPPG Report page V-33 states: "The greatest area of potential military application of Man-In-The-Sea technology, not otherwise being satisfied, appears, to the Planning Group, to be underwater construction.

Indeed, the proposed Man-In-The-Sea Program focal points are underwater construction tasks. The completion of these tasks will involve significant developments in system operations and nuclear energy sources, and finally the translation of underwater construction capabilities to some operating arm of the Navy forces, like the SEABEES construction battalions." The NDS/OEPPG recommends the establishment of a Project Manager for the new Man-In-The-Sea Program. It goes on to say on page V-33 "If an effort substantially less than the recommended one for Man-In-The-Sea is approved then it would appear more appropriate to either continue project management in the DSSPO or to assign management to NAVFAC." It is recommended that NAVFAC take the initiative to present, in an objective and positive manner, to the Chief of Naval Material, the benefits that the Navy will derive if NAVFAC is designated PM for the NDS/OEPPG revised Man-In-The-Sea Program. The Commander, NAVFAC should be able to assume the Chief of Naval Material of NAVFAC's management and technical capability for the MITS PM task.

f. Support Personnel

Requirements for clerical and other support personnel resulting from a numerical increase in technical and management personnel have not been estimated except for the clerk-stenographer in the proposed Director of Ocean Engineering Programs.

g. Contracting.

NAVFAC shall exploit the "Civil Works" NAVDOCKS Form 22 mode of subcontracting for the execution of sea-floor construction in cases where the Government has awarded a package contract for the entire system to a private contractor. Provisions for this must be made in the Acquisition Management Plan.

5. Additional Assets and Resources.

This section presents the personnel, equipment, facilities, and data assets to be required additionally by each fiscal year. Estimates of resources for development and services by other government and industry are also included. They are arranged by the capability areas of Section IV.A.2, and they are summarized in Figures II.C.2 and II.C.3.

a. Site Selection and Environmental Engineering. (As defined in Section IVA(2).)

(1) Personnel.

As stated in Section IV.A.2 the basic NAVFAC capability shall be aimed at the evaluation of tentative sites for selection of the final site. The large scale surveying of large areas of the ocean bottom will be done by others such as NAVOCEANO, or NRL. However, NAVFAC must be able to communicate in terms of and understand the basic capabilities and limitations of geophysical, acoustic and other indirect techniques for surveying the ocean bottom and its environment.

The know-how required for assessing the engineering characteristics during the site survey process is technically closely related to the know-how required for the successful design, construction, and maintenance of foundations, moorings, stabilized bottoms, etc. Essentially, the NAVFAC capability to cope with the ocean bottom shall stem from a balanced core of professionals and technicians from the following disciplines: geophysics, geology, oceanography, soils, civil, ocean and instrumentation engineering. A comparable capability needs to be developed at NCEL over and above present levels.

The tabulation below is in terms of NAVFAC and NCEL personnel subdivided in two broad groupings:

	69	70	71	72	73	74
Additional by year						
Soils/Civil Engineers						
NAVFAC	1	1	1	1	1	0
NCEL	4	2	2	1	1	0
Ocean/Geo. Scientists						
NAVFAC	1	1	1	1	0	0
NCEL	1	1	1	1	0	0
Cumulative						
NAVFAC	2	4	6	8	9	9
OMN ($K)	40	80	120	160	180	180
NCEL	5	8	11	13	14	14
RDT&E ($K)	100	160	220	260	280	280

The above personnel numbers are representative of the order of magnitude required for site surveys, selection, preparation and for foundations, anchorages, and earthwork.

(2) Facilities.

A pressure test facility which has already been programmed at NCEL under MILCON in the amount of $10M will be required by 1971. Facilites that NAVOCEANO will require for processing any additional data and to support any additional survey ships are not included.

(3) Equipment.

Site selection and foundation engineering require the development of equipment to measure the engineering properties of ocean bottoms. In general, the equipment consists of coring, sampling, in-situ testing, lab-testing, and environmental control apparatus. Some geophysical (i.e. electric, acoustic and magnetic) measuring equipment will be involved--though the bulk will be provided and funded by NAVOCEANO.

It is assumed that general purpose support equipment such as boats, ships, planes, etc. will be provided by the fleets and other Navy. Research and support ships in existence or planned are expected to suffice for the foreseeable requirements in the next 5 years. However, if NAVFAC/NCEL determine that a specialized surface support ship and related submersibles and other support craft must be acquired for this specific purpose then additional OPN funding will be required as estimated below:

	69	70	71	72	73	74
Field and Lab Equipment						
RDT&E ($K)	0	150	200	300	300	400
Support Equipment						
OPN ($K) *	0	0	1000	2000	2000	500
RDT&E ($K)	0	100	150	200	200	200
RDT&E*($K)	0	0	500	1000	500	0

* Ship Conversion

(4) Data.

The collection storage and retrieval of data as to the engineering properties of soils and related geologic and geophysical information shall be initially the primary responsibility of NCEL as negotiated with NAVFAC. An agreement and a time-phased plan shall be worked out between NAVFAC and NCEL, after full consultation with NAVOCEANO and CNM, as to the most efficient means of acquiring, manipulating and disseminating data to engineers at NAVFAC, NCEL and others. The early economic utilization of automation with time-phasing, real-time access shall be the objective.

(5) Resources for Industry and Other Government.

Utilization of industry and other government talent is imperative. Accordingly, the tabulation below shows the level of funding to be programmed by NAVFAC RDT&E for the indicated allocations namely: Site Engineering -- this is primarily studies by industry, consultants and universities relating to site selection, site preparation, foundations and anchors. Liaison with NAVOCEANO -- this is R&D effort by NAVOCEANO whose output is required for the NAVFAC mission. It consists of geophysical instrumentation, methods, theory, correlations, etc. Geophysical R&D -- this includes research, development and studies by industry in geophysical and oceanographic measurements and applications, and correlations as required for site selection and environmental engineering.

	69	70	71	72	73	74
Site Engineering Software/Industry RDT&E ($K)	0	100	100	200	200	200
Services from NAVOCEANO RDT&E($K)	0	100	100	100	100	100
R&D Geophysics (Industry) RDT&E ($K)	0	150	150	150	150	150

b. Underwater Structural Sub-Systems. (As defined in Section IVA.2).

i. Materials and Structural Engineering (As defined in Section IVA.2).

(1) Personnel.

Planning, design, specifications, contracting, contractor surveillance, and structural maintenance will be accomplished by a balanced mix of personnel trained and experienced in pertinent aspects of structural engineering (such as cable dynamics, thick and thin shells, fabrication technology, etc.) and materials (such as steels, reinforced and unreinforced plastics, filament wound fiberglass, concrete and their related corrosion and corrosion prevention aspects). The requirements tabulated below are based on the assumption that NAVSHIPS, DSSP, etc. are extensively involved in advancing the state-of-the-art of the technologies referred to above. Requirements are as follows:

	69	70	71	72	73	74
Additional by Year						
NAVFAC	0	1	1	3	0	0
NCEL	1	2	3	0	0	0
Cumulative						
NAVFAC	0	1	2	5	5	5
O&MN ($K)	0	20	40	100	100	100
NCEL	1	3	6	6	6	6
RDT&E ($K)	20	60	120	120	120	120

It is assumed in the above that NAVSHIPS will continue to be the lead development activity in metal pressure hulls. Finally, materials and structural engineering personnel will provide all technical backup to SEABEE executed operations.

NAVFAC personnel will maintain expertise in the efficient design, analysis and maintenance of pressure vessels with special attention to surface installations used for T&E and diving purposes. NAVFAC personnel will conduct the certifications to be required for all work platforms and undersea habitats.

(2) Facilities.

No additional facilities are required other than the already programmed pressure test facility of NCEL and sufficient office space.

(3) Equipment.

No laboratory or field equipment for primary or support operations are required. All equipment will be provided by specific fabrication/erection contractors.

(4) Data.

It is expected that technical data requirements will be identified and NCEL and NAVFAC will design a system capable of rapid evolvement into an automated storage, computation and retrieval system with time sharing/real time access by both organizations. Consideration shall be given to the computation and data systems capability and needs of others, such as NAVSHIPS. Project STORE of ONR shall be utilized to the maximum practicable extent.

(5) Resources for Industry and Other Government.

Studies, research computer services and A&E services from industry and government will be required as follows:

	69	70	71	72	73	74
Software RDT&E ($K)	0	100	250	250	300	200
Computer Services* ($K)	0	100	100	100	100	100

*Reported as Data in Figure II.C.3.

ii. Foundations.

These requirements are included in Section IV.A.5.a "Site Selection" because of the similarity of the disciplines.

iii. Site Assembly and Construction. (As defined in Section IV.A.2).

(1) Personnel.

An assortment of technical personnel with field experience in fabrication, construction, and marine or salvage work is required to bring about efficient designs, and their economic execution and maintenance. Tabulated below are the time-phased personnel requirements:

	69	70	71	72	73	74
Additional by year						
NAVFAC	0	1	1	1	1	1
NCEL Civilian	0	3	3	2	2	2
Military: divers EM		5	15	5		
officers		1	0	0	0	0
Cumulative						
NAVFAC	0	1	2	3	4	5
O&MN ($K)	0	20	40	60	80	100
NCEL	0	3	6	8	10	12
RDT&E ($K)	0	60	120	160	200	240
NCEL (Military)		6	21	26	26	26
MPN ($K)		37	112	137	137	137

(2) Facilities

No major facilities will be required. Use of existing or contractor facilities will suffice. Additional office space must be provided as necessary.

(3) Equipment.

Additional specialized field test equipment will be required as estimated below:

	69	70	71	72	73	74
Equipment	0	250	300	400	500	500
RDT&E ($K)	0	250	300	400	500	500

(4) Data.

Collection of experience and its reduction to data form and manuals will be accomplished on a continuing basis by NCEL and NAVFAC jointly. Industrial experience will have to be monitored, collected and stored in data banks.

(5) Resources for Industry and Other Government.

A variety of design and special studies will be required in the development of equipment work platforms raising and lowering techniques and others. Included are the hardware for "In-bottom" and CONSHELF Manned Habitat.

	70	71	72	73	74
Software (Industry)					
RDT&E ($K)	150	250	250	150	150
Hardware (Industry)					
RDT&E ($K)	500	1000	1500	2000	2000
Hardware for Site Preparation *					
RDT&E ($K)	3000	3500	3000	3000	2500
OPN ($K)	0	4000	5000	1000	14000
Hardware for CONSHELF Manned Habitat					
RDT&E ($K)	2000	5000	15000	8000	2000

* Hardware for earth moving tunneling and soil stabilization as well as "In-bottom" habitat hardware are included.

c. Power. (As defined in Section IV.A.2).

(1) Personnel.

A balanced and evolving mix of nuclear, electrical and mechanical engineers will be required in addition to the present capability of Code 042. These personnel should be

able to plan, contract and exercise contractor surveillance and field engineering for SEABEES. Summarized below are the present and proposed personnel assets.

	69	70	71	72	73	74
Additional						
NAVFAC	0	0	1	2	2	1
NCEL	0	0	0	1	0	0
NRDC	0	0	2	2	2	1
Cumulative						
NAVFAC	0	0	1	3	5	6
O&MN ($K)	0	0	20	60	100	120
NCEL	0	0	0	1	0	0
RDT&E ($K)	0	0	0	20	20	20
NRDC	0	0	2	4	6	7
RDT&E ($K)	0	0	40	80	120	140

(2) Facilities.

A Navy test facility at NRDL for the testing of AEC developed prototypes will be required in 1974. The facility is estimated at $50,000 for approximately 5,000 sq. ft. of spaces.

(3) Equipment.

The above facility will require approximately $500,000 of installed test equipment. Funds to be programmed for FY 71, and 72 at $250,000 per year. Development costs of test equipment to be part of the reactor prototype development. Equipment required for development work will be acquired through R&D contracts with industry and other government agencies.

(4) Data.

All required experimental and engineering performance data will be accumulated in NAVFAC Code 042. Automated data bank will be planned and coordinated with other agencies such as AEC to insure compatibility, efficiency and economy of data systems. Consideration should be given to access to such data banks by other organizations such as NCEL and NRDL. It is expected that Code 042 should initiate immediate action for the design of a data system with provisions for its eventual transition to an automatic time sharing system by 1973 - 1975 compatible and consistent with existing systems and needs. This data bank will be the basis for designs and specifications.

(5) Resources for Industry and other Government

It is expected that NAVFAC will have to be supported in software and hardware efforts from private industry and other government. The following additional RDT&E effort specifically directed to ocean related power development is estimated:

	69	70	71	72	73	74
Feasibility and A&E Studies by private industry						
RDT&E ($K)	0	60	60	60	60	60
Development and Hardware						
RDT&E ($K)	0	300	300	300	300	300
Power development by AEC						
RDT&E ($K)	0	500	500	500	500	500
Computer Services						
O&MN ($K)	0	100	100	100	100	100

d. Life Support and Human Factors. (As defined in Section IV.A.2.)

(1) Personnel.

Based on the assumption that primary developments in the state-of-the-art will be spearheaded by industry and NAVSHIPS, the emphasis in NAVFAC should be one of application with the ability to identify knowledge gaps for R&D by others. The blend of skills includes: mechanical, electrical, bio-medical, and human factors engineers. The ability to plan and specify internal (habitat) and external (divers) life support sub-systems is the objective. These personnel will provide pertinent in depth engineering to SEABEES for complex problems and man-machine integration. Summarized below are the envisioned requirements.

	69	70	71	72	73	74
Additional						
NAVFAC	0	1	1	1	0	1*
NCEL	1	1	3*	0	0	0
Cumulative						
NAVFAC	0	1	2	3	3	3
O&MN ($K)	0	20	40	60	60	60
NAVFAC	0	0	0	0	0	1
MPN ($K)	0	0	0	0	0	12
NCEL	1	2	4	4	4	4
RDT&E ($K)	20	40	80	80	80	80
NCEL	0	0	1	1	1	2
MPN ($K)	0	0	12	12	12	24

* Included is 1 Medical Officer 2100

(2) Facilities.

The now programmed pressure test facility and other diving tanks already in existence or programmed will be sufficient for any needs the NAVFAC life support and human factors engineers are likely to require. The manned tank programmed at NSRDC(MDL) will require close coordination

(3) Equipment.

No specific equipment is required for the application and adaptation of life support technology within and without habitats (i.e. divers). However, there will be R&D prototype equipment and tools that the life support and human factors engineers will have to work with because of the empirical nature and importance of this activity. Most such equipment will ultimately become part of a specific project or scrapped in favor and replaced by new developments.

(4) Data.

There are now in existence in NAVSHIPS, BUMED, DSSP, SUPSAL, ONR, NUWC, and NCEL large quantities of data. These data will suffice and will have to be utilized by NAVFAC engineers. It is envisioned that initially NAVFAC may obtain such data from NCEL. Ultimately, NAVFAC should gain time-sharing, real-time access to an automated data storage systems that SHIPS, MED and others may have developed. It is believed that life support and psycho-physiological data will multiply rapidly in quantity and complexity in the next few years as the ocean activity gains momentum.

(5) Resources for Industry and Other Government.

NAVFAC needs to program and sponsor R&D in those areas that are not likely to be pursued by NAVSHIPS. Following is an estimate of effort:

	69	70	71	72	73	74
Software Industry						
RDT&E ($K)	10	10	100	50	50	0
Hardware (Cryogenic Systems)						
RDT&E ($K)	0	50	200	50	0	0

e. Command and Control. (As defined in Section IV.A.2)

(1) Personnel.

The know-how encompasses the fields of navigation and positioning, communication, acoustics, optics and weaponary. It is not envisioned that in the next five years the volume of NAVFAC business will be sufficient to warrant a full time professional in each of these fields. However, there will be requirements for a modest nucleus of all-around engineers of technicians with suitable mix of background experience in the above mentioned fields. The estimated time phasing of this capability is as follows:

	69	70	71	72	73	74
Additional						
NAVFAC	0	0	1	0	1	0
NCEL	0	1	0	1	0	0
Cumulative						
NAVFAC	0	0	1	1	2	0
O&MN ($K)	0	0	20	20	40	40
NCEL	0	1	0	2	0	0
RDT&E ($K)	0	20	20	40	40	40

There are other alternatives that can be used singly or in combination with the above where the above capability is furnished by officers on active duty or retired. It is expected that the capability will be mainly for operational and liaison purposes with other Commands who undoubtedly will be the Principal Developing Activities for the total systems -- facilities being only a sub-system.

(2) Facilities.

None.

(3) Equipment.

None

(4) Data.

None; other than what is minimum for an engineer to function.

(5) Resources for Industry and other Government.

None of any significance.

f. Management Personnel

In addition to the technical personnel required for the development of the technical capability, discussed in Section IV.A.5, it is necessary to provide CEC officers, and civilian management and coordination personnel as follows:

	69	70	71	72	73	74
Officer 5100 (Cumulative)	2	2	2	2	2	2
MPN ($K) (Cumulative)	24	24	24	24	24	24
Civilian (Cumulative)	2	3	3	2	2	2
O&MN ($K) (Cumulative)	40	40	40	40	40	40

These personnel will staff the Office of the Director, Ocean Engineering Programs.

CEC Officers and civilian shall have appropriate experience and training in ocean engineering.

IV. CAPABILITY PLAN

B. SEABEES

1. Background

The Naval Construction Force (SEABEES) involvement near the shore line and in underwater construction will be varied. It is known that SEABEES have, in the past, worked on the sea's surface and underwater in accomplishing such tasks as harbor clearance, obstruction removal, channel dredging, obtaining coral aggregate supply, submarine cable emplacement, utility inspection and repair, construction of piers, quays, marine railways, amphibian landing ramps, bulkheads, cofferdams, bridge pier foundations, piers, and bottom surveys.

In the future, new tasks can be expected which will derive from modern concepts of riverine warfare, amphibious warfare, inshore underseas warfare, the development of "Instant Port" facilities, the ABFC System, oceanographic program, harbor defense, dredging, salvage, underwater navigation and floating bases. In building the above capabilities for combat readiness there is an inherent capability to support on-going RDT&E efforts in peacetime which will provide the SEABEES an arena in which to refine and develop underwater construction techniques and equipment.

Emphasis is directed toward developing an "instant" port capability within the SEABEES. During the next 5 years (near term) SEABEES should acquire appreciably improved capability in underwater construction using state-of-the-art techniques, to develop ABFC's, tools, techniques and equipment that will provide for the rapid construction of near shore facilities such as ports.

The shallow underwater construction operational capability during the near-term period will serve as a baseline from which the capability to work at continental shelf depths of 600-1000 can be derived. It is anticipated that during the 5 to 10-year period (mid term) development of tools and diving techniques will permit the SEABEES to perform ocean construction tasks, including covert combat construction missions on the continental shelves (less than 1000 feet).

The development of a deep-ocean construction capability in support of military operations would be accomplished during the 11 to 20-year (long term) period. The basic techniques, tools and equipment for the placement, operation and maintenance of deep-ocean bottom installations will in part be developed during the mid-term period and the continued support of on-going R&D programs at that time will permit refinement and translation of developed capabilities into that required for deep-ocean work. (See Appendix B presentation brief by Captain Searle SUPSAL).

2. Capability Discussion

An analysis of the operational requirements, Appendix A, indicates the need for specific capabilities in ocean engineering which require SEABEES in the ocean environment and which are part of the combat mission. The specifics developed below relate primarily to the near time-frame requirements for capability development.

a. Site Survey and Environmental Effects

Techniques and capability in topographic surveying and on-site soil analysis will be required over relatively small areas in the combat arena. The capability for performing such functions can be acquired by providing general support to NAVOCEANO and NCEL programs and by appropriate training exercises.

b. Underwater Structures and Construction Systems

(1) Structures.

The STINGER system element most closely related to structures is the Advanced Base Functional Component (ABFC) System. (ABFC's provide the materiel pagkages which SEABEES emplace in the forward area as part of their combat construction mission.) NAVFAC, as the responsible agent for ABFC facilities design, must develop that family of ABFC's which meet the Navy's operational requirements for conduct or support of warfare in the ocean.

As an integral part of ABFC development, the SEABEE experience must be contributed towards the formulation of requirements, concepts, and designs of improved systems. Assessment of Military Worth, Technical Feasibility and Economic Acceptability require SEABEE operational experience. Feedback for the correction of design deficiencies and training programs must be initiated early to provide the required SEABEE capability.

In addition, SEABEE underwater construction capability should be used in Test and Evaluation of ABFC designs and hardware as a test of STINGER system performance in support of ABFC development and as a measure of operational readiness of the ABFC and the SEABEES.

(2) Construction Techniques/Capabilities

The SEABEE combat mission requires development of underwater construction capability commensurate with operational techniques and tactics.

(a) Establishment of a trained diver base.

(b) Establishment of communication link between the constructor and the operationally oriented planner.

(c) Provision for visibility to and identification of the SEABEE role in Ocean Engineering.

(d) Offering of the means for an increasing spectrum of alternative solutions to weapons system designers problems in system design and analysis efforts.

Earth moving and bottom stability in general will be accomplished overtly. However, there will be missions requiring covert activity provided the state-of-the-art of earth moving will permit it. The requirement relates to large volume efforts (as in harbor dredging or slope stabilization) and to low volume efforts (as in foundation preparation for tower or pad construction for an underwater supply cache). Short range, overt shallow water capability can be achieved with barge-mounted cranes or dredges augmented by diver inspectors. Explosive devices and "water-hammer techniques" should be developed for application in excavation and trenching.

Related to the above are certain equipments which must be investigated and developed. The development objectives shall be: capability for covert operations, and highly efficient overt operations. These equipments include:

(a) Bottom-operated dredges, earth drills, dozers, trenchers, materials handling devices, pile drivers, concrete and placement equipment.

(b) Surface Support equipment: concrete devices, work barges and diving support gear.

Included in the development of the equipment capability is an underwater work vehicle. It will be specifically designed to fulfill the shallow water construction needs of the Navy's Deep Ocean Technology Program. It will be designed as an Advanced Base Functional Component, possibly with a modular system of construction components which may be added or removed as the tasks require. The vehicle must be able to function in depths down to 1,000 feet, may be manned or unmanned, bottom crawling or free swimming, or a combination of crawling and swimming vehicles.

An underwater work vehicle designed to support construction on the continental shelves will need to possess a range of capabilities, exceeding those of existing research

submersibles. Using the Navy's Deep Ocean Technology Forecast as a guideline, it appears that the following tasks may be accomplished by such a vehicle:

(a) Site exploration--bottom survey, coring, and drilling.

(b) Foundation construction--site clearance, soil leveling and stabilization, excavation, tunneling, pile driving, underwater concrete pouring, weight handling, and fastening (riveting, welding, etc.).

(c) Erection of structures (including umbilicals and utilities)--fastening, gripping, weight handling, and alignment.

(d) Construction and maintenance of navigable channels--buldozer-type dredging, suction-type dredging, and carrying proper alignment from surface to bottom.

(e) Miscellaneous--towing ability, check of surface measurements, cable handling, and inspection.

A detailed study of alternative methods of completing the above tasks must be made, since it may be more effective to use alternate methods for a number of them.

Considering the combat requirement for rapid construction and the adversity of water environment, one concludes that to the maximum extent possible underwater facilities must be prefabricated. The accomplishment of assembly underwater is therefore basically a matter of taking the trained SEABEE constructor underwater to do his tasks.

Weight and bulk handling techniques are major construction considerations. For the short term, state-of-the-art capability can satisfy SEABEE requirements in conduct of overt construction tasks. Convert tasks will require new equipment and techniques.

Cutting, welding, riveting, bolting are basic skills now available in the SEABEES. These skills must be extended to the ocean environment through new tools, equipment and techniques developed.

Utility connections are state-of-the-art skills for which the comments above apply. However, for electrical connections the state of technology needs advancement.

SEABEE construction personnel are also qualified for maintenance and operation tasks. The utilization of SEABEE underwater units would be primarily directed to maintaining operational capability for advance base combat construction and as a service to other commands and units in peacetime operations.

c. Power

As power sources and units are developed by others, SEABEES should participate in the test evaluation, and installation of such items as they relate to ABFC hardware.

d. Life Support, Habitability & Human Factors

SEABEES will adopt and utilize life-support systems that have been or will be developed by others. Special effort must be directed to combining the diver-constructor first and the operator-ocean bottom work vehicle later. These integrations will require considerable human factors expertise working in NAVFAC and in the field.

e. Command and Control

Communication and navigation devices developed by others will be adopted to SEABEE diver missions. Adaptation to the unique requirements of construction activities is not considered a significant problem.

2. Certification and inspection requirements are intensified by the hostile environment of the ocean. SEABEES have provided their own inspection services. The requirement to certify that underwater structures are ready for occupancy or use requires a quantum increase in the training and validation of SEABEE inspector capability.

3. STINGER System Implementation Concept

a. Alternatives

There are several ways by which the NCF capability for underwater combat construction can be established. However, the method selected must:

(1) Provide as combat construction capability in consonance with DPM force level requirements.

(2) Establish a baseline capability for (1) above, within as short a time frame as is practicable, which minimizes immediate impact on short range fund and personnel requirements.

(3) Provide a peacetime capability for test and evaluation of concepts, hardware and techniques.

(4) Ensure focus of task selection and assignment to maximize readiness and enhance development of expanded capability.

The alternatives are summarized on Figure IV.B.1.

Concept option three is selected as that which best satisfies the requirements outlined above. Three units are required: One attached to CBPAC, one to CBLANT, one unit equivalent would be assigned to support SEABEE System Engineering Office (SSEO) RDT&E requirements by augmentation of NCEL divers. These three units parallel instant port requirements related to MEF support. Units would be homeported at the CBC's and rotated to assignments in support of battalions (deployed or in homeport training), other Naval Operational or RDT&E units, or other government agencies involved in oceanographic work. The Units will be self-sustaining insofar as the diving mission is concerned and will be air-transportable. Equipment will include such floating support equipment and barges as are necessary. Berthings, Messing, Administration and other such support will be provided by the SEABEE or other Naval unit being supported. The availability of these units for disaster control, intelligence collection and CI missions is the same as that specified by OPNAV Instruction 5450.46D. NMCB's will retain present diver capability for underwater construction tasks related to inshore warfare support assignments.

Development of deep diving capability will be attained initially by temporary detailing of selected individuals from the SEABEE Underwater Construction Unit (SUCU) duty to work with the Harbor Clearance Units. This will take advantage of the saturated diving experience and equipment now available to those units, while enhancing their capability by the introduction of Group VIII personnel. As pure construction operational requirements develop in the deep ocean environment, additional SUCU's composed of experienced saturated divers will be formed and equipped within the NCF.

4. Implementation Plan

The STINGER System underwater construction capability must be developed in a rational, time phased order to effectively satisfy the requirements of fleet operational needs as they surface; i.e. underwater material storage and handling facilities, underwater components of an "Instant Port", surveillance facilities, etc. Figure IV.B.2 graphically portrays the implementation plan envisioned. Specific details relating to the plan are outlined in the following paragraphs.

a. Organizational

SEABEE Underwater Construction Unit (SUCU) Organization: Each unit will be composed of 23 officers and men, configured as follows:

Summary Evaluation for the
Organizational Location of SEABEES

CAPABILITY	(1) Group of SEABEES within each ACB/MCB	(2) Group of SEABEES within selected ACBs/ MCBs	(3) Group of SEABEES forming special units within STINGER SYSTEM	(4) Group of SEABEES forming special units within Harbor Control Units (SUPSAL)
PRO	1. Provides the highest degree of readiness, i.e. every ACB/MCB (no matter how employed) would have underwater construction capability	1. Provides readiness to a limited degree 2. Less expensive than (1)	1. Less expensive than (1) and (2) 2. Optimum utilization of personnel in underwater work 3. Maintains maximum proficiency 4. Optimum readiness assuming air transportable 5. Easy to administer and control	1. Joins organization that already has diver capability expertise/equipment
CON	1. Difficult to maintain proficiency because unable to keep all occupied in underwater work 2. Requires duplicate suits of gear 3. Expertise would be diluted because of assignment to other surface construction tasks 4. Administration of special unit within another unit is difficult especially when OPCON is chopped to another unit	1. Difficult to maintain proficiency because unable to keep all occupied in underwater work 2. Parent unit may be employed at disadvantageous location when capability is required 3. Administration of special unit within another unit is difficult especially when OPCON is chopped to another unit	NONE	1. Definite conflict of interest between construction and salvage operations 2. Dilutes underwater construction capabilities of SEABEES 3. Dilutes underwater construction readiness of SEABEES 4. Difficult to administer and control SEABEES/Divers

Figure IV.B.1

SEABEE OCEAN ENGINEERING CAPABILITY DEVELOP

GOALS/ACTIONS	TOTALS FY 69-70	FY 71	FY 72	FY 73-75	FY 76-80	SSEO FY 69-70	SSEO FY 73-75	CBPAC FY 69-70
1. Establish SUCU Trained Diver Base**								
a. SUCU-Establish Billet*	6/63			2/43	2/43	2/21		4/42
b. SUCU-Diver Training (CEC/GROUP VIII ONLY)	1/20	2/40		1/42	1/42	1/20		
c. SUCU-Fill Billet*	2/21	4/42		2/43	2/43	2/21		
d. SUCU-Outfit (K$)								
e. SUCU- Provide O&M Fund (K$)								
2. Establish Fleet Communication Link Thru Staff Ocean Engineering Support								
a. Establish Billets (CEC/GROUP VIII)	3/2	1/3		8/0		1/0	2/0	1/2
b. Diver Training (CEC/GROUP VIII)	2/2	1/3	-	4/0				1/2
c. Fill Billets (CEC/GROUP VIII	3/2	1/3	-	8/0***		1/0	2/0***	1/2

	NAVFAC (OC) FY 69-70	71	72	74	75-80	CECOS	NAVSCO
3. Identify SEABEE Ocean Engineering Role Thru Increased Training							
a. Establish Billets/ Quotas			-		(All OFF and selected civilian FY 69-70)		(FY-7 Const
b. Develop Curricula			-		(All OFF and selected civilian FY 70)		(FY-7 Const
c. Initiate Homeport Unit Readiness T&E Program					(All divers in organic unit FY-70)		
d. Add Training Facilities & Equipment (K$)	350	1800	750	500	2500		

	FY 69-70	71	72	74	75-80
4. Increase Navy Ocean System Design Flexibility Thru Improved SEABEE Inshore/Underwater Hardware Capability					
a. Develop and Procure AEPC (K$)	2000	2000	500		
b. Develop and Procure New Tools and Equipment (K$)	150	700	1300	2500	3000/yr

*Includes Medical Officer and corpsman
**SUCU - SEABEE Underwater Construction Unit
***Additional Staffing to Support Ocean Capability

‡ Quantities listed are This summary does not included in Figures I

FIGURE IV.B.2

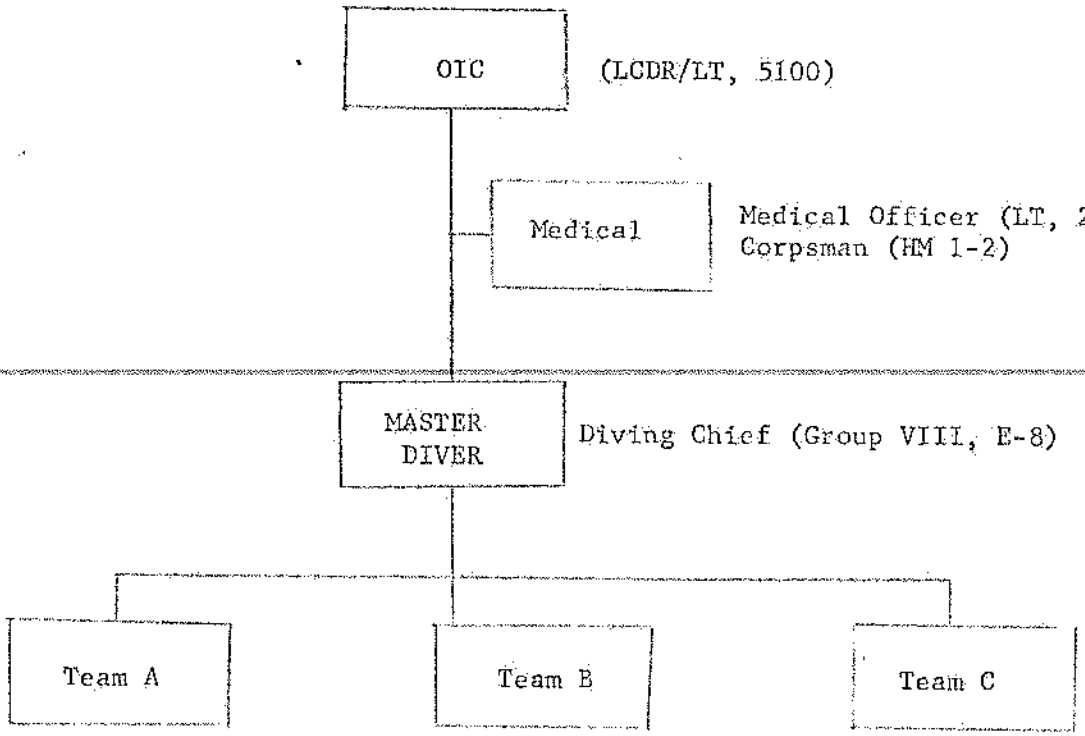
N ENGINEERING CAPABILITY DEVELOPMENT PLAN SUMMARY†

	SSEO		CBPAC/CBLANT					NAVFAC (06)				
FY 76-80	FY 69-70	FY 73-75	FY 69-70	FY 71	FY 72	FY 73-75	FY 76-80	FY 69-70	FY 71	FY 72	FY 73-75	FY 76-80
2/43	2/ 1		4/42			2/43	2/43					
1/42	1/20			2/40		1/42	1/42					
2/43	2/21			4/42		2/43	2/43					
								500	1000	1000	1000	10000
								200	600	600	600	5000
Engineering Support												
	1/0	2/0	1/2	1/8		4/0		1/0			2/0	
			1/2	1/8		4/0		1/0				
	1/0	2/0***	1/2	1/8		4/0		1/0			2/0***	

CECOS	NAVSCON	FG SCHOOL (INPUT)				
Training		FY 69-70	71	72	73	74
30						
1 OFF and selected ilian FY 69-70)	(FY-70 All GRP VIII Underwater Construction)					
1 OFF and selected ilian FY 70)	(FY-70 All GRP VIII Underwater Construction)	3-3	3	2	2	
1 divers in organic t FY-70)						
00						
r.ved SEABEE Inshore/Underwater						
75-80						
5000/yr						

† Quantities listed are in addition to those now in existence. This summary does not contain civilian personnel which is included in Figures IV.C.2 and II.C.3.

FIGURE IV.B.2



SWC	CEC	EO1
SW1	CE2	EO2
SW2	CE2	CM1
SW2	UTC	CM1
BU1	UT1	EA1
BU2	UT2	
BU2	UT2	

To establish diver expertise at command level for operational and training planning; and for liaison with other Naval/governmental offices the following staffing requirements are identified:

CBLANT/CBPAC staffs (located at NCRs): one officer each

NAVFACENGCOM: one officer (Code 06)

Note: These officers must have diver training.

NAVFAC Code 06 capability requires the establishment of a SEABEE Projects coordinator at the SSEO. This individual will coordinate NAVFAC 06 and 03 developmental programs with Fleet units and NCEL; he will also coordinate development of training programs, collection of technical data and preparation of STINGER System technical manuals. In addition, STINGER R&D mission support liaison will be effected by the SEABEE System Engineering Office (SSEO). Staff capability will be provided by the assignment of one Underwater Construction Unit to the SSEO. A major effort of this unit will be support of NCEL RDT&E programs.

To coordinate the NMCB organic diver crew training effort at each of the two Naval Construction Regiments (NCR's) at home port locations at Port Hueneme, California and Davisville, R. I., four second class divers will be required.

b. Material and Equipment

The initial outfitting and operation of each SUCU requires the following:

Initial Outfitting:	$.5M
O&M:	$.2M

In addition, a family of ABFC's must be developed and procured to support the Navy underwater construction system.

NCEL assistance will be required to provide bottom construction equipment, tools, techniques, basic research and development work.

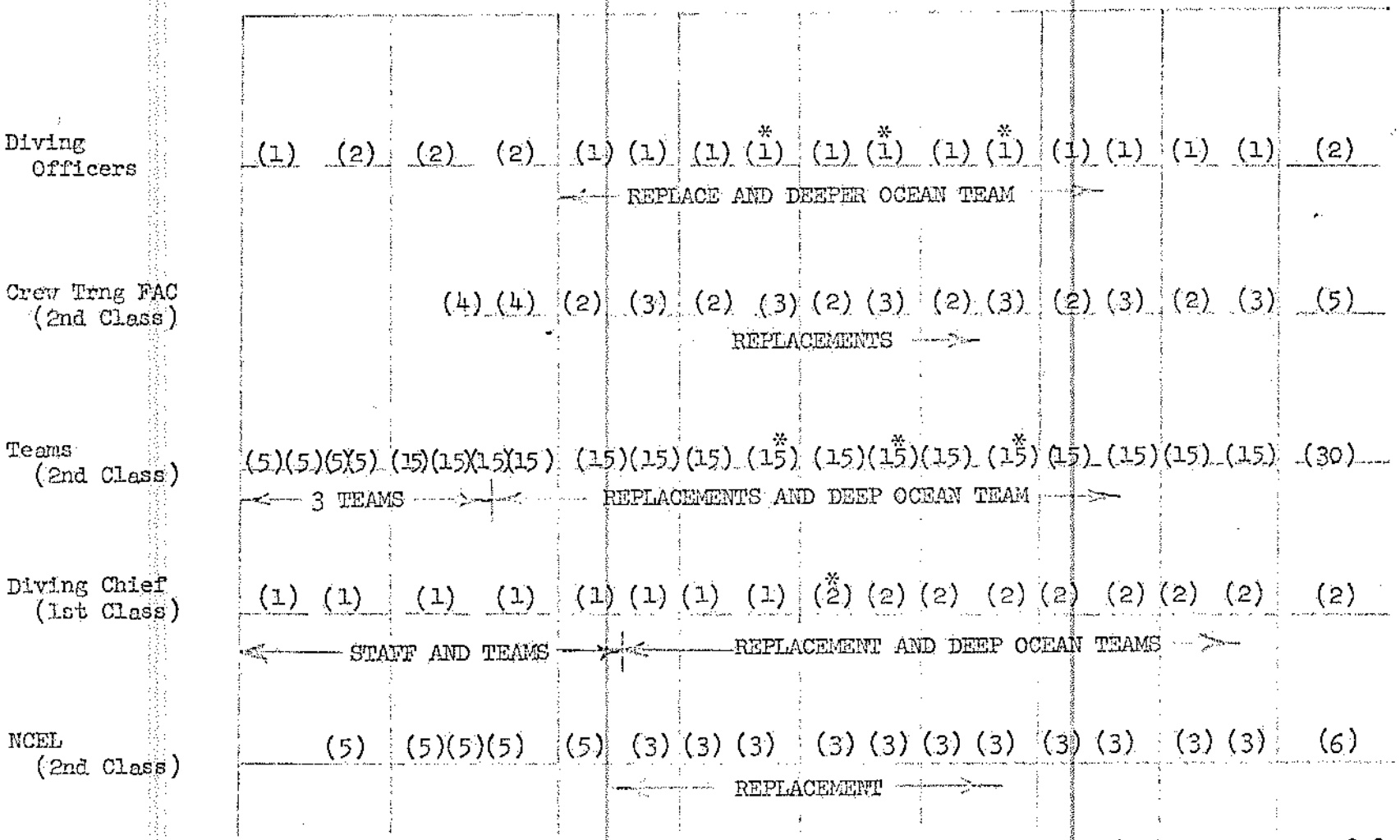
c. Facilities

The effort that will be expended in support of other agencies engaged in underwater construction RDT&E work is a real form of training but it is assumed that no support costs are involved. A fleet-oriented and controlled crew training capability must be developed at each ACB/MCB homeport (LANTFLT and PACFLT) to provide an arena for the SEABEE underwater combat construction unit to develop techniques in underwater construction teamwork and to permit this same group to work with and in the ACB/MCB training program. The emplacement of fixed underwater training facilities (not MILCON) will require approximately $2 million OPN.

d. Training

Although the SEABEES will depend on BUPERS to conduct formal diver training, it should be pointed out that existing programs are not adequate to accommodate a significant increase in diver training requirements. Action must be initiated now to ensure availability of additional diver training capability to meet the needs of the SEABEE program. Figure IV.B.3 shows the phased diver training requirements.

DIVER TRAINING SCHEDULE



* Deep Ocean Teams

Figure IV.B.3

Exhibit IV.B.1 details the NEC requirements statements for those Group VIII personnel not now eligible for diver training.

EXHIBIT IV.B.1

NEC Requirements for Group VIII
Ocean Construction Training

A. CE

1. Install, operate, service and repair:

a. Electric power sources, including radio isotopes, batteries, and fuel cell types.

b. Illumination systems.

c. Power distribution systems.

d. Communications cables and telephone systems, including splicing.

e. Transformers and switch gear.

f. Motors and appliances.

2. Install and maintain facility/habitat wiring, lights, subsets, signal circuits, phone/voice systems, TV cables.

3. Assist in installation, maintenance and monitoring of inshore/underwater defense equipment such as navigational aids, signals, detector/sensor arrays and other countermeasure apparatus, devices or networks.

B. EA

1. Line survey and marking for setting free swimmer courses to a defined destination or fixed habitat.

2. Leveling sensitive recording instruments to be fixed to the bottom.

3. Bottom sampling and sediment analysis.

4. Setting markers and bench marks and plotting bottom positions and boundaries.

5. Providing quantity estimates for bottom excavation.

6. Use of on-site photo-survey and testing-instruments in construction operations and experimentations.

7. Measuring and layout anchor chain and guy-wire positions.

8. Reconnaissance.

9. Measuring foreign object/obstacle size and estimating volume and weight.

C. UT

1. Installation, operation and maintenance of the following systems, including bottom-to-surface lines when applicable:

a. Breathing gas supply, reclamation, circulation, distribution and air conditioning; and such other oxygen, helium, CO_2 apparatus as may be required.

b. Heat generation and distribution.

c. Refrigeration.

d. Fuel, including appurtenant piping, valves, fittings, etc., for fuel delivery from storage caches.

e. Water supply, purification, distribution.

f. Sanitary packages, facilities, and special waste disposal techniques.

g. Pressure vessels and decompression chambers.

2. Sea water sampling and testing.

3. Breathing gas and water decontamination from all foreign agents.

D. CM

1. Maintenance of all special ocean bottom equipment and machinery required under water which provides motive power for weight lifting, handling, transportation, assembly and/or construction activities.

2. Maintenance and repair of all prime mover (excluding electric motors) for generators, pumps, compressors, etc.

E. EO

1. Operation of special ocean bottom work vehicles including those having mechanical/articulated arms; walking or crawling cranes and dozers.

2. Accomplish clearing and preparation of bottom sites thru use of trenching, dredging, and grading equipment.

3. Perform necessary tunneling and drilling in connection with recovery of large heavy objects or bottom construction.

4. Operate all types of swimmer propulsion/transporter units and buoyancy lift apparatus.

5. Operate equipment in connection with the recovery of mineral, gas, and oil deposits.

F. BU

1. Place and/or anchor prefabricated foundation forms; place rebar; pour concrete foundations.

2. Installation and repair of pile foundations, bents, frames, towers, dolphins, cofferdams, trestles, fabrication and erection of Rest and Refuge way stations or collapsible/floodable structures.

3. Use all types explosives, shaped charges, etc., in construction/demolition of objects, structures; anchor imbediment; making attachments.

4. Assemble a concrete structure from precast panels on ocean floor.

5. Assembly of structural components using variable buoyancy weight handling systems and quick-acting clamps and bolts as fastening devices.

6. Assemble marine life wooden cages and pens.

7. Use of all types special tools including modified pneumatic hammers, wrenches, saws and magnets as diver/constructor aids.

8. Prepare and apply special underwater preservative coatings, as required.

G. SW

1. Prepare, handle and install metal ballasts in underwater facilities and equipment, fabricate, erect, and dismantle metal structures, tanks, pontoons, towers, piers, pipelines, tubing, etc.

2. Rig lines, blocks, tackle, jacks, cables, slings, winches and all underwater weight lifting equipment.

3. Repair wire rope guy wires, anchor cable, surface lines, including splicing.

4. Use underwater cutting, drilling, pinching and welding equipment in pipeline repair, metal storage tank assembly, large object salvage or recovery, foundation and piling attachments, structure assembly and dismantling, etc.

5. Assemble, afix, and repair metal components of anchors, chains, buoys, markers, navigational aids, sensor/detector devices, etc.; fabricate marine life metal cages and pens.

IV. CAPABILITY PLAN

C. NAVFAC & NCF (SEABEE) TRAINING REQUIREMENTS

Time phasing assumes that personnel filling the specified billets will be fully productive early in the FY indicated. Accordingly, billets must be established at least 6 months prior to the required date to permit the establishment of a recruiting and training "pipeline." Tantamount to the establishment of the training "pipeline" is the availability of the necessary facilities and the development of suitable curricula and courses.

To provide visibility to the civilian and academic communities, for recruiting purposes initially, a center of excellence must be established. NCEL is already one, however, another one ought to be established at an EFD - initially at CHESDIV. The civilian recruiting program must commence immediately. When hiring to fill existing vacancies preference should be given to qualified individuals with ocean engineering related backgrounds and possibly diving experience. Position descriptions for the FY 69 civilian billets should be written and ready for advertisement by January 1969. In addition, a program to train engineers presently employed by NAVFAC/NCEL in ocean engineering should be developed and implemented as soon as possible in FY 69.

Recruiting of 5100 officers, intended for ocean engineering specialization, should also begin immediately. EFD's making CEC presentations to colleges must stress the need for undergraduate ocean engineers point to the tremendous growth potential available in Navy. The Director, Ocean Engineering Programs will provide appropriate material to EFD's for presentations.

The ocean engineering post graduate (P.G.) quota is usually two, 5100 designator officers each fiscal year. Because the ocean engineering curriculum is two years in length for a Master's degree and in order to provide 15 new 5100's with a Master's in ocean engineering or related fields by FY 74 the following input by FY is required:

FY	69	70	71	72	73	74
In	3	3	3	2	2	2
Out	2*	2	3	3	3	2

* Available FY 68.

CECOS must also develop a 2 to 3 week ocean engineering orientation course that includes such items as current programs,

Navy's organization for ocean programs, maritime law, SEABEE instant port capability, NAVFAC's role in ocean engineering, etc. In addition CECOS should commence the development of a series of ocean engineering correspondence courses for officers.

Development of a "C" school curricula for enlisted underwater construction must be developed by NAVFAC/BUPERS for the SEABEES. A prerequisite for the course and subsequent awarding of an appropriate NEC would be the successful completion of mixed gas diver training. Correspondence courses for enlisted personnel on underwater construction techniques must also be developed by NAVFAC/BUPERS. In developing training courses, lead ocean engineering laboratories and NAVOCEANO will be consulted.

In order to establish a deep ocean capability in the time frame indicated, at least three 5100 officers and 45 SEABEES must be qualified as mixed as gas divers by FY 75. Diver training facilities are at a premium and every effort must be made to assist BUPERS in planning sufficient training facilities to meet our needs. An emergent repair project is desperately needed this FY to rehab diving facilities at the diving school in Washington, D. C. BUPERS is presently conducting diver training at nights and on weekends using SUPSAL's facilities.

A suggested Ocean Engineering Course for CEC Officers and selected NAVFAC engineers is shown in Exhibit IV.C.1. Both the correspondence course and the crash course, referred to in paragraph IV.A.4, should have the same general content but the degree of detail would differ. The crash course would be supplemented by extensive handouts and reference material for each subject. Sections 3, 4, 5, 6, 7, and 8 should receive the major emphasis. The course would be introduced with a review of environmental factors which affect engineering. These environmental factors would also be stressed where applicable throughout the course.

EXHIBIT IV.C.1

CONTENT FOR NAVFAC OCEAN ENGINEERING COURSE

1. Vehicles
   a. Oceanographic Ships
   b. Manned deep submersibles
   c. Unmanned deep submersibles

2. Environmental Measurements
   a. Buoys
   b. Spacecraft oceanography
   c. Instrumentation

3. Energy Sources and Conversion
   a. Nuclear power
   b. Fuel cells
   c. Batteries

4. Materials and Structures
   a. Steels, titanium, glass GRP, concrete
   b. Floatation material
   c. Corrosion
   d. Structural shapes

5. Diver Technology
   a. Life support
   b. Tools and equipment
   c. Communication

6. Mechanical, Electrical, and Hydraulic Systems
   a. Pressure compensation
   b. Lights
   c. TV
   d. Navigation
   e. Control systems
   f. Manipulators

7. Test Facilities
   a. Underwater ranges
   b. Pressure test chambers
   c. Wave tanks
   d. Instrument calibration

8. Seafloor Engineering
   a. Habitat design
   b. Site selection
   c. Foundation design
   d. Engineering properties of marine sediments
   e. Bottom work systems

9. Ocean Resource Utilization
   a. Offshore petroleum and gas
   b. Seafloor mining
   c. Aquaculture
   d. Desalination

10. Ocean Engineering Programs
    a. Government
    b. Industry
    c. Institutions

V. ORGANIZATION PLAN

A. Considerations Bearing on Organization

There are a large number of oceanographic applications and warfare missions, previously discussed, which will require the total ocean engineering and construction capabilities of the Naval Facilities Engineering Command in addition to the research and technological developments. The Navy has a prime interest in ocean engineering and the Naval Facilities Engineering Command has a prime role in this effort as indicated by NAVFAC's role in the DOT Program. Although NAVFAC's role in this program has already been established, to acquire resources and to receive specific task assignments does require aggressive action. An in-house capability is the key. Development of such capability requires intensive management. The proposed capability is one which will develop with time to accommodate growing numbers and types of requirements.

The concurrent development of many diverse areas of expertise crossing the entire spectrum of CEC, NAVFAC, and SEABEE interests is required. Planning, R&D, contracting, design, materiel and equipment procurement, contract management, maintenance and operation, real estate, repair and rehabilitation, and finally disposal in both combat and peacetime environments will be involved. At any one point in time we will be engaged in several of these phases. The development of expertise must be guided - continually and intensively - to the development of a system of ocean construction capability in which all interrelated disciplines are developed at the proper rate and to the needed level. The nature of the capability must lead in time the press of routine business from the existing environment; it must anticipate needs. This calls upon Command attention to provide stimulus for leading the user world.

Visibility is important, both within and without NAVFAC. Within NAVFAC the necessary degree of authority and direction must be applied to ensure that capability is developed in a balanced way vis a vis resources applied and capability needed. Visibility outside NAVFAC is paramount to successful support to others, most objective use of resources, and to ensure that NAVFAC expertise is applied where and when it should be applied.

B. Recommended Management

1. Functions

The Commander must be able to make the business and technical management decisions required in successful prosecution

of NAVFAC Ocean Engineering Programs. With the foregoing in mind, it is considered that a Director, Ocean Engineering Programs, be established having the following responsibilities:

(a) Plan, organize, and administer a management staff or Ocean Engineering.

(b) Establish and develop detailed planning by coordinating the development of long range objectives for capability development.

(c) Monitor, coordinate, and direct as necessary the accomplishment of experimental test, engineering, and analytical studies (working with Assistant Commanders) related to future ocean engineering efforts.

(d) Develop estimates of resources required to meet established objectives; study and recommend alternatives relating to Ocean Engineering objectives, requirements, and Assistant Commander recommendations relative to resource requirements.

(e) Coordinate the development of Planning and Programming System documentation related to Ocean Engineering system development.

(f) Review and appraise Ocean Acquisition Management Planning for work effort in the ocean engineering field. To include integration of the planning of the individual Assistant Commanders related to:

Procurement,
Management Information Systems
Configuration Management
Integrated Logistics, and
Systems Effectiveness

(g) Coordinate appropriate interfaces between Assistant Commanders and between NAVFAC and the several SYSCOMS and Bureaus, the CNO, and fleets. Act as principal point of contact within NAVFAC for ocean engineering programs.

(h) Manage the development of criteria for test, demonstration, evaluation and installation of systems, sub-systems, components, and equipment.

(i) Establish management control techniques and procedures to provide accurate and comprehensive information concerning the status and progress of ocean construction capability development. Evaluate performance.

(j) Maintain a continuing review of Navy operational requirements to ensure development of ocean construction capability which is consistent and compatible.

(k) Direct the development of conceptual studies directed to reflecting in ocean engineering capability programs. The mission and performance envelopes of developing operational requirements. Direct the process of conveying appropriate concepts to Project Managers, SYSCOMS, and CNO.

(l) Integrate the ocean engineering plans and programs into NAVFAC plans and programs in other areas.

Assistant Commanders participating in the Ocean Engineering Program shall continue to be responsible for management of their respective functional areas. Their planning, programming, program development, and day-to-day actions shall be such as to support and implement the approved plans and programs defined by the Director, Ocean Engineering Programs.

2. Staffing

Success of operation of the Director, Ocean Engineering Programs will be measured by the degree of involvement by the rest of the NAVFAC/SEABEE organization. A large organization would work against this criterion of success. A small staff is required. Staffing is recommended as follows:

(a) Captain, CEC, Director

(b) Commander, CEC, Assistant Director

(c) Ocean Engineer (Civil or General), GS-14

(d) Ocean Engineer (Mechanical or General), GS-13

(e) Management Analyst or Administrative Assistant, GS-13

(f) Clerk-Stenographer, GS-6/7

3. Procedures

The functional statements require a systematic review of Navy planning and programming documentation and guidance given to other organizational elements of NAVFAC to assemble a NAVFAC Ocean Engineering Plan. Included are appraisal of NAVFAC program and initiating actions to improve NAVFAC response to Navy needs in

in ocean engineering. The major influence must be exerted through short-range planning in cooperation with Assistant Commanders, with a minimum occurrence of day-to-day demands by the Director for new types of response from the Assistant Commanders. "Goals and Targets" shall be employed.

4. Resources

Effort expended by the Director, Ocean Engineering Programs should be lodged against Program X. Productive efforts of the various program managers (e.g. 03, 04, 05, 06, etc.) should be lodged against the various programs. It is estimated that man-years per year are being expended as follows:

NAVFAC	10
EFD's	10
SEABEES	30 (Approx.)
NCEL	26

Additional man-years in FY 69 would be as follows:

NAVFAC	5 (3 mgmt. 2 technical)
EFD's	0
SEABEES	20 (in training)
NCEL	7

These represent new established positions. In addition, existing organizations in NAVFAC will find a greater proportion of their time devoted to ocean engineering matters.

5. Organizational Location

a. Criteria

The following factors are considered desirable in determining the organizational location of the Director, Ocean Engineering Programs:

(1) Visibility to other Navy organizations.

(2) Stature within and without NAVFAC.

(3) Access to top management (Commander, Vice Commander, Deputy Commanders).

(4) Access to line management (Assistant Commanders).

(5) Access to operation management (Division Directors, Branch Managers).

(6) Compatibility with existing duties of immediate superior.

(7) Conformance to existing NAVFAC functional organization, management communications procedure, and program management practice.

(8) Response of NAVFAC functional organization to command needs as expressed by Director, Ocean Engineering Programs.

b. Advantages and Disadvantages of Various Organization Concepts

Figure V.B.1 shows the various alternatives and presents some significant advantages and disadvantages of each. Where advantages or disadvantages are not specifically listed, general satisfaction of the criteria exists.

The task group recommends that the Director, Ocean Engineering Programs be at the second level, as a staff or line subordinate to a Deputy Commander. If it is desired to preserve the functional integrity of the existing groups, the staff relationship is preferred.

The functional statement of the Deputy to whom the Director is assigned would require modification to include responsibility for overall direction of ocean engineering plans, programs, plan execution, and appraisal.

The effort is intended to provide Navy capability to acquire undersea facilities for other elements of the Navy, at least for the foreseeable future. Assignment to the Deputy Commander for Acquisition would be compatible with his activities in the initial stages of product life cycle at present: R&D, Design, Procurement, Construction. The interface relationship with the remaining element principally involved, Military Readiness, is not sensitive to the specific choice of organizational location, other than within Military Readiness itself. Assignment within Military Readiness would put the position at the third level insofar as internal NAVFAC operations are concerned, would give the same access to the Commander and Vice Commander but would provide for multiple interfaces with the NAVFAC Acquisition organizations.

COMPARISON OF ORGANIZATION ALTERNATIVES FOR THE DIRECTOR, OCEAN ENGINEERING PROGRAMS

Level	Line or Staff	Title	Immediate Superior	Advantages	Disadvantages
1	Staff	DOEP	00/09	Stature superior.	Poor compatibility with existing duties of immediate superior. Access to operations management poor.
	Line	Deputy Commander for Ocean Engineering		Access to top and line management superior.	Incompatible with NAVFAC functional and program management concepts.
2	Staff	DOEP	09A or 09B 09P		None
	Line	Assistant Commander for Ocean Engineering	09 09A 09B 09P	Stature good.	Poor conformance to existing NAVFAC functional organization in that either (a) Military Readiness, Construction, Design, R&D functions would be duplicated, or (b) a line position would be established with no operating force to direct.
3	Staff	DOEP	Assistant Commander		Visibility inferior. Stature inferior.
	Line	Division Director			

Figure V.B.1

VI. RECOMMENDED FY 69 ACTIONS

A. Major Management

1. The Deputy Commander for Acquisition will initiate correspondence and presentations to NAVMAT setting forth NAVFAC's capability to manage the MITS program as outlined in the OEPPG and paragraph IV.A.e. A target date for completion of this action is tentatively established for 31 December 1968.

2. As recommended in Section V as soon as practicable in FY 69 the Director, Ocean Engineering Programs, should be established. Staffing is estimated at: 1 military and 3 civilians. Code 01 should initiate appropriate action to generate functional descriptions, organizational changes and ceilings.

3. Codes 01, 03, 04 and 06 will report, at the end of each quarter for FY 69 and 70, to the DOEP the extent of completed actions and plans for future actions. The DOEP will report to the Vice Commander accordingly.

B. Staffing

1. Code 01, in consultation with Codes 03 and 04, will initiate appropriate action to provide in their respective organizations one additional engineer each for ocean engineering. This action to be completed by the end of the third quarter of FY 1969.

2. Code 06 will initiate by the end of the second quarter FY 69 actions to fill CEC officer and Group VIII enlisted billets as called for in Sections IV.A and B for headquarters management and SEABEE management and training functions.

3. Codes 06, 03, and 05 will designate, in the second quarter of FY 69, selected personnel to the Ad Hoc interim ocean engineering task force as described in Section IV.A.3. In collaboration with other codes, Code 01 will provide for the crash training of this task force in aspects of ocean engineering as described in Sections IV.A.4 and IV.C.

4. Code 01 will submit to the Vice Commander by the end of the second quarter FY 69 a detailed report of the extent to which ocean engineering billets can be established within existing ceilings. The report shall contain recommendations for shifting old ceilings and creating new ones.

C. Resources

1. Code 04 will establish at Chesapeake Division a field center of ocean engineering expertise, Section IV.A and IV.C. Southeast Division existing expertise shall be maintained, anticipating its eventual specialization and expansion. One man-year of effort should be assigned to Program III for CHESDIV in FY 69 to permit early availability of engineering capability. Codes 01 and 04 will initiate action.

2. Code 01 will establish an IPMS task within each appropriate program to accumulate data on NAVFAC effort in ocean engineering activities.

3. Codes 03, 04, 06 and 01 will initiate appropriate programming and reprogramming actions to incorporate in budget plans the additional estimated resources, called for by this report, commencing with the FY 71 budget cycle. Their actions shall not be delayed pending the establishment of the DOEP but they shall be initiated as early as possible after approval of this plan by the Commander. The DOEP will assure coordination control of their actions when he comes into being.

D. Organizational

1. As recommended in Section V as soon as practicable in FY 69 the Director, Ocean Engineering Programs, should be established. Staffing is estimated at: 1 military and 3 civilians. Code 01 should initiate appropriate action to generate functional descriptions, organizational changes and ceilings.

2. Code 04 will establish at Chesapeake Division a field center of ocean engineering expertise, Section IV.A and IV.C. Southeast Division existing expertise shall be maintained, anticipating its eventual specialization and expansion. One man-year of effort should be assigned to Program III for CHESDIV in FY 69 to permit early availability of engineering capability. Codes 01 and 04 will initiate action.

E. Training

1. Codes 01 and 06 will establish the recommended (Section IV.A, B, C) training programs for civilian and military personnel respectively. The training program plan will be completely coordinated with other NAVFAC codes and it will be in effect by the end of the second and third quarters of FY 69 for civilian and military personnel respectively. Training program for military personnel for the SEABEE Underwater Construction Unit (SUCU) to be timed as may be required by many other considerations unforeseen at this time.

2. Codes 04, 06, 03, and 05 will designate, in the second quarter of FY 69, selected personnel to the Ad Hoc interim ocean engineering task force as described in Section IV.A.3. In collaboration with other codes, Code 01 will provide for the crash training of this task force in aspects of ocean engineering as described in Sections IV.A.4 and IV.C.

3. Code 06 will initiate a plan to train diver-crew members organic to battalions by conducting a readiness test and evaluation program during each home port assignment. Implementation of the plan should commence FY 70.

F. Technical Administration

1. Codes 04, 06, and 03 will develop technical proposals for constructing facility sub-systems to be presented to OPNAV, NAVMAT, SYSCOMS and other in an effort to help them formulate their concepts and resulting technology needs. The Director, Ocean Engineering Programs will direct and coordinate this effort in its entirety.

2. Under the direction of the Director, Ocean Engineering Programs, Codes 03 and 06 will generate inputs for Navy requirement documents such as COR's, ADO's and will generate new suggested requirement documents to insure complete visibility and consideration of the SEABEE/NAVFAC end products. This action to be completed by the third quarter of FY 69, however, preferably it should be initiated and completed as soon as possible.

3. Under the coordination and direction of the Director, Ocean Engineering Programs (DOEP), Code 03 will request NCEL to develop selected advanced concepts to be presented to OPNAV through presentations and proposals for systems developments. This to be initiated visibly and carried on continuously as necessary.

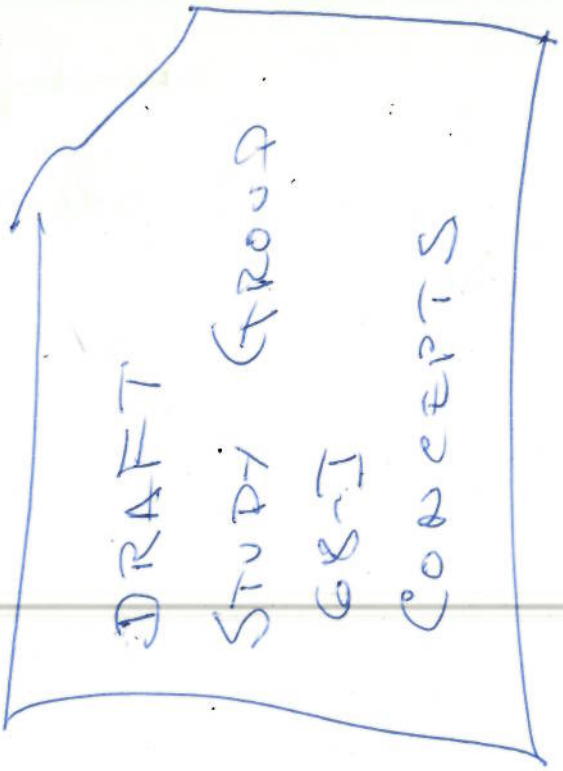
4. In furthering NAVFAC's image in the ocean engineering community, Codes 20, 21 and 05 will establish specific procedures for effective liaison and expeditious response to those Navy elements requiring both shore and ocean facilities in support of their ocean engineering and operational efforts. Further, Codes 20 and 21 will direct specific inquiry in FY 69 to EFD's, SYSCOMS and the FLEETS to identify existing and foreseeable MILCON requirements for ocean engineering and its developmental support.

5. Under the coordination of the DOEP, Codes 06 and 03 will formulate a joint long range plan for the development of SEABEE diver tools and diving gear to complement ongoing effort by others. Action to be completed by the end of the third quarter of FY 69.

6. Code 02 will compile, by the end of the second quarter of FY 69, a list of contractors and A&E firms qualified to perform ocean engineering functions. Code 02 will insure that the NAVDOCKS 22 (Civil Works) mode of contracting is understood and properly utilized by Project Managers SYSCOMS procuring ocean related systems.

7. Codes 03, 04, 06 and 01 will initiate appropriate programming and reprogramming actions to incorporate in budget plans the additional estimated resources, called for by this report, commencing with the FY 71 budget cycle. Their actions shall not be delayed pending the establishment of the DOEP but they shall be initiated as early as possible after approval of this plan by the Commander. The DOEP will assure coordination control of their actions when he comes into being.

8. Code 06 will initiate a plan to train diver-crew members organic to battalions by conducting a readiness test and evaluation program during each home port assignment. Implementation of the plan should commence FY 70.



APPENDIX A

DESIGN CONCEPTS

I ASW

Surveillance

A. Anti-Neutrino Detection System

B. Ocean Bottom Acoustic Telescope

C. Vertical Arrays

D. Horizontal Arrays

II SHALLOW WATER

A. Harbor and Port Facilities

1. Piers, wharves

2. Pipe terminals

3. Weight handling

4. Breakwaters

5. Underwater drydock

6. Underwater storage

B. Instant Port

1. Piers, wharves

2. Highline

3. Pipelines

4. Ship moorings

C. Riverine Warfare

III MINE WARFARE

Weapons Systems

IV AMPHIBIOUS WARFARE

A. Recon and Logistical Support Station

B. Fuel Station (underwater)

C. Fuel Farm

D. Logistics Modules (underwater)

E. Logistics Base

F. Supply Delivery System (drone)

V UNDERWATER CACHE

A. POL

B. Supplies

VI SURFACE LOGISTICS & WORK PLATFORM

VII SEABASED STRATEGIC DETERRENT SYSTEMS

A. Platforms

B. In Bottom

C. On Bottom

VIII RDT&E SUPPORT PROJECTS

A. Tektite

B. Sealab

C. Hydrographic Data Collection

D. Oceanographic Data Collection

E. Ocean-air Interface Data Collection

F. Weather Data Collection

G. Geological Data Collection

H. Pressure Test Facility

1. Underwater

2. Surface

IX FOCAL PROJECTS

A. DS/OEPPG

1. Prototype underwater work unit

a. Aquanaut equipment

b. Movable habitat

2. Manned underwater lab

B. Marine Commission

1. Fixed Continental Shelf Laboratory

2. Movable habitat

3. Ocean platforms

4. National Oceanographic Buoy System

C. Deep Ocean Technology

1. Test-Bed Manned Bottom Installation

2. Test-Bed Manned Submersible

a. Support Systems

b. Work/Test Subsystem

3. Ancillary Development

4. Weapons Support Interface Development

c. Identification of SEABED functions and tasks

1. Excavate
2. Install EMPLANT
3. Install LOWERING
4. Emplace and make connections
5. Install EXCAVATE, EMPLACE
6. Core borings, perform emplacement

d. Identification of other NAVFAC responsibilities

1. Design
2. Design
3. Design
4. Design
5. Design
6. Develop procedures

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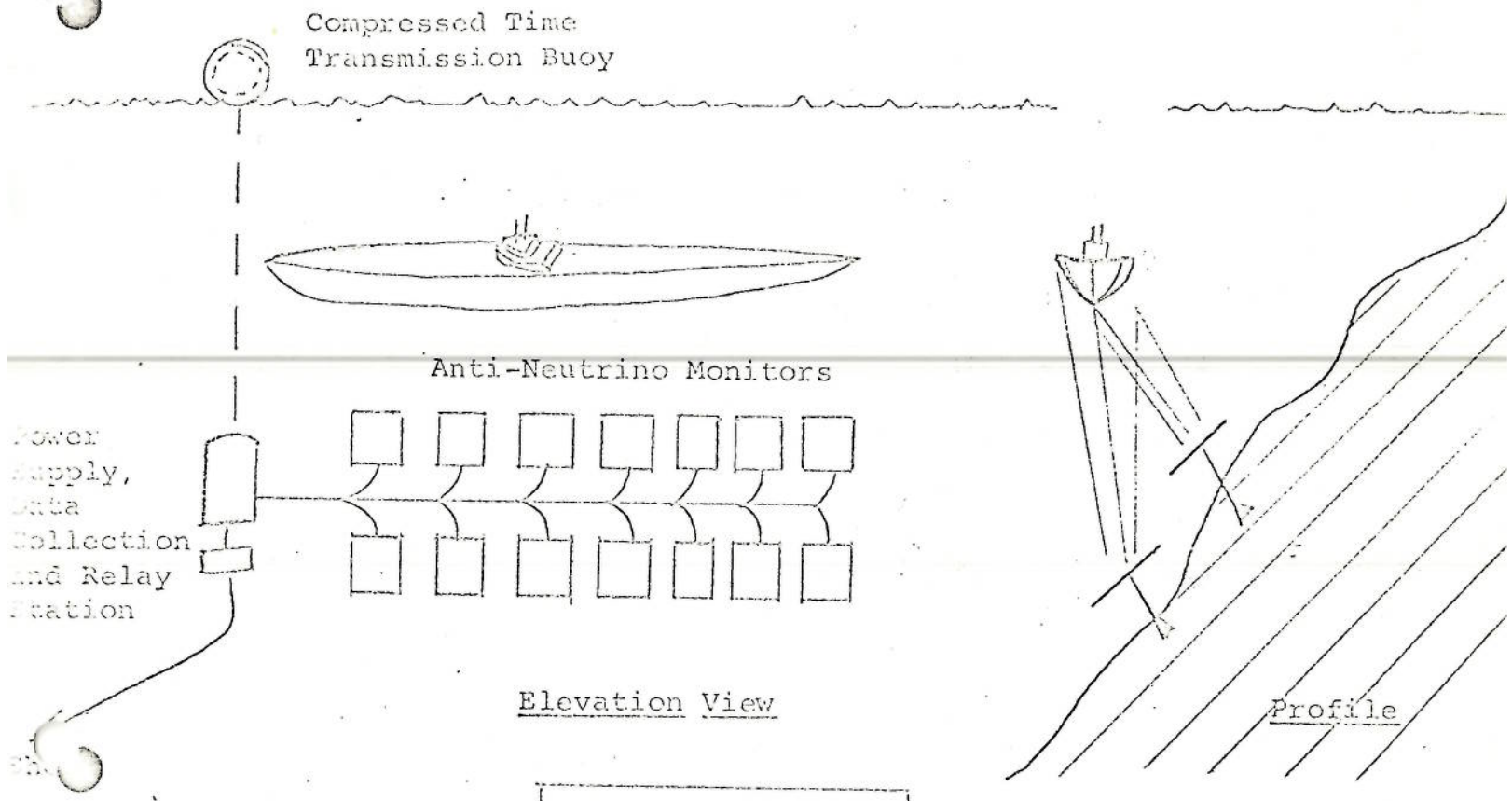
ANTI-NEUTRINO DETECTION SYSTEM

a.



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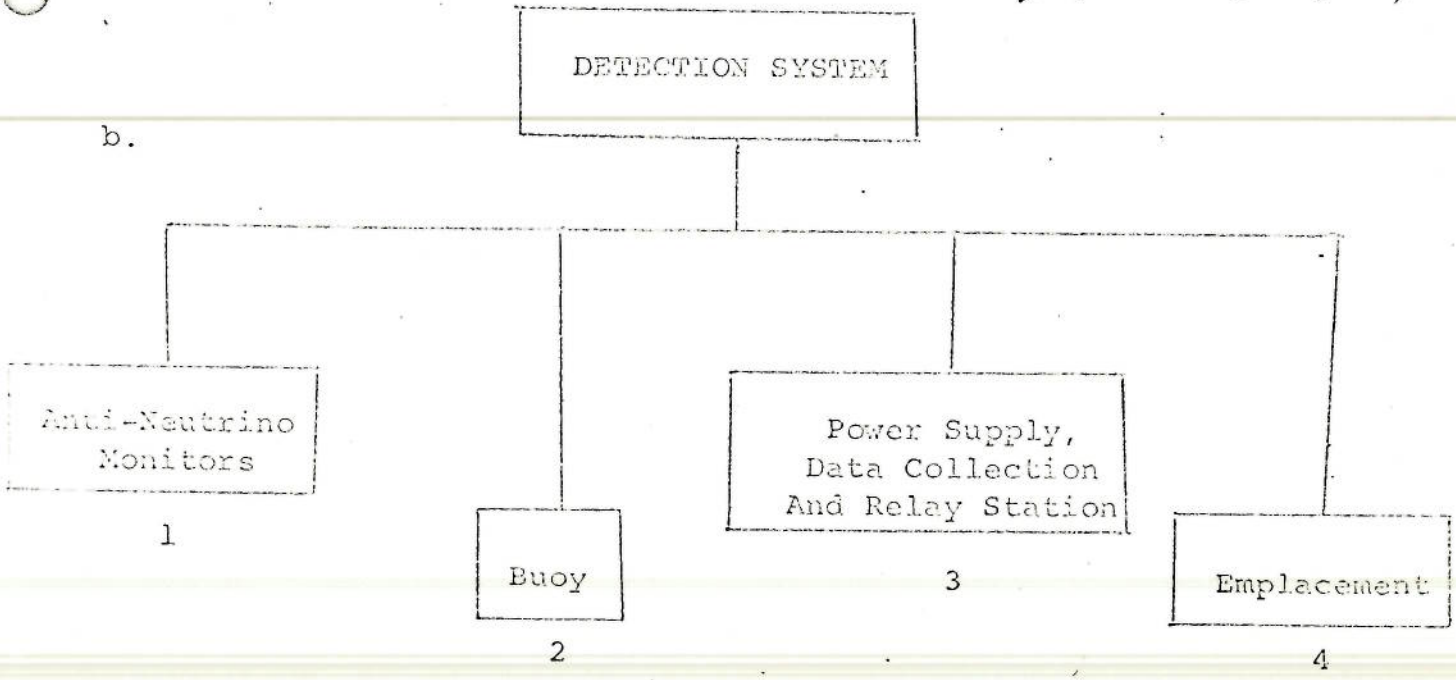

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GROUP 3
Downgraded at 12-year intervals; not automatically declassified

c. Identification of SHARED functions and tasks

1. Install

2. Install

3. Install

4. Core borings, excavation, connections, perform emplacement.

d. Identification of other NAVFAC responsibilities

1. Design

2. Design

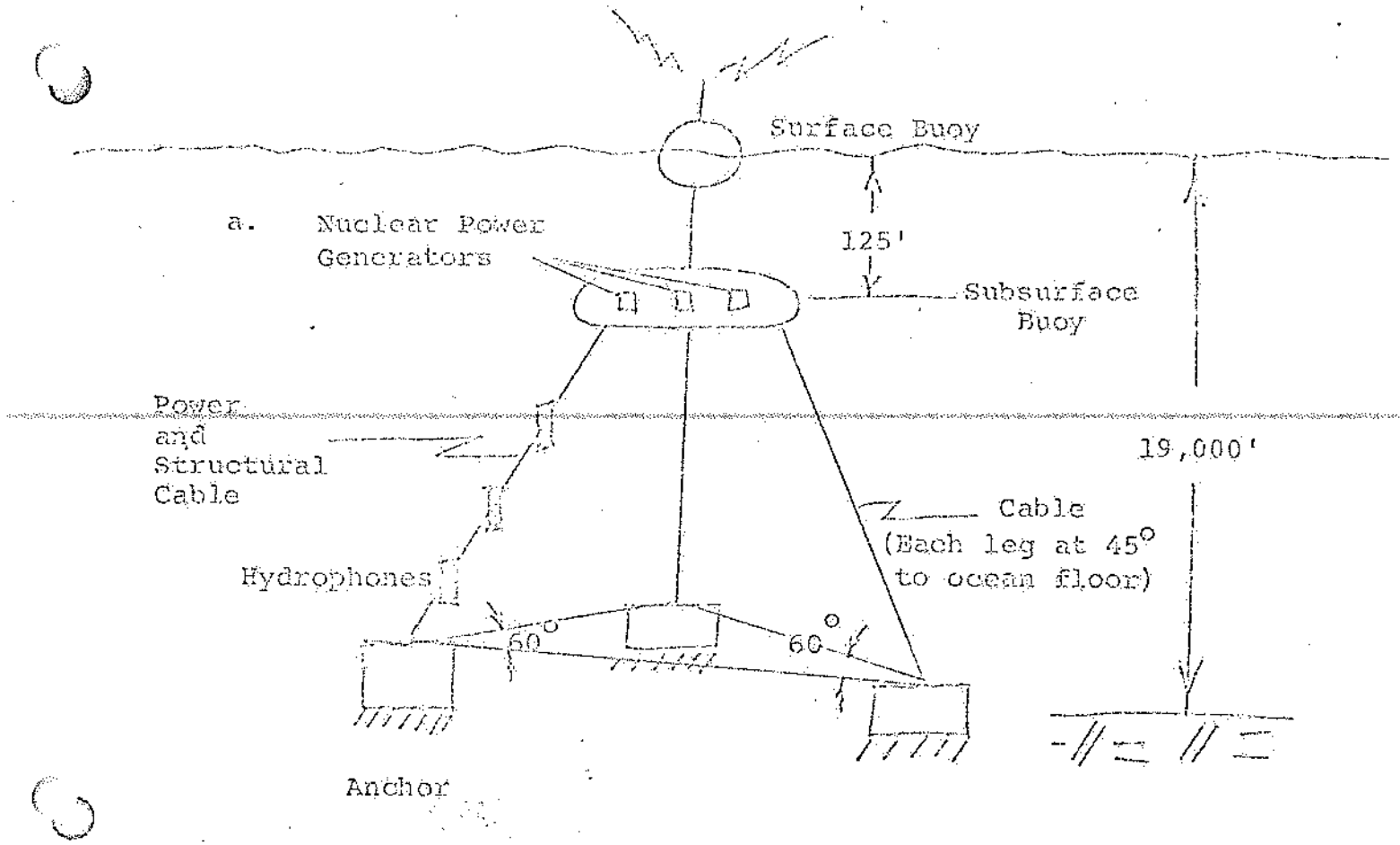
3. Design

4. Develop procedures

VERTICAL ARRAYS

Concept 1 - Sea Spider

a.



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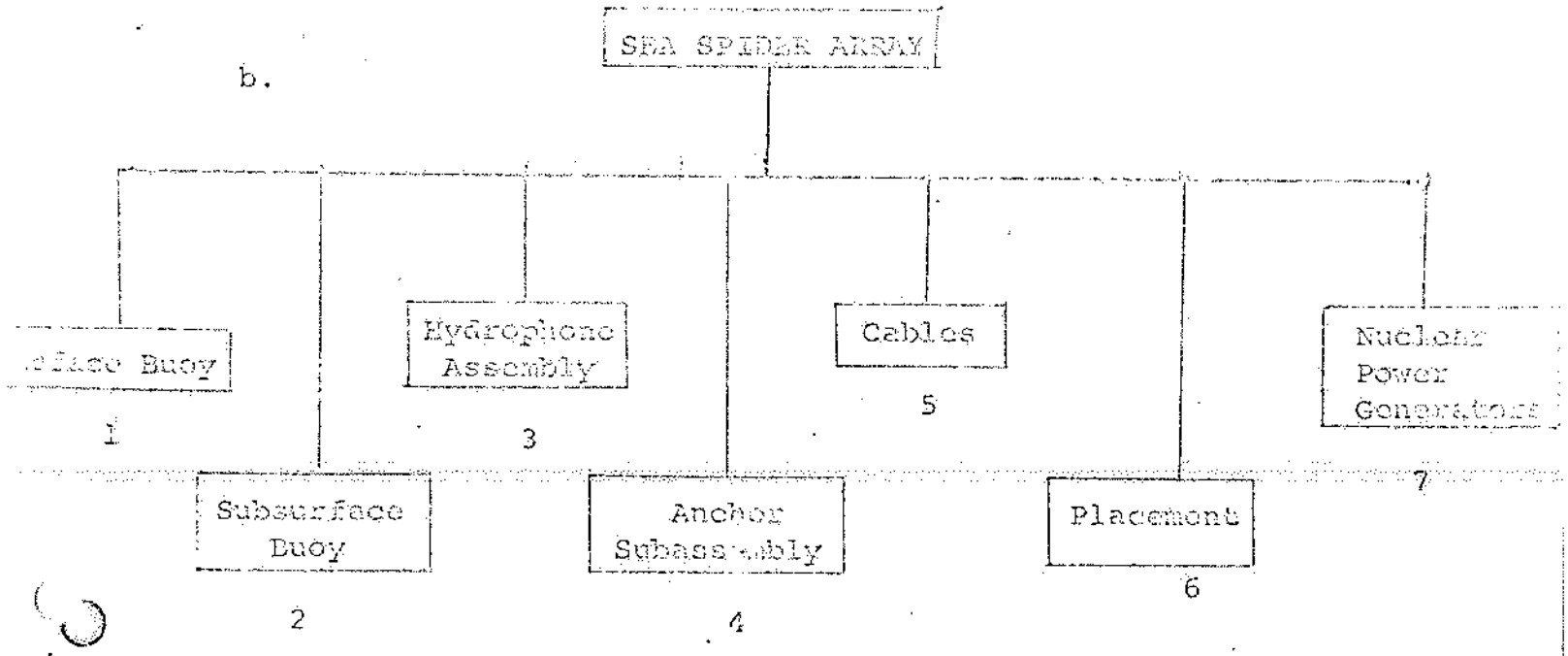


Concept 1 - Sea Spider

c. Identification of NAVFAC Functions and Tasks

1. Maintain and Inspect
2. Divers to check chafing and replace buoy
3. None
4. Prefab anchors and connector
5. None
6. Weight Handling (Seabees can operate cranes during installation)
7. None

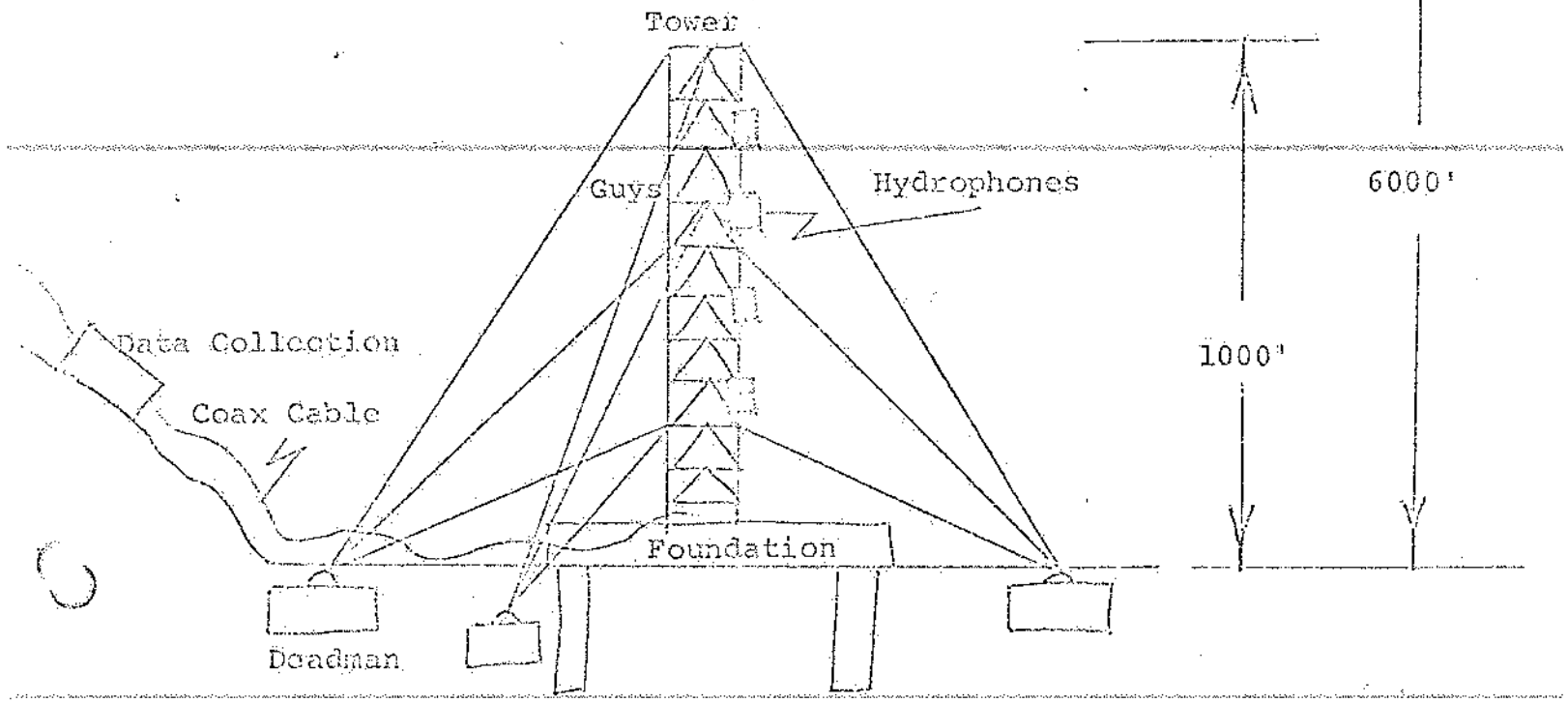
d. Identification of Other NAVFAC Responsibilities

1. Structural design, design of connectors and cables.
2. Structural design, design of cables and connectors.
3. Design of cables and connectors
4. Anchor design
5. Cable design
6. Soils exploration
7. Design and certification

VERTICAL ARRAYS

Concept 2a - Guyed Tower

a.



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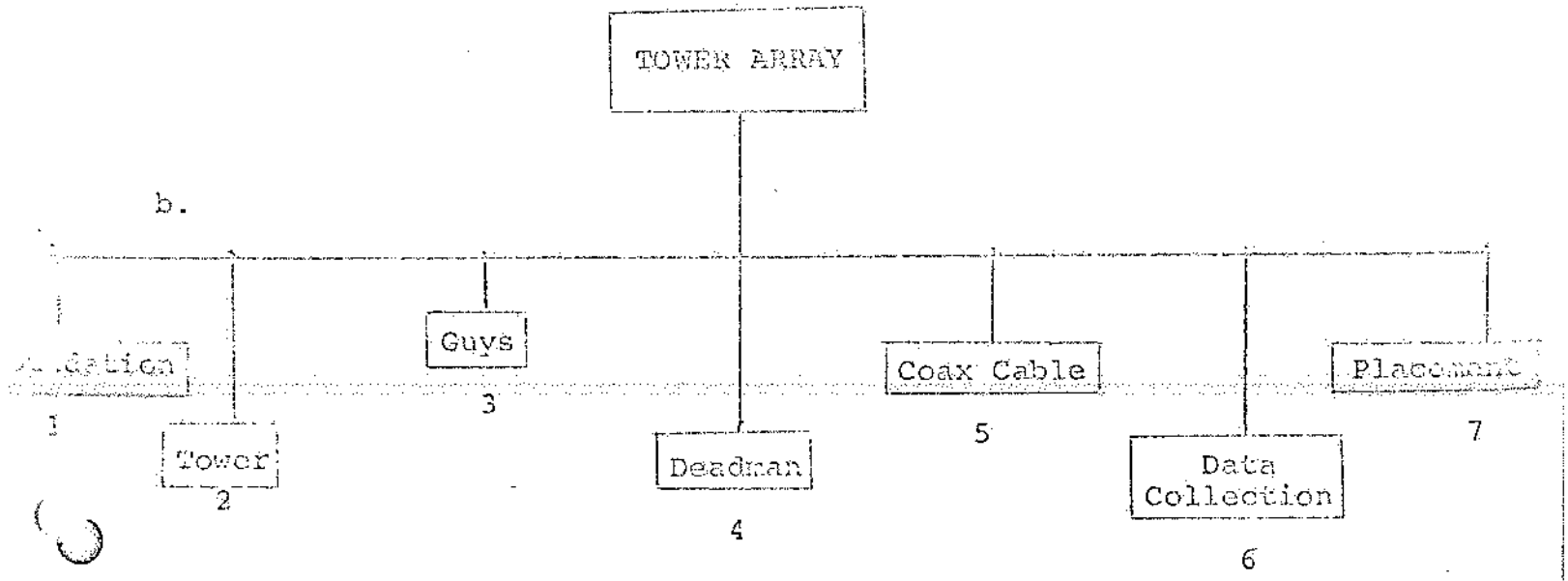


VERTICAL ARRAYS

Concept 2a- Guyed Tower

c. Identification of SEABEE Functions and Tasks

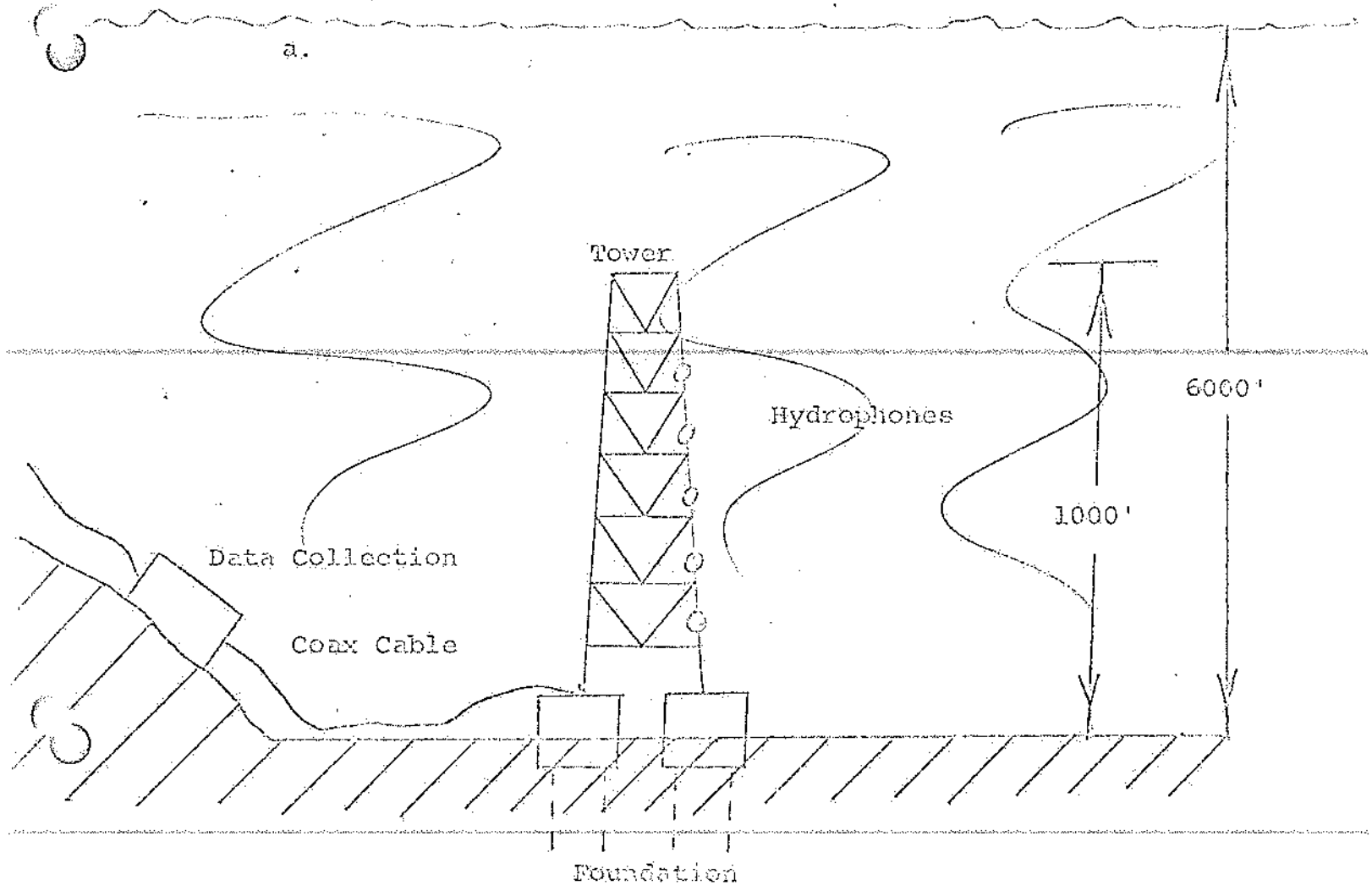
1. Prefab foundation
2. Prefab tower sections
3. Make connectors
4. Prefab deadmen
5. None
6. Prefab container
7. Weight handling, barges to carry sections

d. Identification of Other NAVFAC Responsibilities

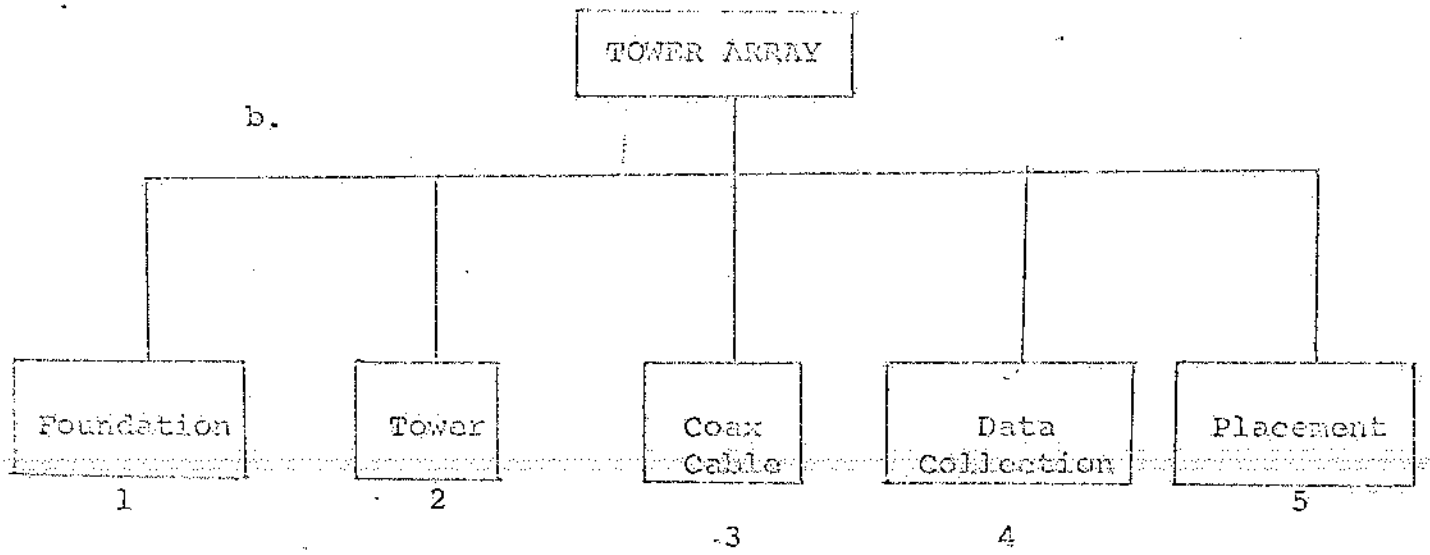
1. Design foundation, maintain and inspect
2. Design of tower, maintain and inspect
3. Design of guys , maintain and inspect
4. Design of deadman
5. None
6. Design of housing , maintain and inspect
   Provide power, maintain and inspect
7. Bottom survey
   Soil exploration
   Develop implantment procedures

VERTICAL ARRAYS
Concept 2b - Self-Supporting Tower

a.



b.



VERTICAL ARRAYS

Concept 2b - Self Supporting Tower

c. Identification of SEAVEH Functions and Tasks

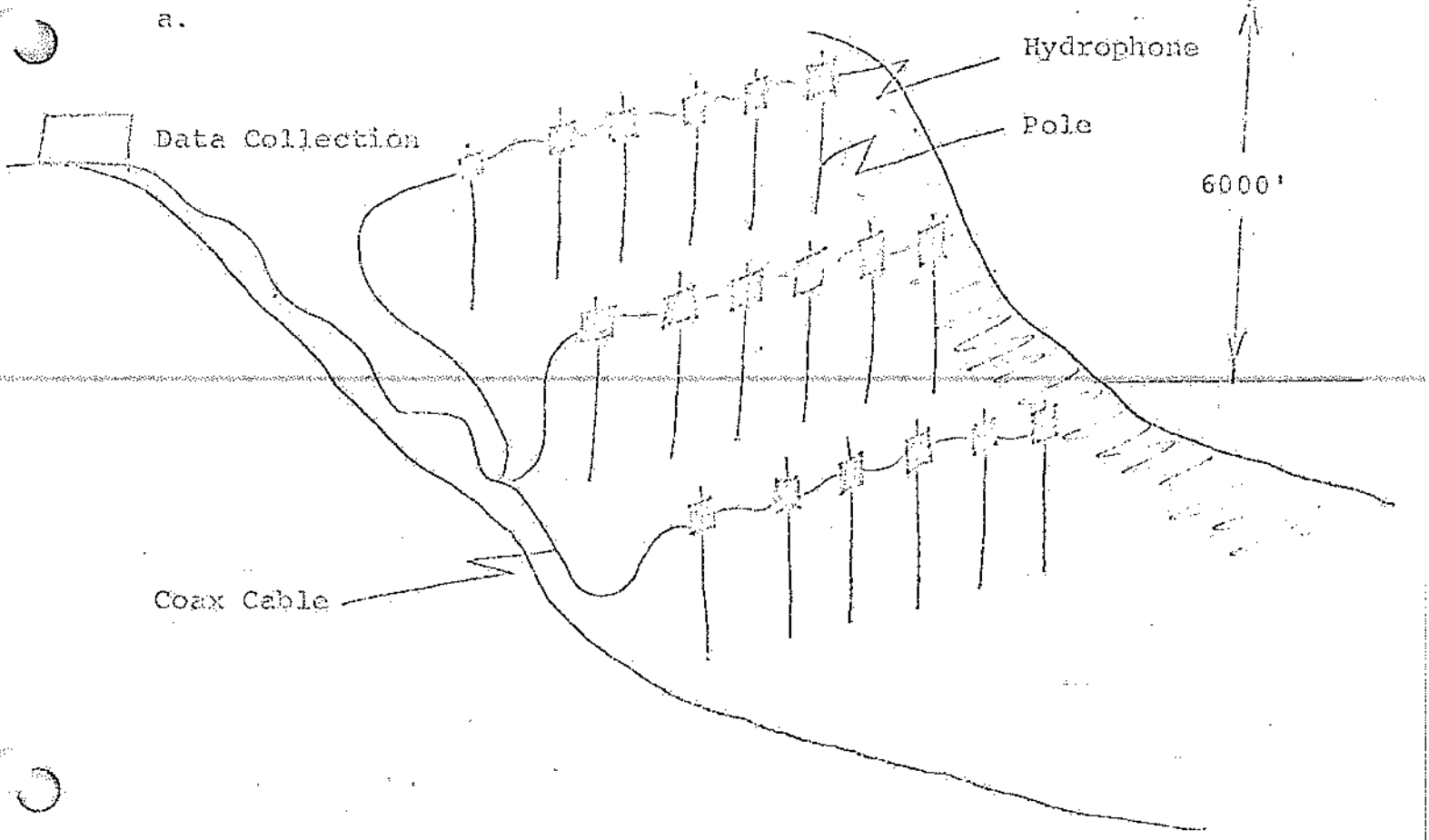
1. Prefab foundation
2. Prefab Tower Sections
3. None
4. Prefab Container
5. Weight handling, barges to carry sections

d. Identification of Other NAVFAC Responsibilities

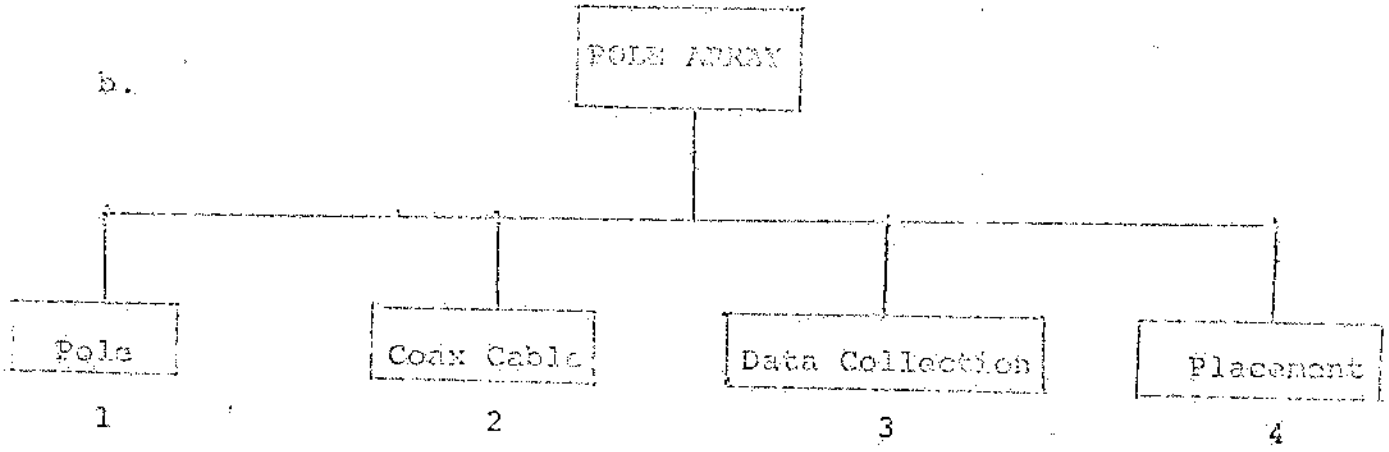
1. Design foundation, maintain and inspect
2. Design tower, maintain and inspect
3. None
4. Design of housing provide power, maintain and inspect
5. Bottom survey
   Soil exploration
   Develop implantment procedures

Concept 3 - Pole-Grid

a.



b.



VERTICAL ARRAYS

Concept 3 - Pole Grid

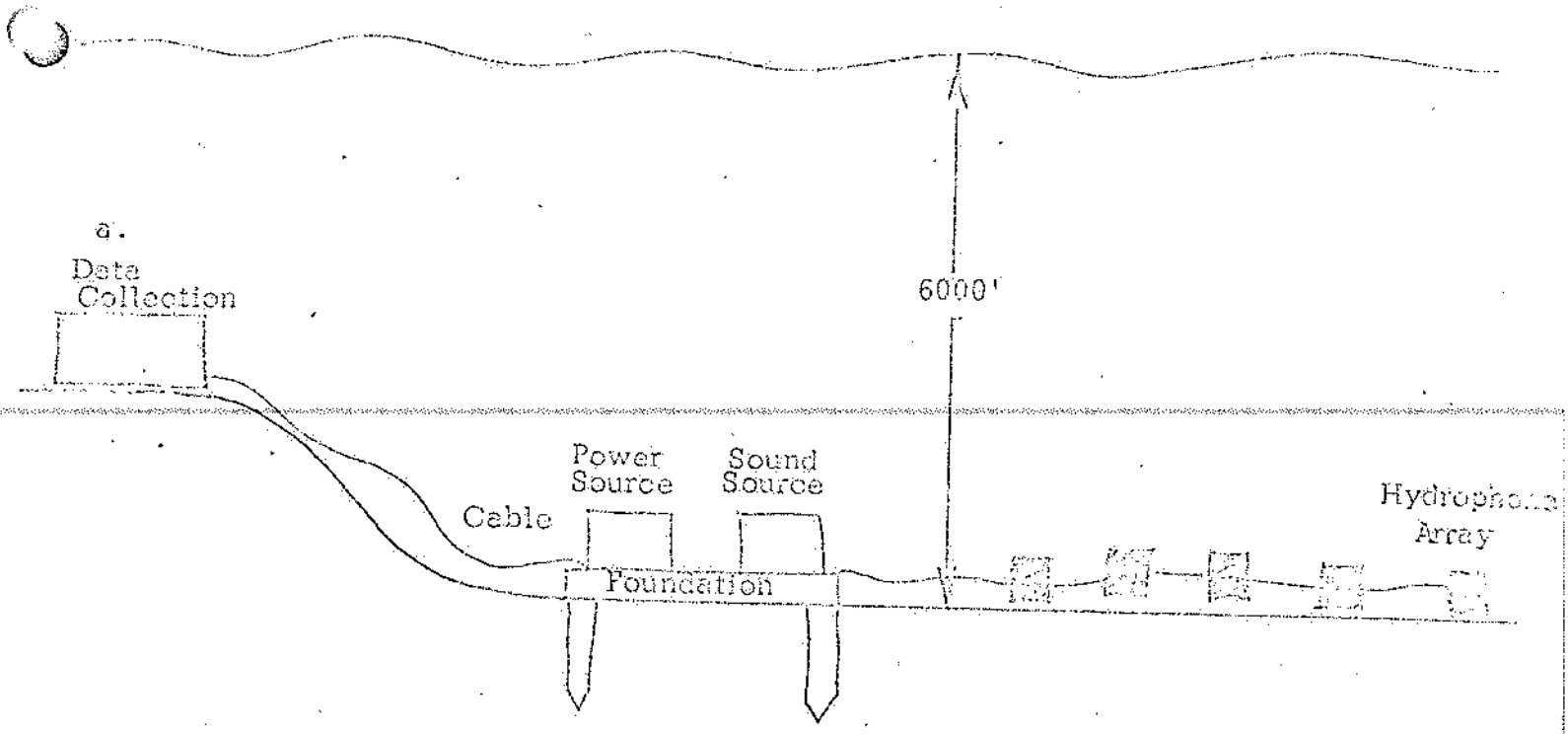
c. Identification of SEABEE Functions and Tasks

1. Provide treatment, install
2. None
3. Prefab container
4. Weight handling, Auger operation, Setting operation

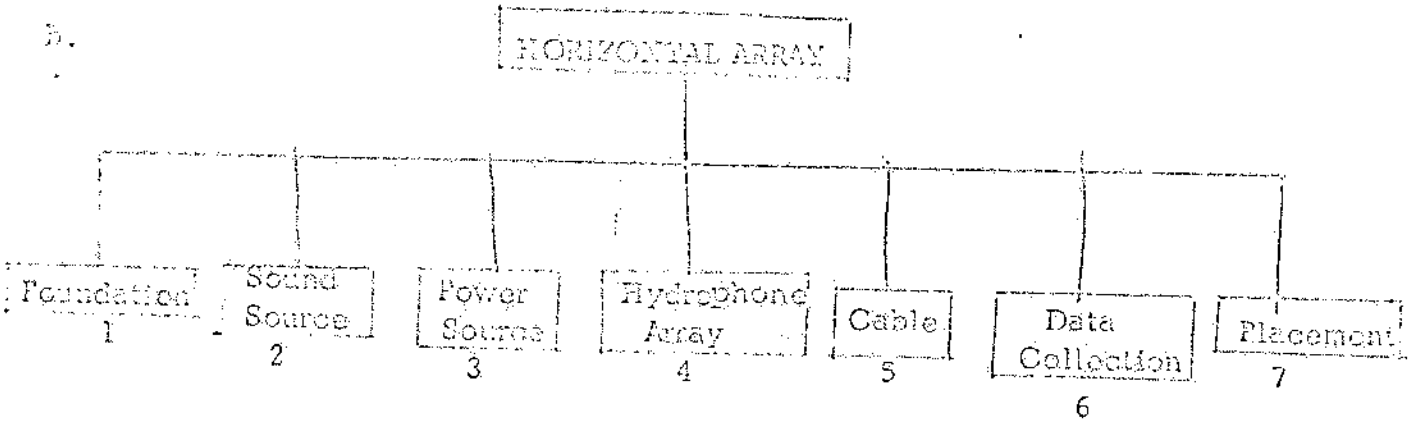
d. Identification of Other NAVFAC Responsibilities

1. Design pole, maintain and inspect
2. None
3. Design housing , maintain and inspect
   Provide power
4. Bottom survey, soils exploration, develop implantment procedures

a.


Data Collection
6000'
Power Source
Sound Source
Cable
Foundation
Hydrophone Array

b.


HORIZONTAL ARRAY
Foundation 1
Sound Source 2
Power Source 3
Hydrophone Array 4
Cable 5
Data Collection 6
Placement 7

HORIZONTAL ARRAYS

c. Identification of SEABEE Functions and Tasks

1. Foundation prefabrication
2. Fabrication of housing, and attachment to Foundation
3. Fabricate housing, attachment to foundation, connection with sound source
4. None
5. None
6. Fabricate housing for data collection
7. Weight handling

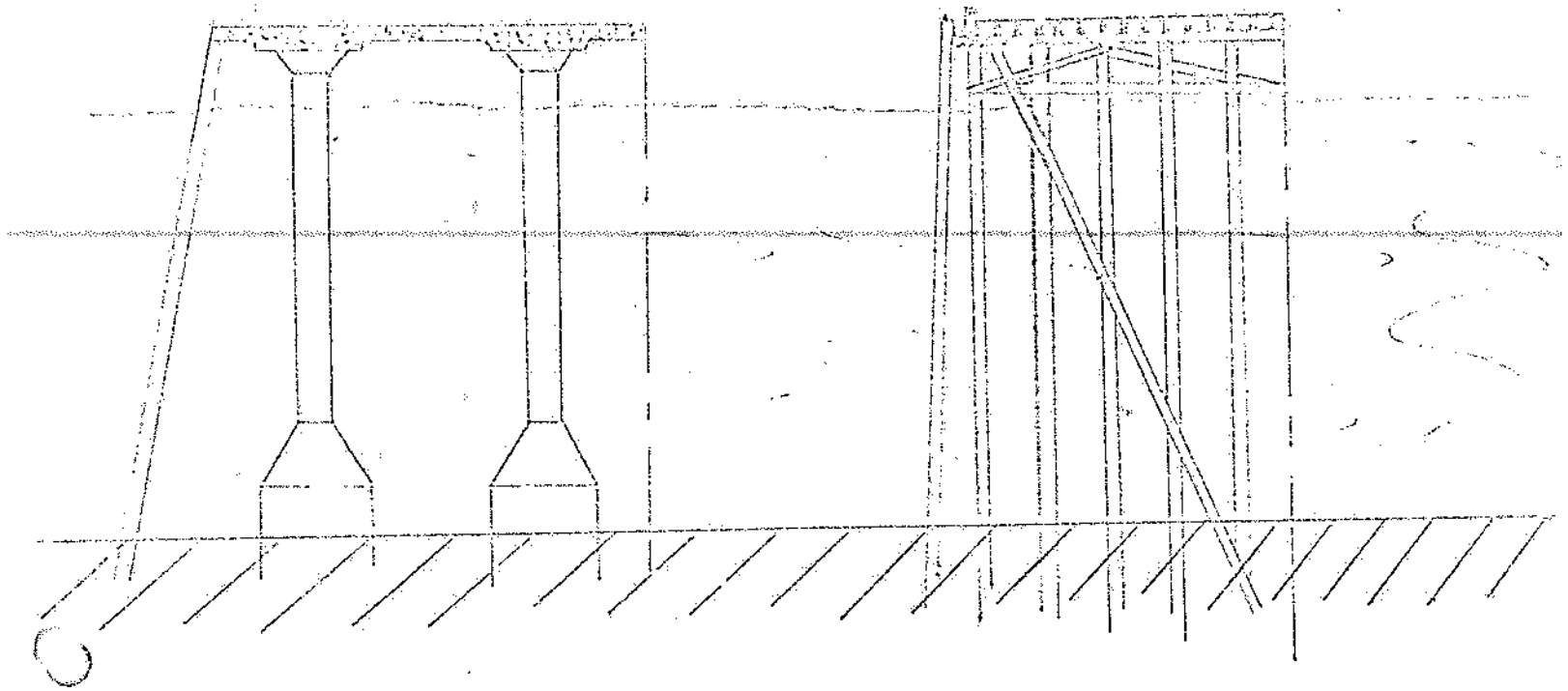
d. Identification of Other NAVFAC Responsibilities

1. Foundation design
2. Design of attachment to foundation
3. Design of source, provide nuclear source, design housing, design attachment
4. None
5. None
6. Design housing
7. Bottom survey, soil exploration, site selection, develop implacement procedures

PIERS, WHARVES

Concept 1 - Open structure

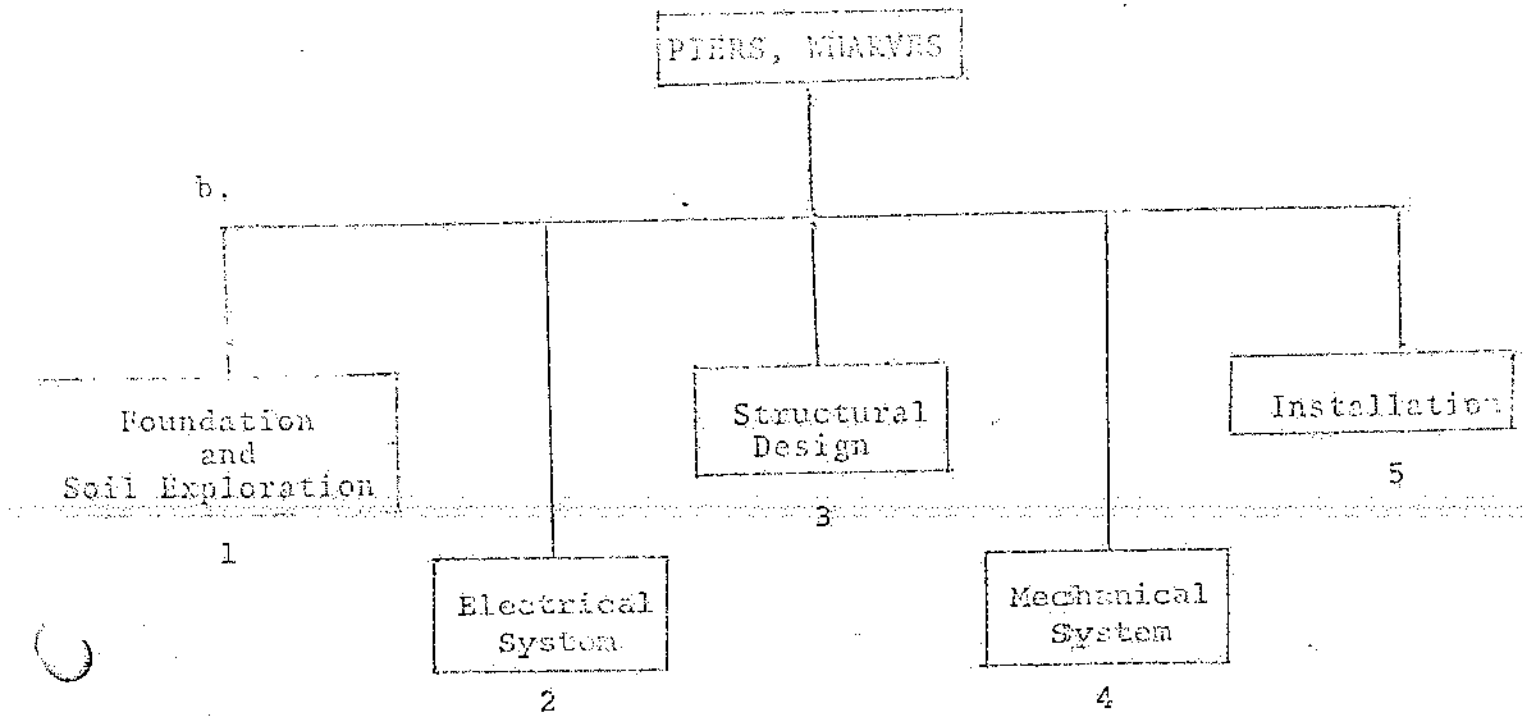
a.



Timber, Concrete or Steel Construction on Caissons.

Timber, Concrete or Steel Construction on piles.

b.



PIERS, MIARVES

Concept 1 - Open Structure

c. Identification of SEAFIC Functions and Tasks

1. Excavation, core samples
2. Install
3. None
4. Install
5. Install

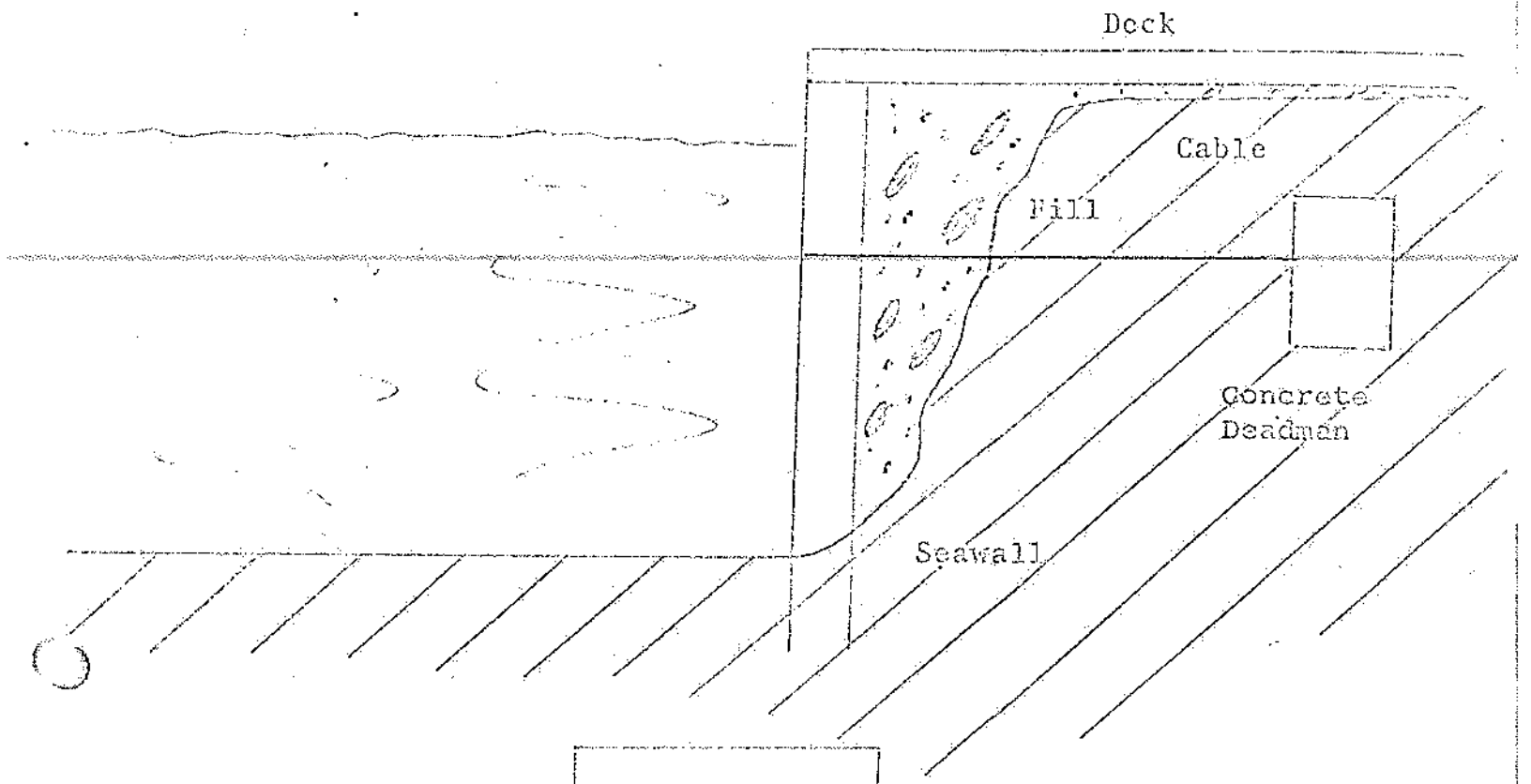
d. Identification of other NAVFAC responsibilities

1. Site selection, bottom survey, analyze cores
2. Design, contract, maintain and inspect
3. Design, contract, maintain and inspect
4. Develop installation procedures
5. Design, contract, maintain and inspect

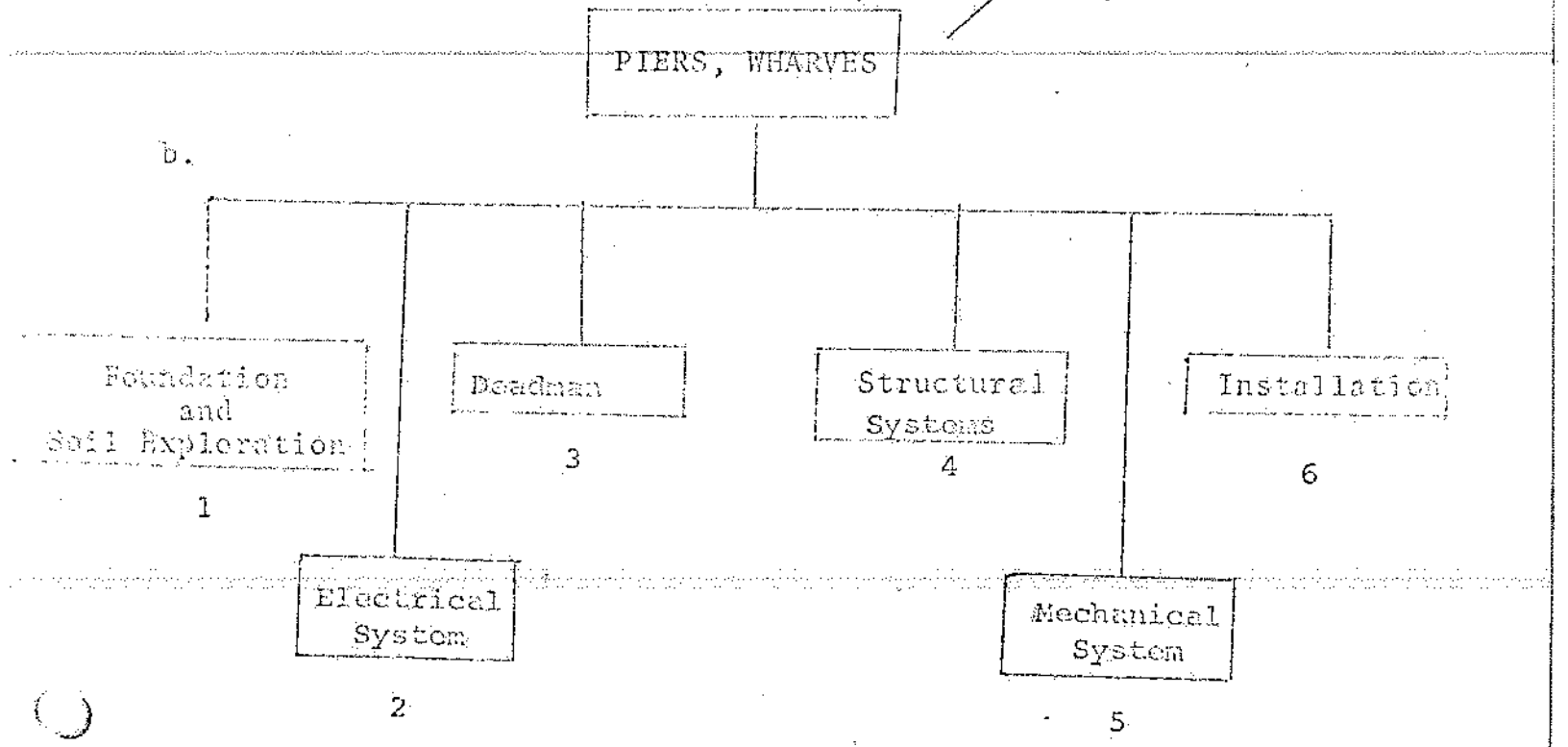
PIERS, WHARVES

Concept 2 - Solid Construction

a.



b.



Concept 2 - Solid Construction

c. Identification of SHORE Functions and Tasks

1. Excavation, fill, and core samples
2. Install, maintain, inspect
3. Install
4. Install, maintain, inspect
5. Perform installation
6. Install, maintain, inspect

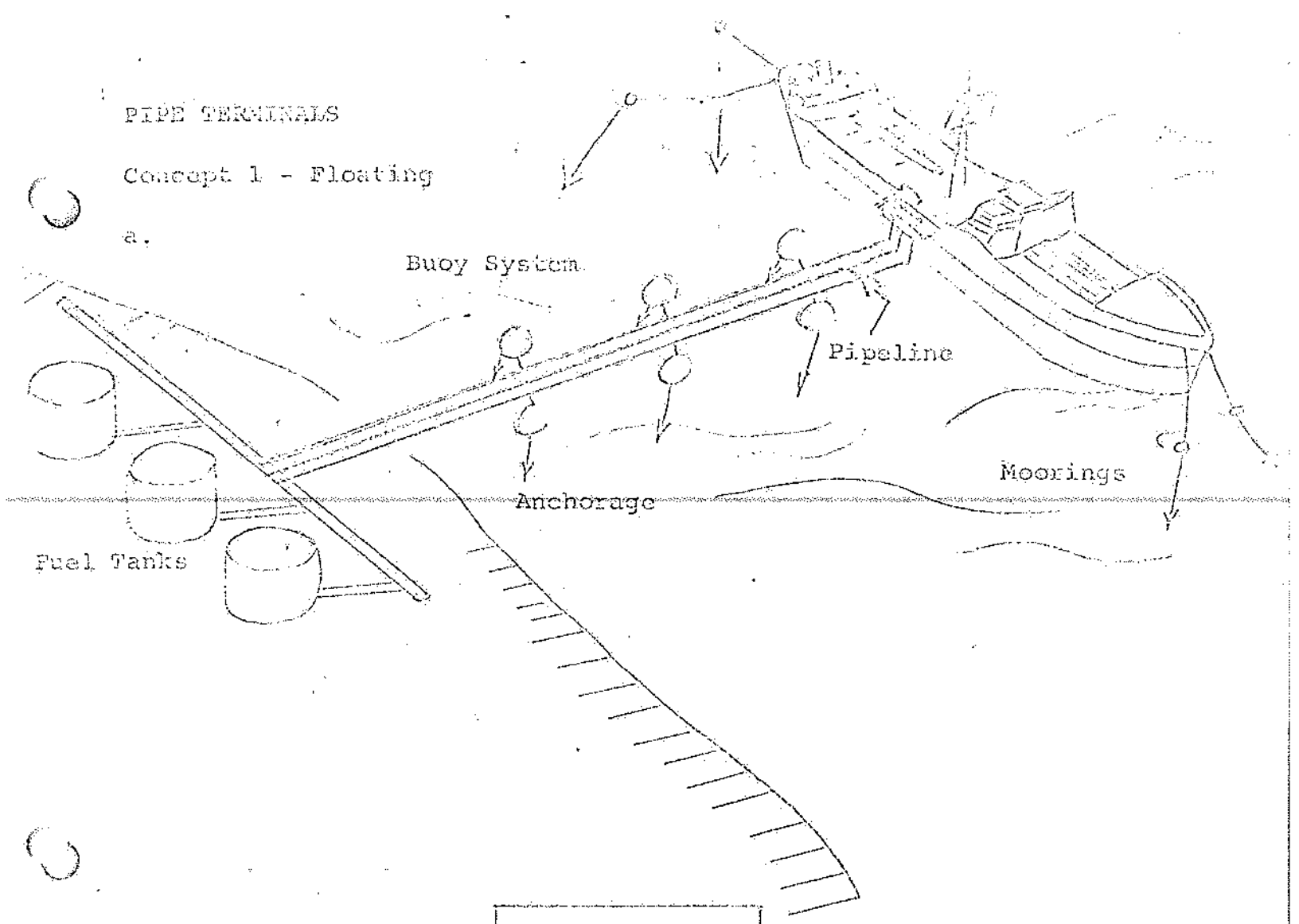
d. Identification of other NAVFAC responsibilities

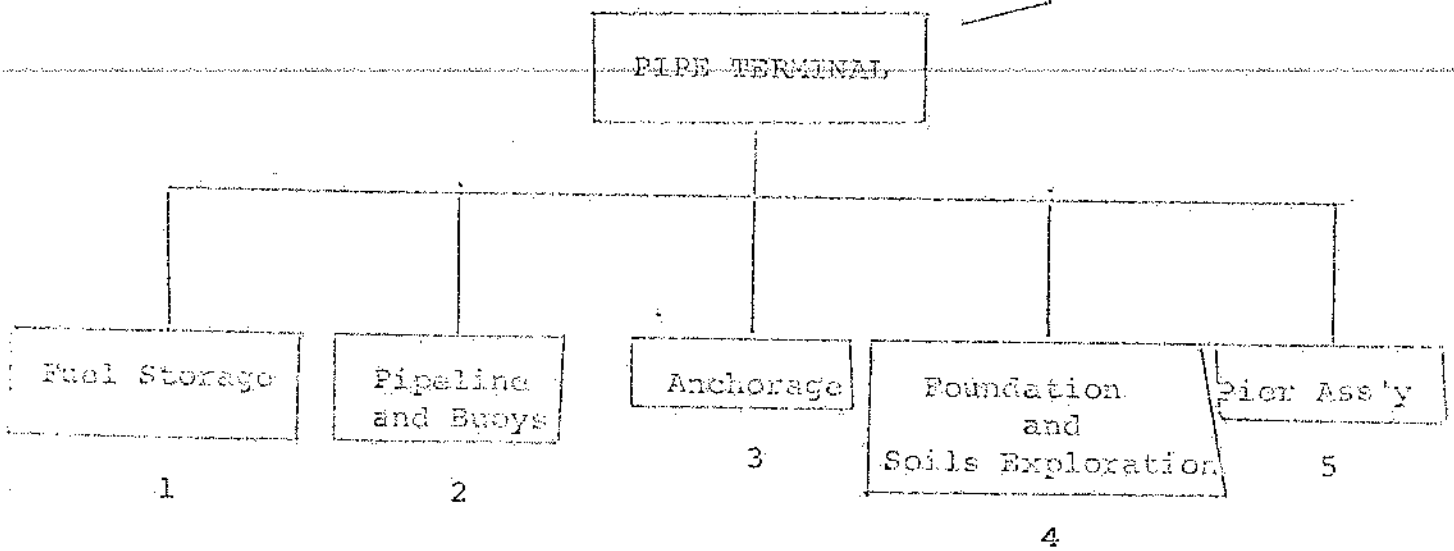
1. Site selection, bottom survey, and analyze cores
2. Design, contract, maintain and inspect
3. Design, contract, maintain and inspect
4. Design, contract, maintain and inspect
5. Develop construction procedures
6. Design, contract, maintain and inspect

PIPE TERMINALS

Concept 1 - Floating

a.





PIPE TERMINALS

Concept 1 - Floating

c. Identification of SEABEE Functions and Tasks

1. Erect storage tanks and install

2. Install buoys

3. Install and inspect

4. Core samples, perform earthwork

5. Assemble pier assembly and make all connections.

d. Identification of other NAVFAC responsibilities

1. Design, contract, maintain, and inspect

2. Design, contract, maintain, and inspect

3. Design, contract, maintain, and inspect

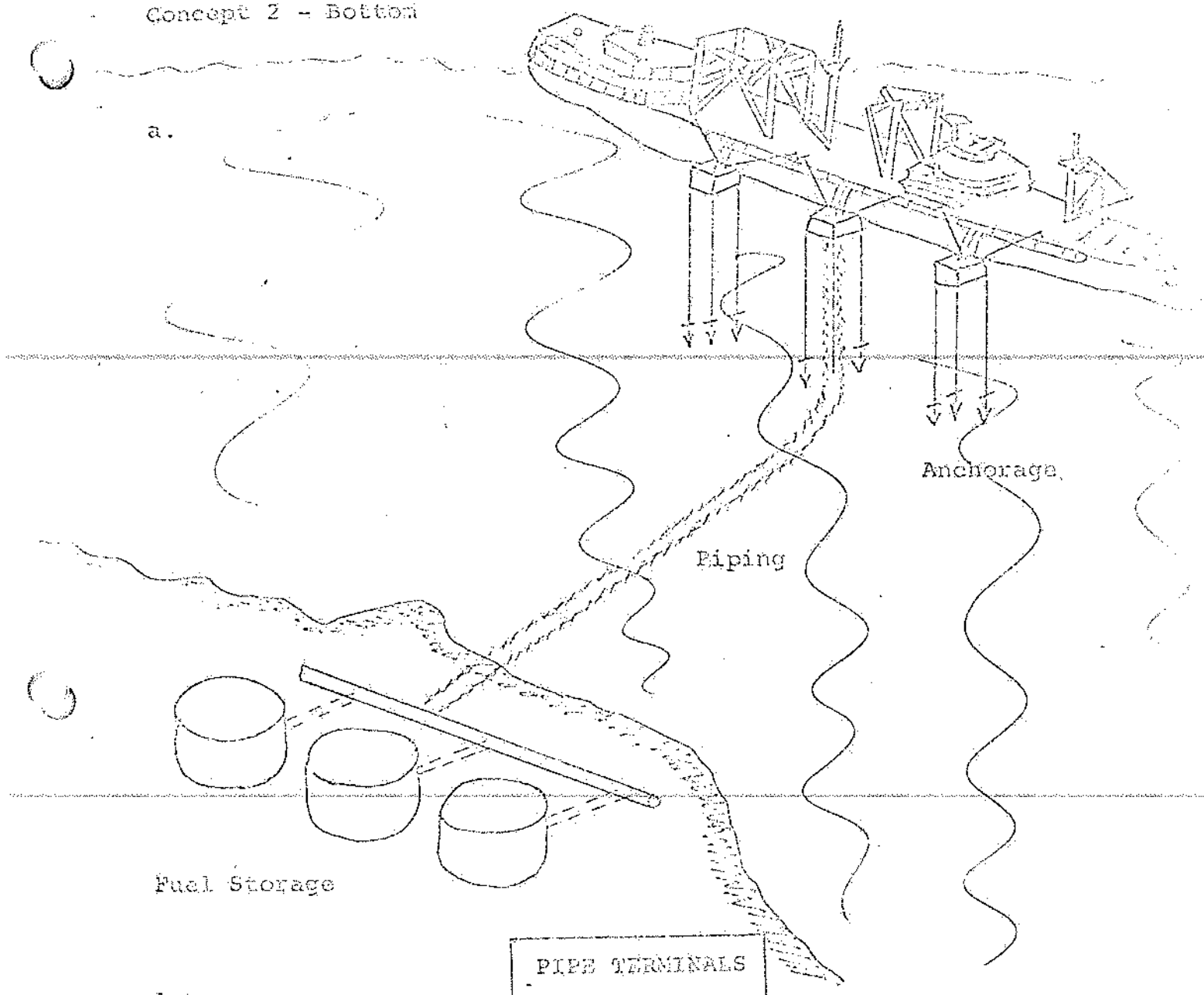
4. Core analysis, site survey

5. Design, contract, maintain and inspect

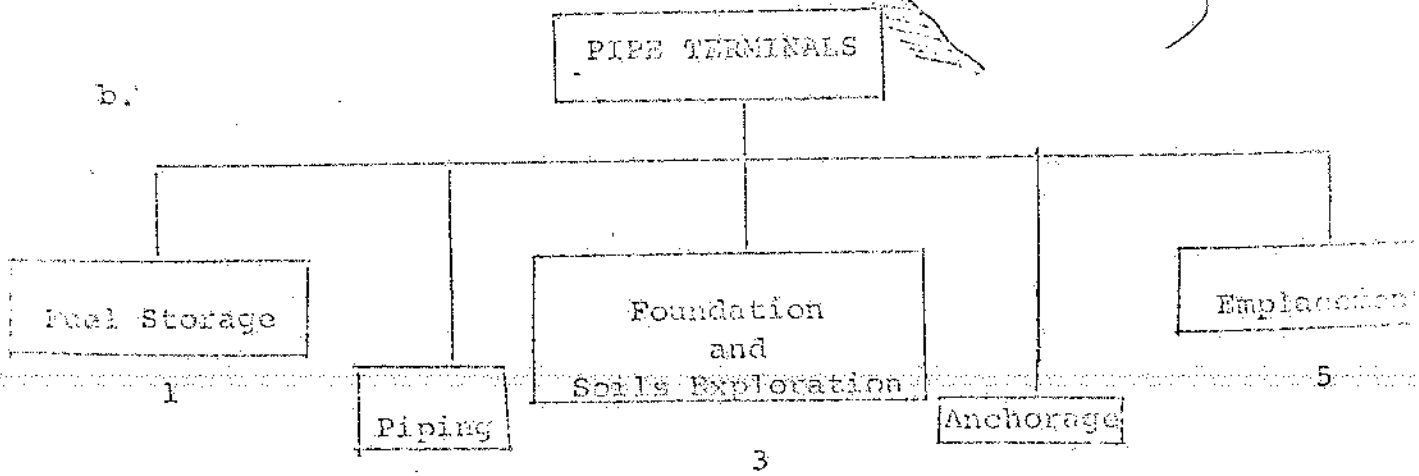
PIPE TERMINALS

Concept 2 - Bottom

a.



b.



PIPE TERMINALS

Concept 2 - Bottom

c. Identification of SEABEE Functions and Tasks

1. Emplace

2. Emplace

3. Core samples, excavation

4. emplace and inspect

5. Cut, lay piping, back-full, perform earthwork, erect storage tasks, assemble pair assemblies and make all connections.

d. Identification of other NAVFAC responsibilities

1. Design

2. Design

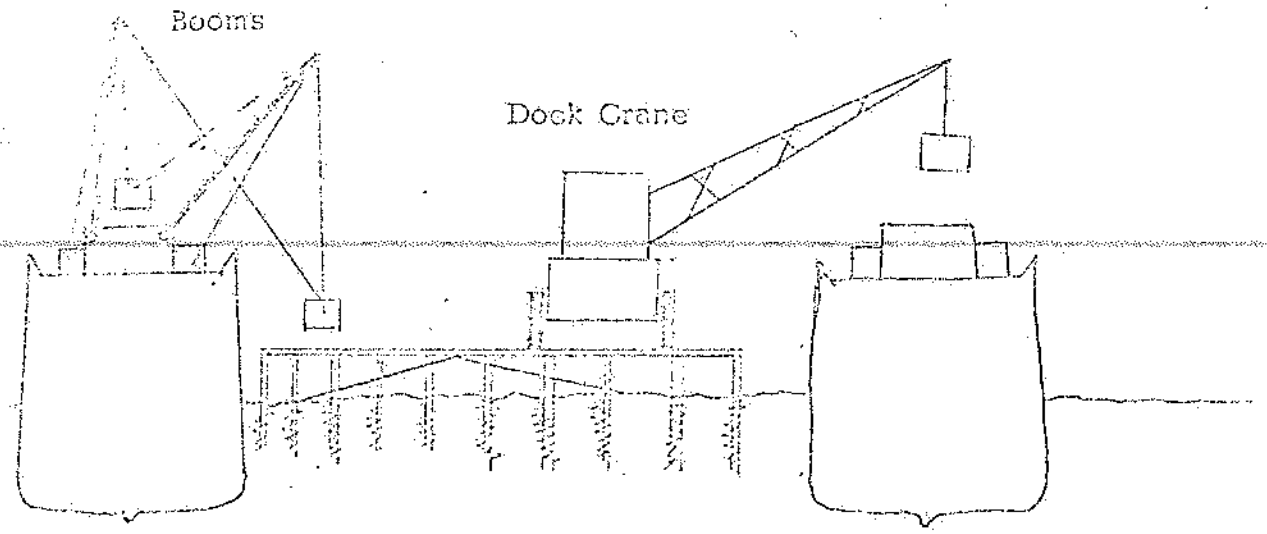
3. Core analysis

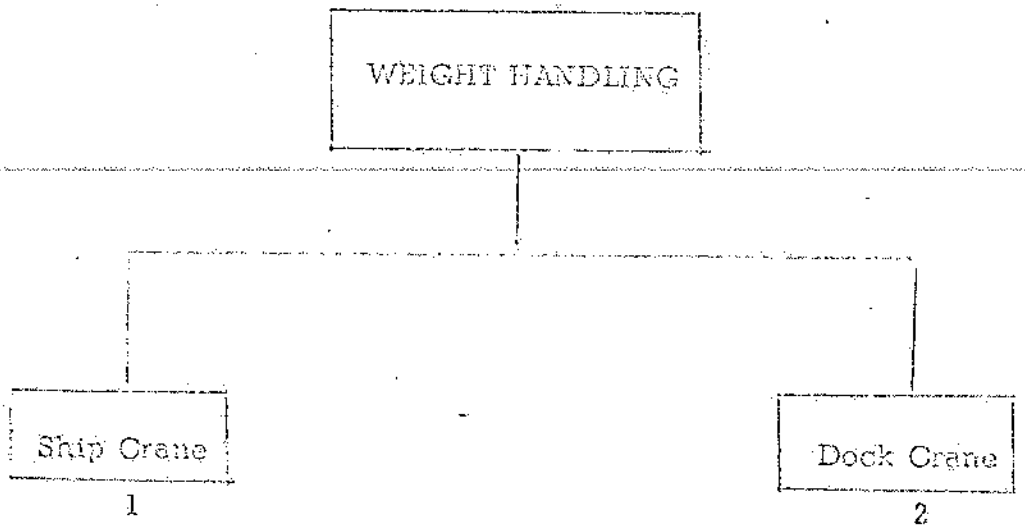
4. Design

5. Design

WEIGHT HANDLING

Concept 1 - Crane Operations





WEIGHT HANDLING

Concept 1 - Crane Operations

c. Identification of SEABEE Functions and Tasks

1. Operate cranes

2. Operate cranes

d. Identification of other NAVFAC responsibilities

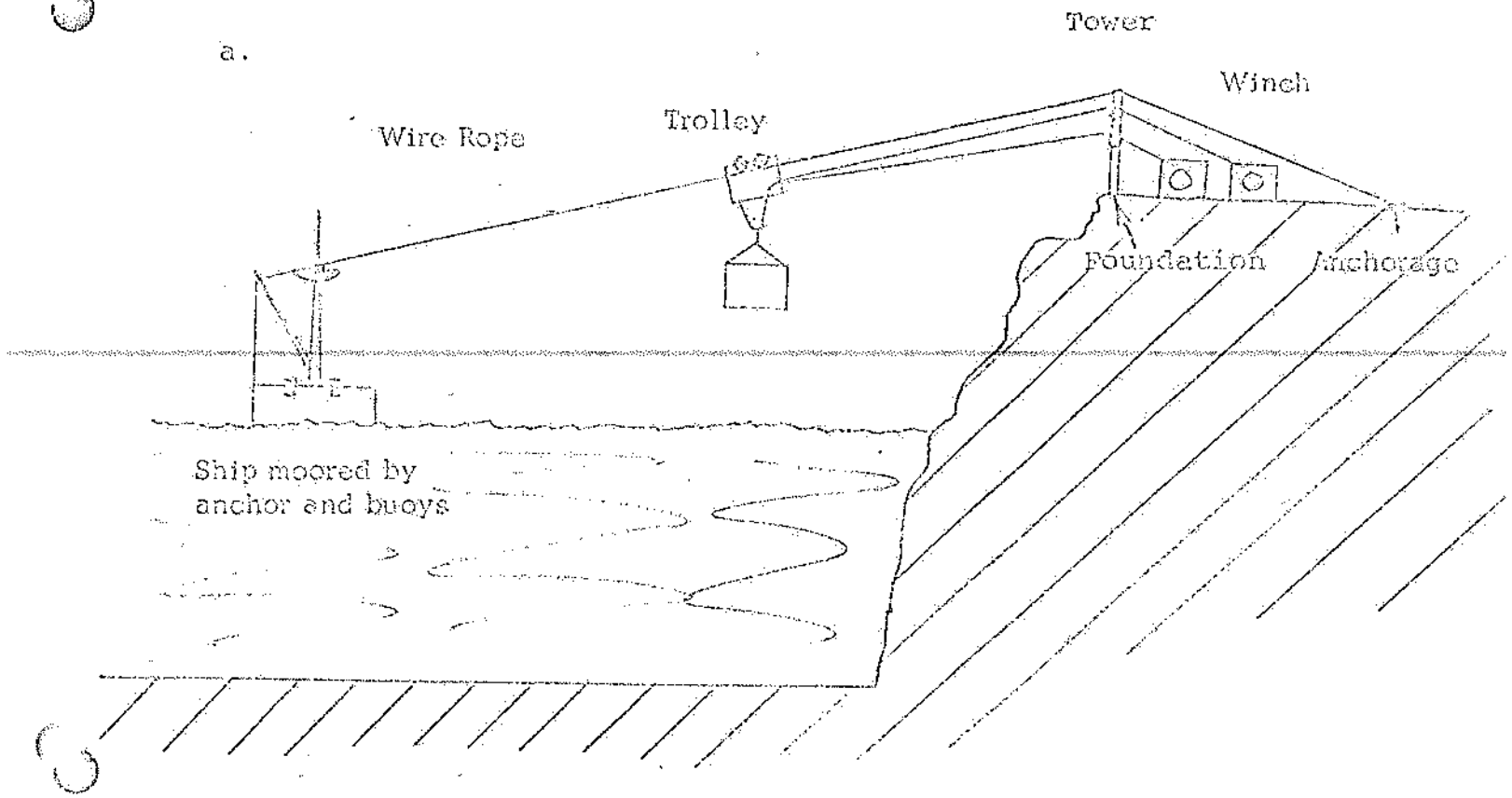
1. Design special crane capabilities for barges, lighters, etc.

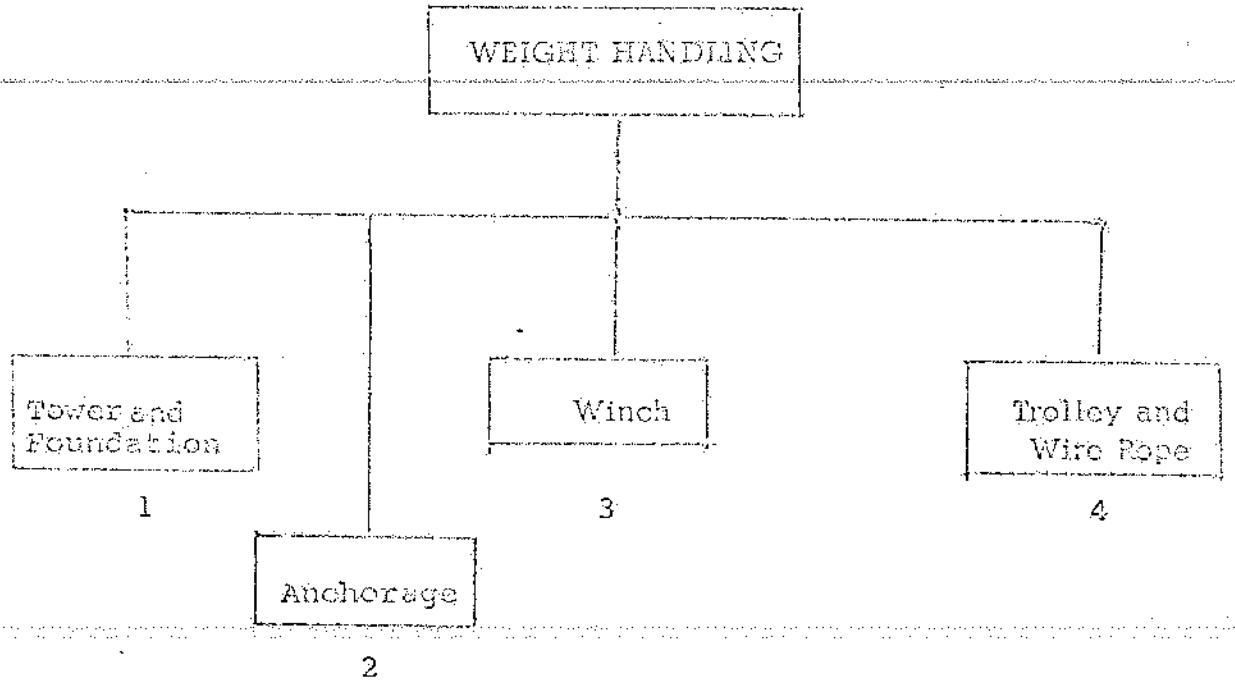
2. Contract for cranes

WEIGHT HANDLING

Concept 2 - Aerial Ropeway

a.





WEIGHT HANDLING

Concept 2 - Aerial Ropeway

c. Identification of SEABEE Functions and Tasks

1. Prefabricate and construct
2. Install
3. Operate, maintain, and inspect
4. Install, maintain and inspect

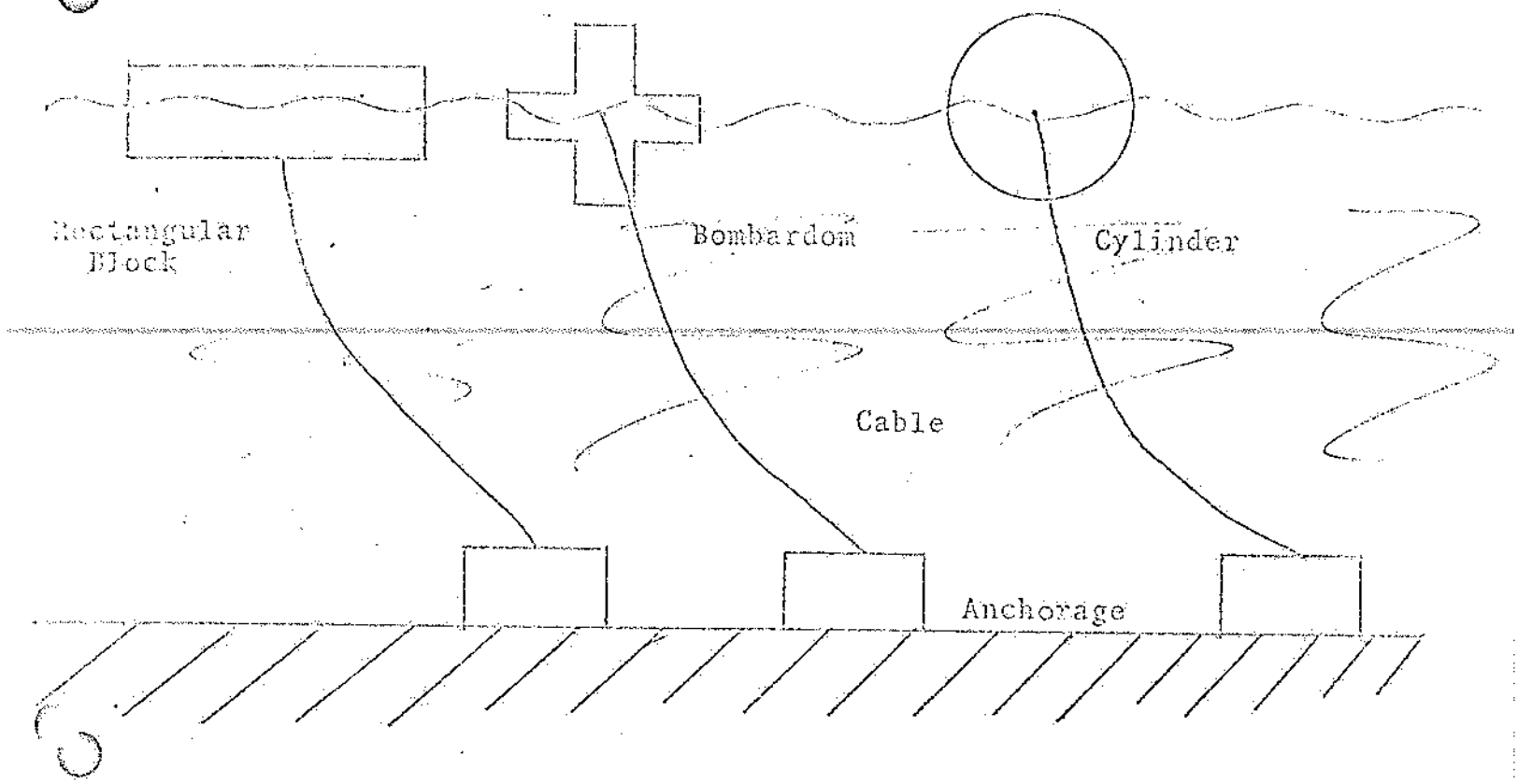
d. Identification of other NAVFAC responsibilities

1. Design, contract, maintain and inspect
2. Design
3. Design, contract, maintain and inspect
4. Design, contract, maintain and inspect

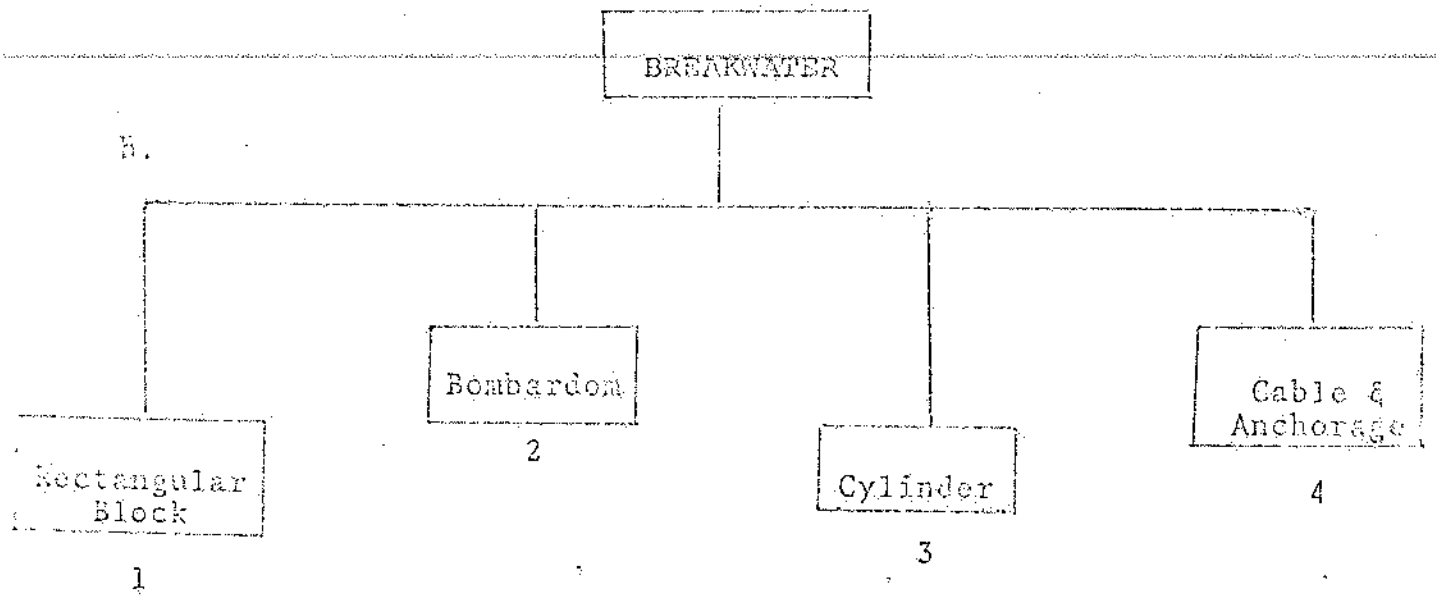
BREAKWATERS

Concept 1 - Floating

a.



b.



Concept 1 - Floating

c. Identification of SEABEE Functions and Tasks

1. Install
2. Install
3. Install
4. Install

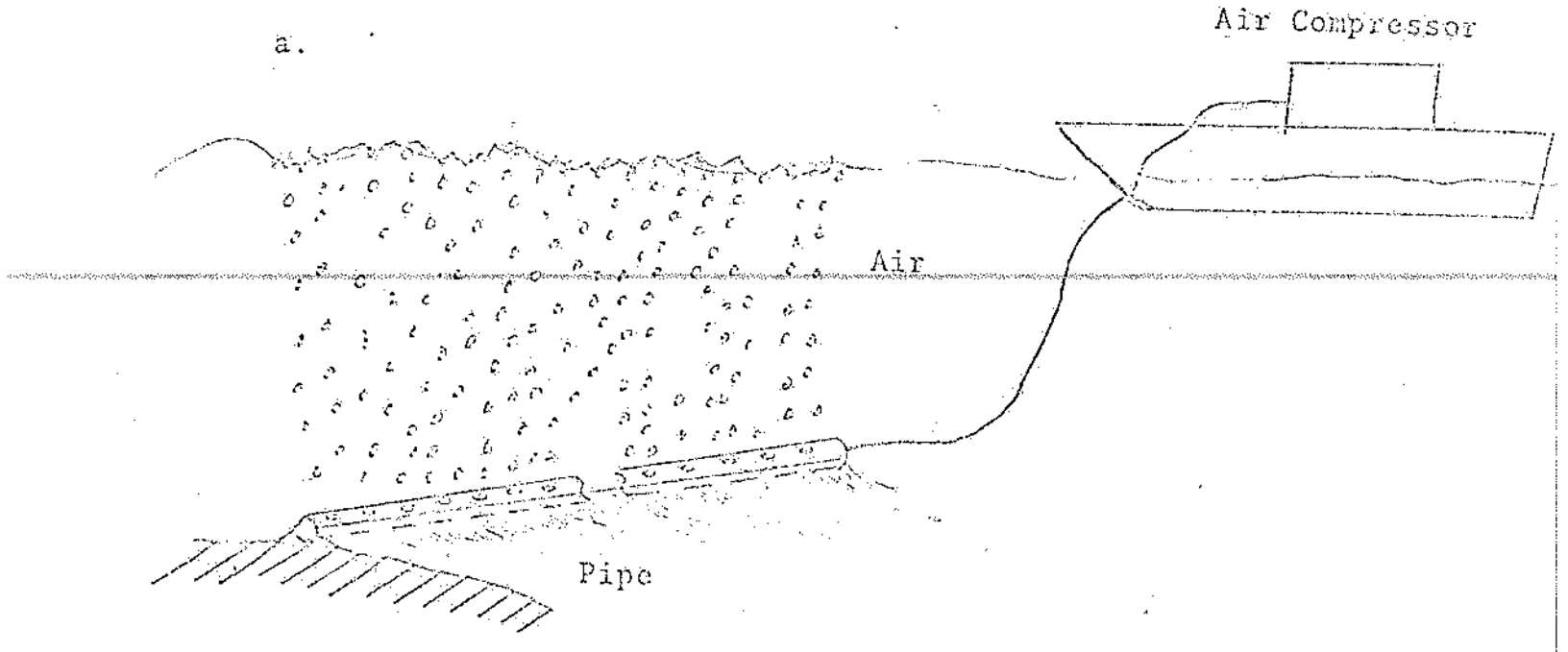
d. Identification of other NAVFAC responsibilities

1. Design, contract, maintain and inspect
2. Design, contract, maintain and inspect
3. Design, contract, maintain and inspect
4. Design, contract, maintain and inspect

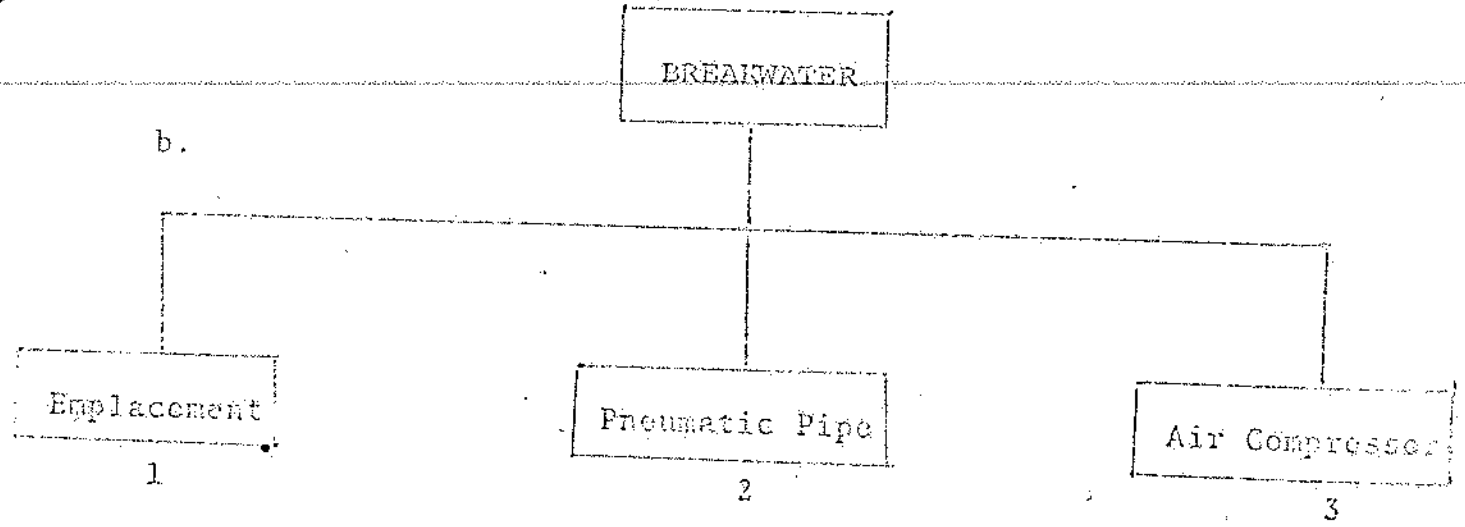
BREAKWATERS

Concept 2 - Pneumatic

a.



b.



Concept 2 - Pneumatic

c. Identification of SEABEE Functions and Tasks

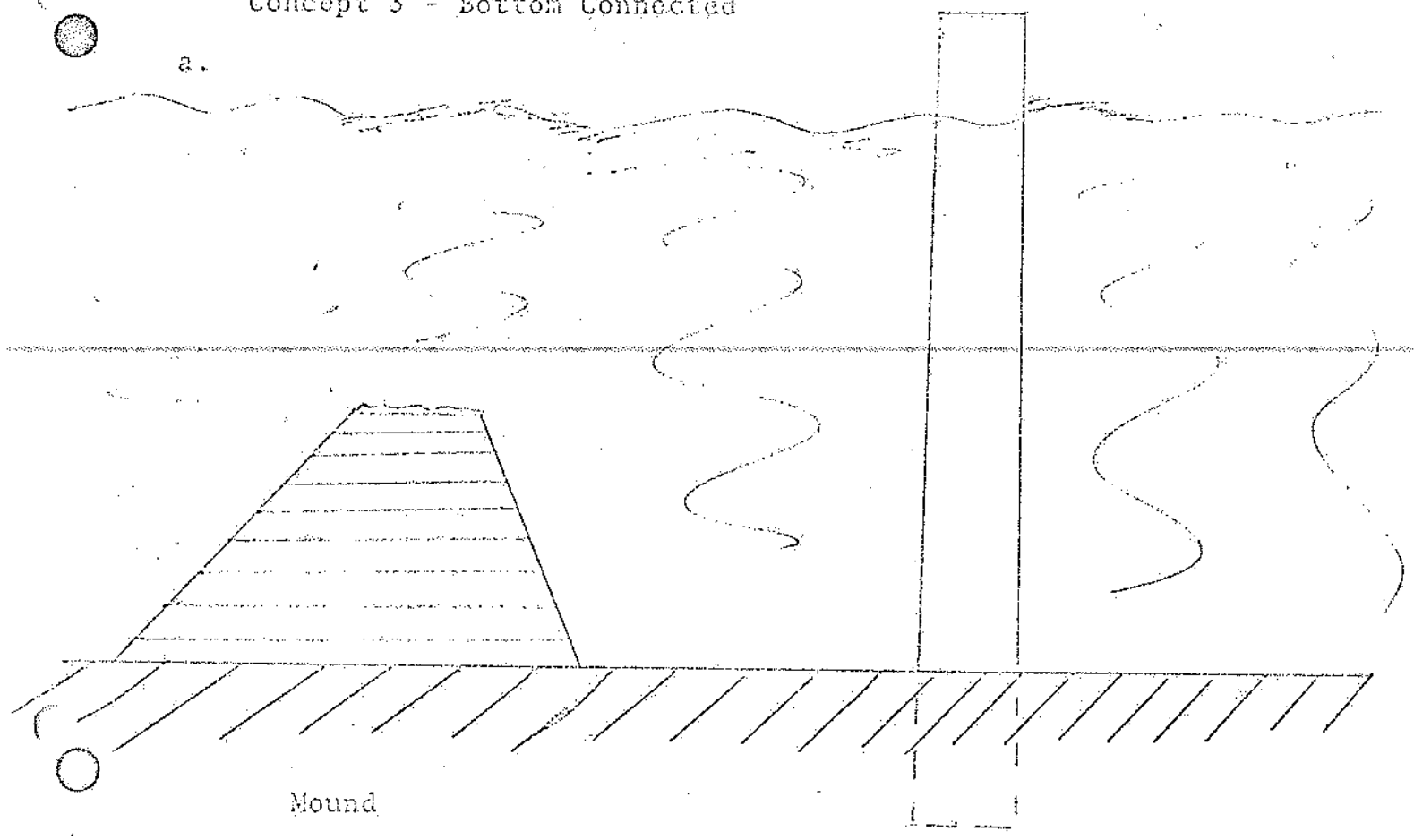
1. Perform emplacement, obtain soil cores
2. Make connections, provide cathodic protection
3. Operate air compressor form barge (land-optional)

d. Identification of other NAVFAC responsibilities

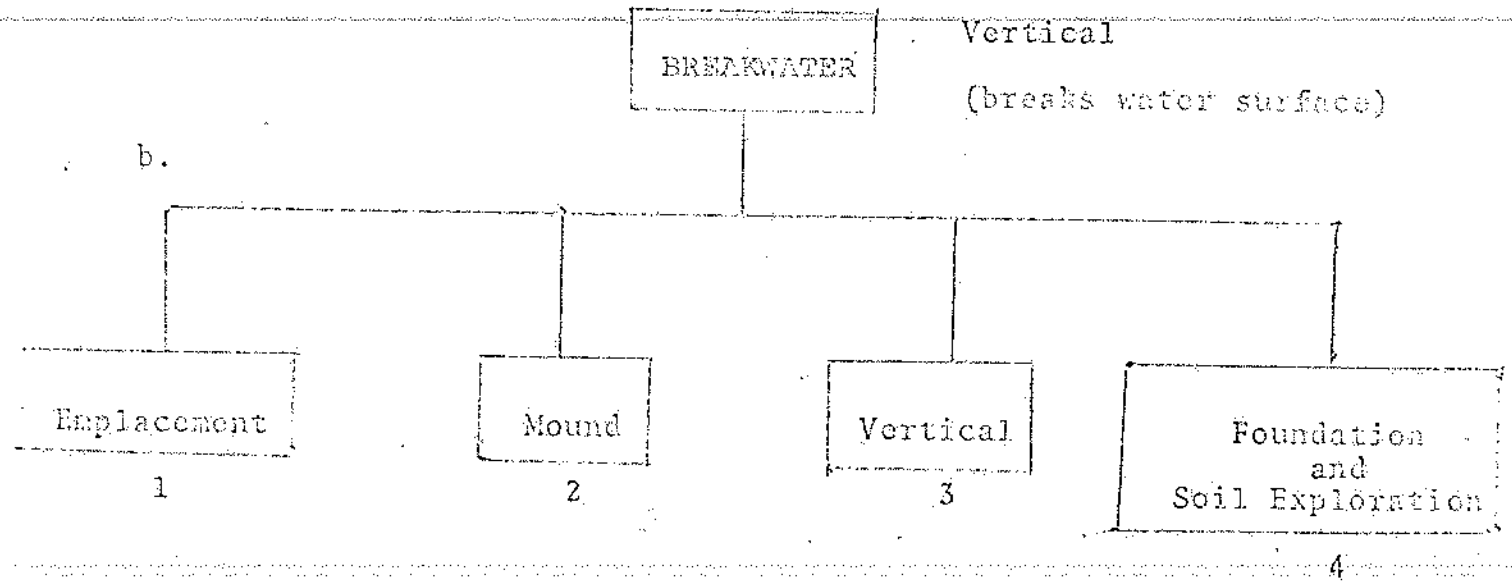
1. Bottom survey, site selection
2. Analyze core samples
3. Design, contract, maintain and inspect
4. Contract for barge

Concept 3 - Bottom Connected

a.



b.



Concept 3 - Bottom Connected

c. Identification of SEAPER Functions and Tasks

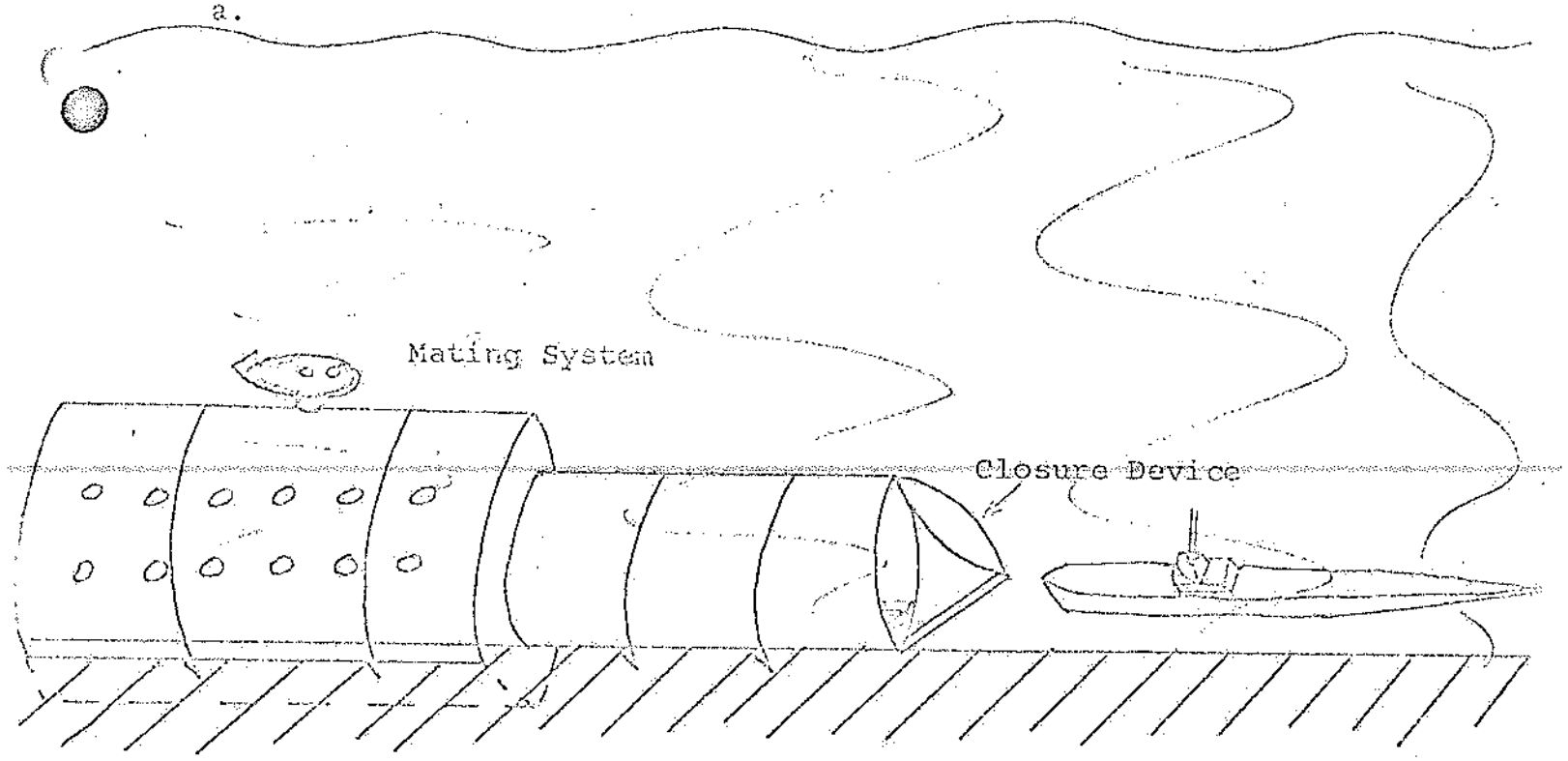
1. Perform emplacement
2. Operate lifting equipment, barge operations
3. pile driving, excavation
4. Obtain core samples, site preparation

d. Identification of other NAVFAC responsibilities

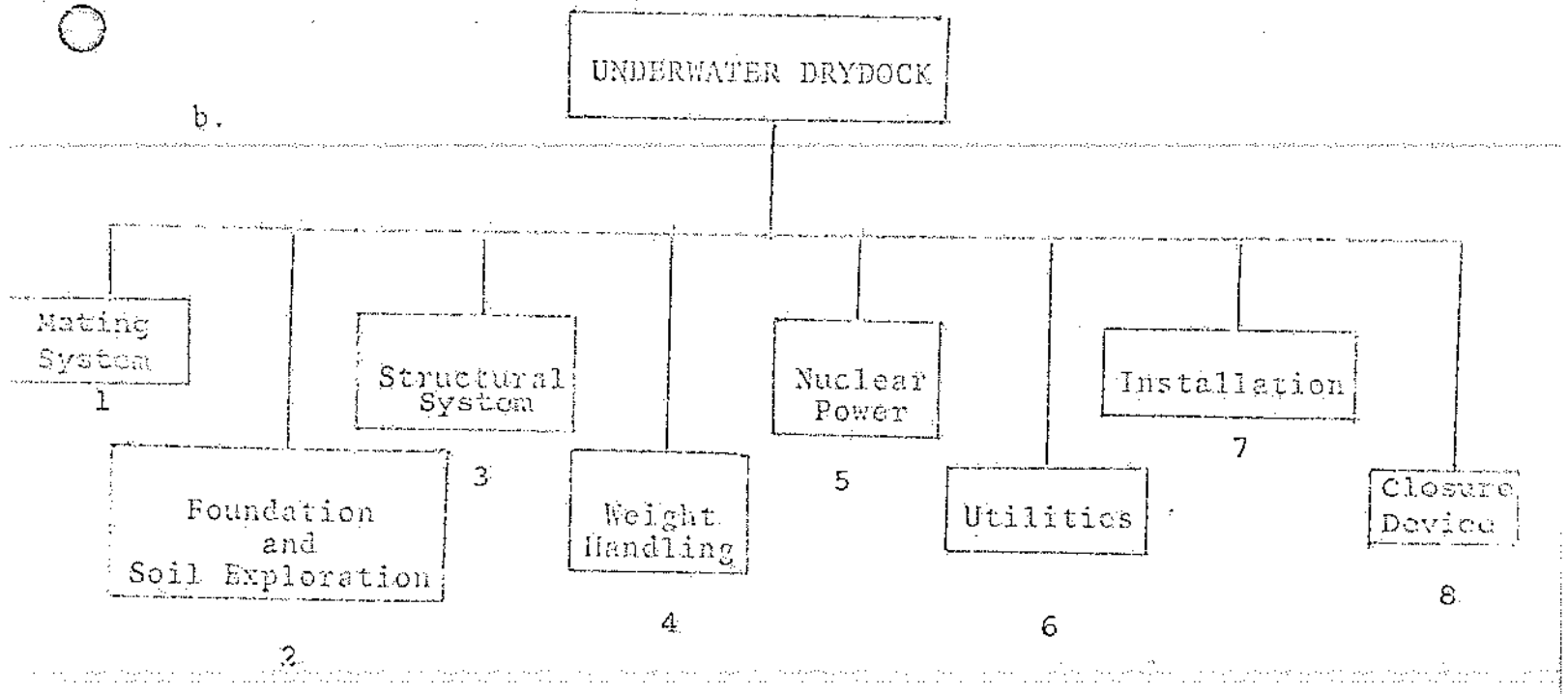
1. Develop emplacement procedures
2. Design, contract lifting equipment
3. Design, contract, maintain and inspect
4. Analyze core samples, site selection, bottom survey.

UNDERWATER DRYDOCK

a.



b.



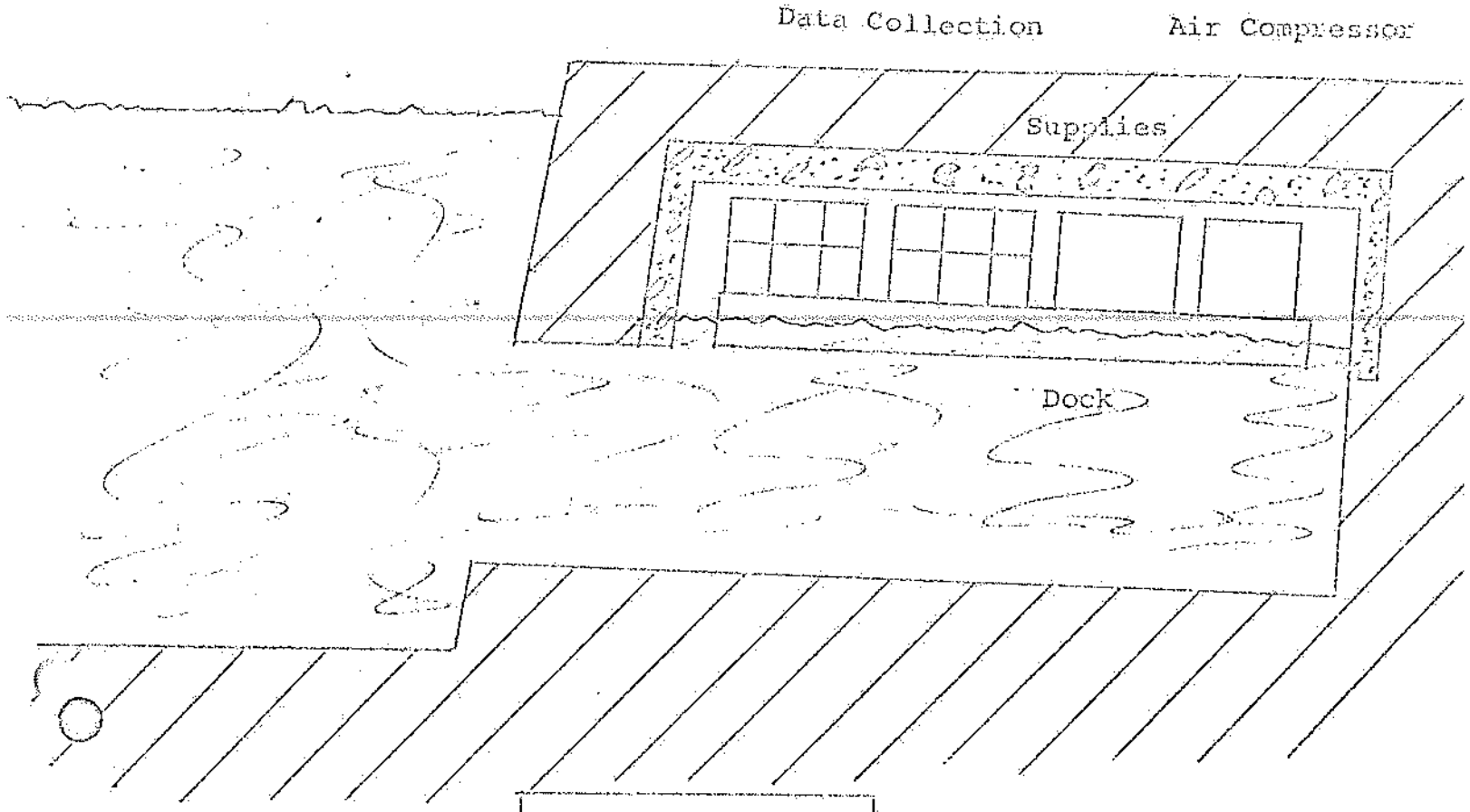
c. Identification of NEEDS Functions and Tasks

1. None
2. Soil cores, placement
3. None
4. Perform handling
5. None
6. Install
7. Install
8. None

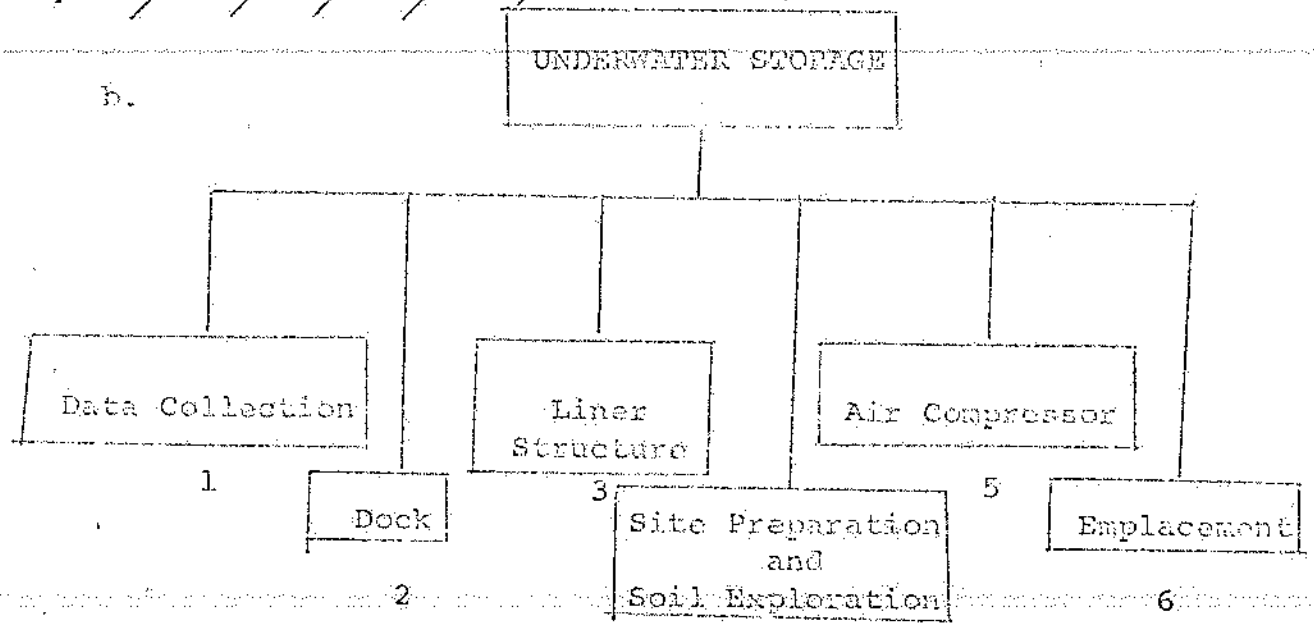
d. Identification of other NAVFAC responsibilities

1. Provide design criteria.
2. Site selection, bottom survey
3. Analyze soil cores - design foundations
4. Design and contract
5. Prepare specifications and contract for weight handling equipment
6. Design
7. Design
8. None

a.


Data Collection
Air Compressor
Supplies
Dock

b.


UNDERWATER STORAGE
Data Collection
1
Dock
2
Liner Structure
3
Site Preparation and Soil Exploration
4
Air Compressor
5
Emplacement
6

c. Identification of SEABEE Functions and Tasks

1. None

2. Install

3. Install

4. Core samples, excavation, drilling

5. Make connections, perform emplacement

d. Identification of other NAVFAC responsibilities

1. Design

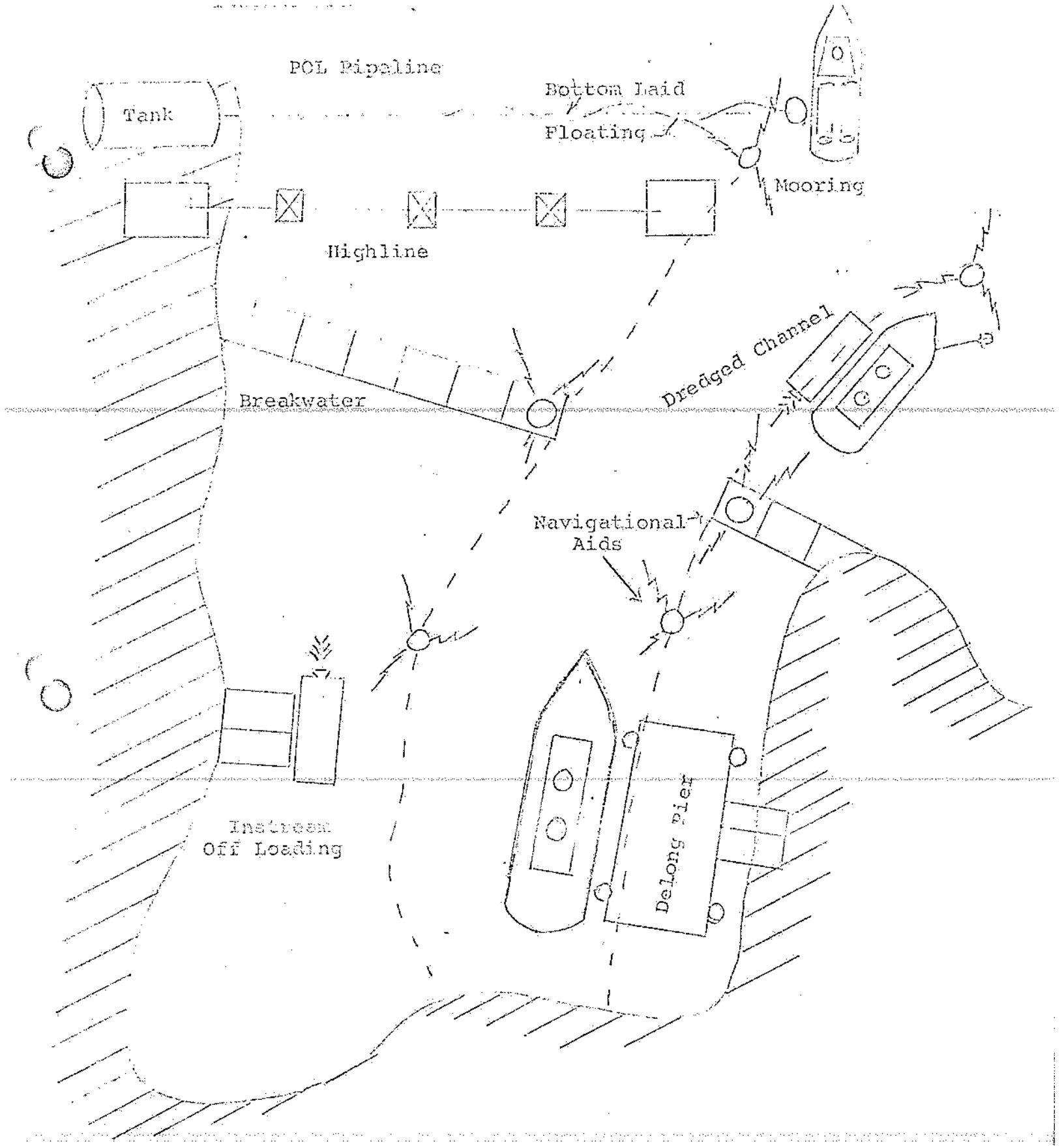
2. Design

3. Design

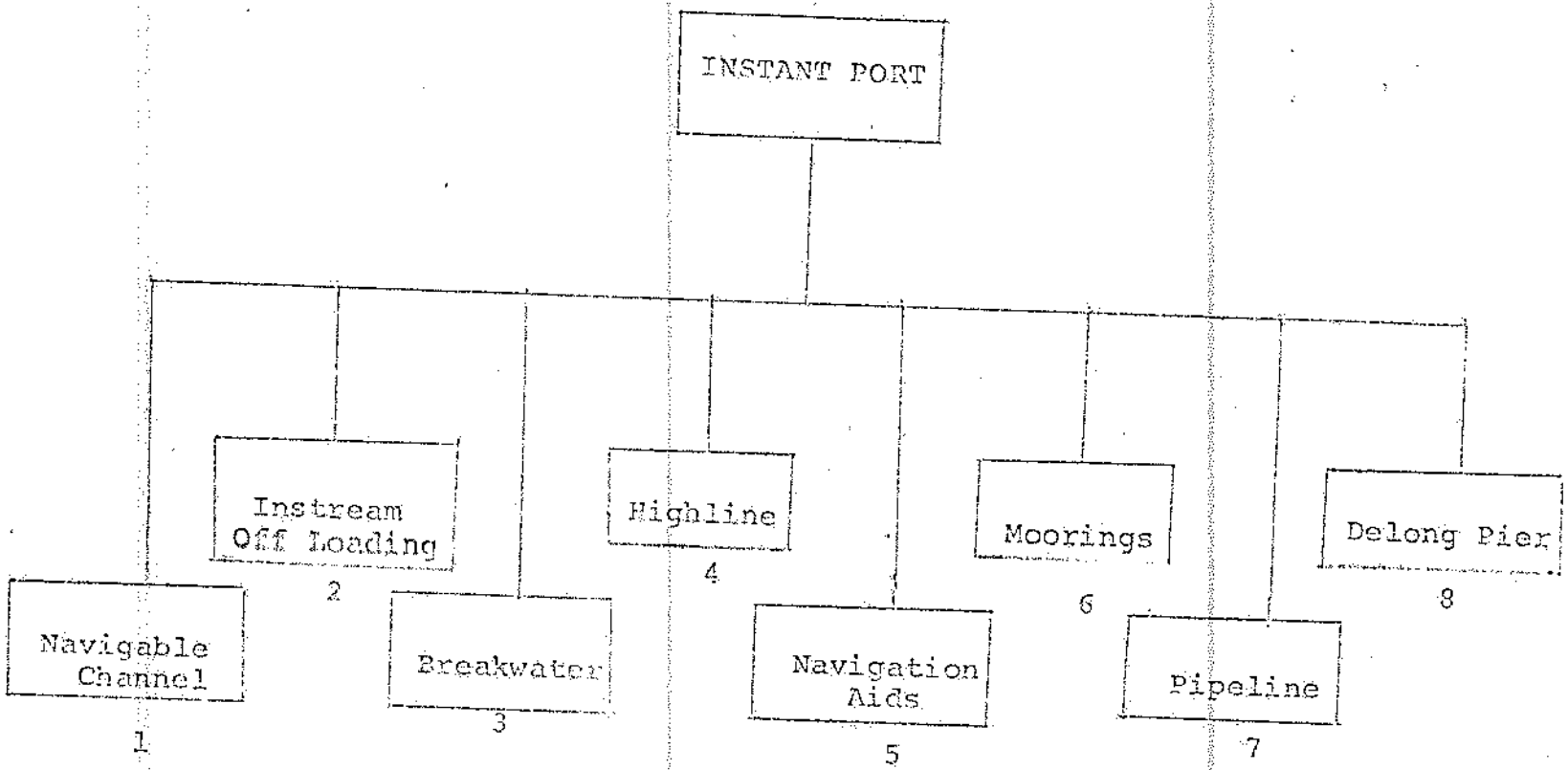
4. Core analysis, design

5. Design

6. Develop emplacement procedures



INSTANT PORT


INSTANT PORT
Navigable Channel
1
Instream Off Loading
2
Breakwater
3
Highline
4
Navigation Aids
5
Moorings
6
Pipeline
7
Delong Pier
8

INSTANT PORT

c. Identification of NAVFAC Functions and Tasks

1. Perform dredging
2. Barge operations (ship to shore) and offloading
3. Assembly and emplacement of AMMI DOCK
4. Construct offshore, onshore and intermediate support towers
5. Emplace channel buoys and install harbor entrance lights
6. Install

Floating

7. Install ship to shore system including tanker moorings

bottom layed

7a. Same as "7"

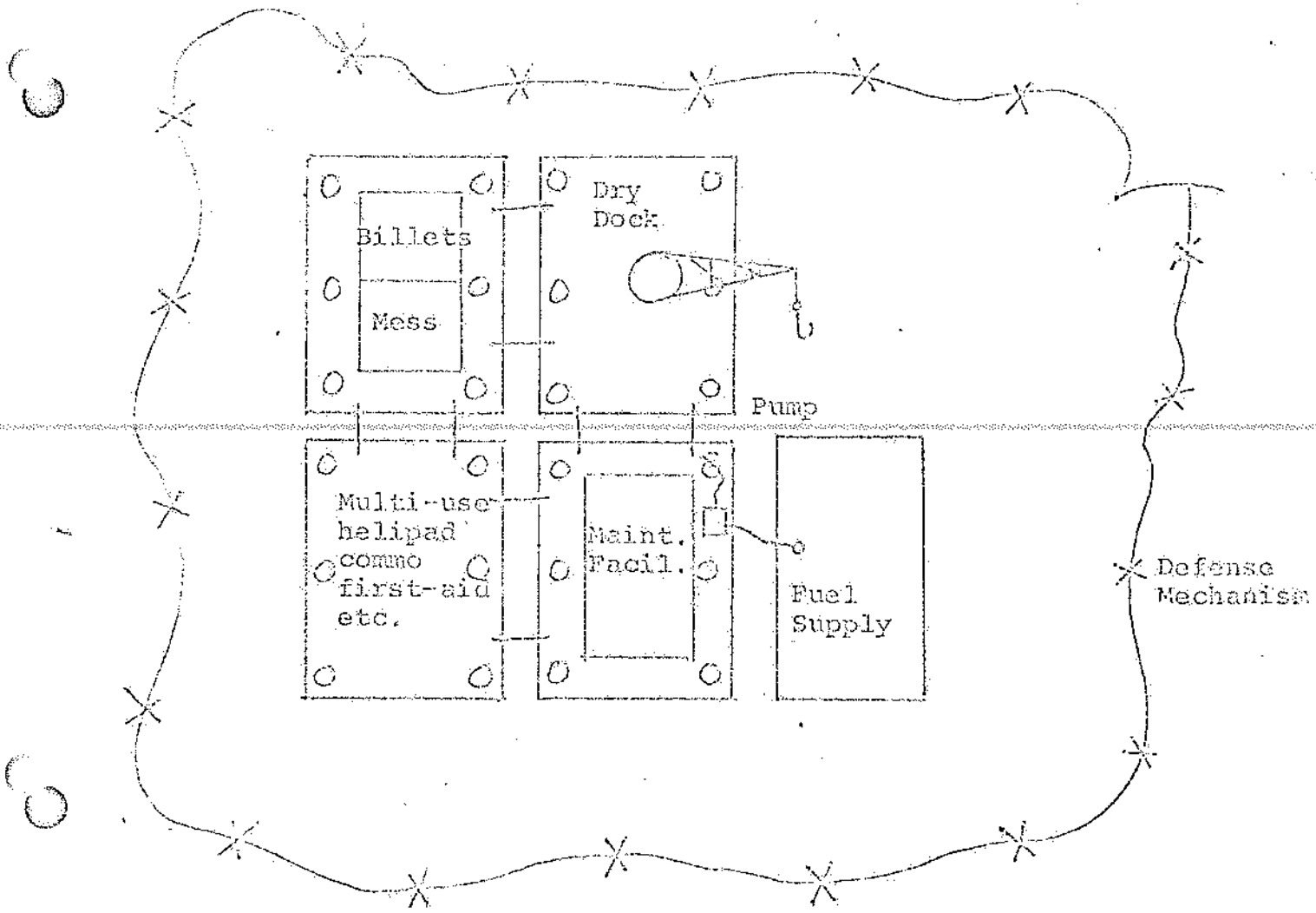
8. Position, assemble and erect Delong Pier and dock to shore approach

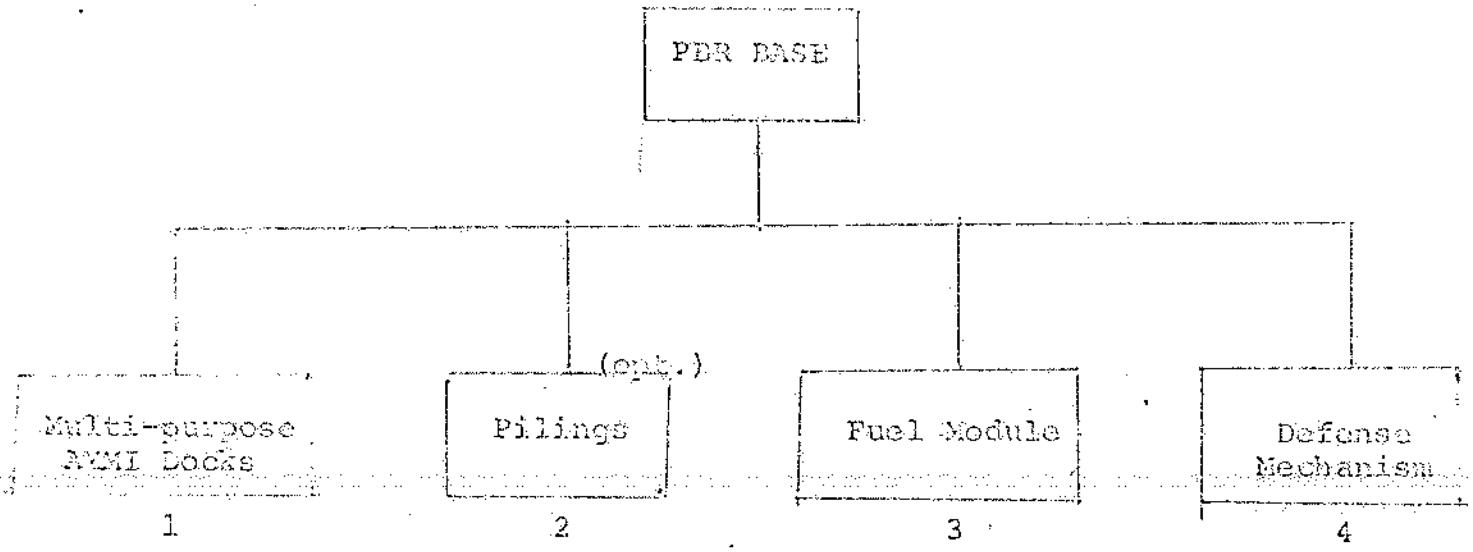
d. Identification of Other NAVFAC Responsibilities

1. Design high capacity dredging equipment
2. Design advanced base functional components
3. Improve AMMI DOCK Techniques
4. Design highline
5. None
6. None
7. Design "lightweight" system

7a. Same as "7"

8. None


Billets
Mess
Dry Dock
Pump
Multi-use helipad commo first-aid etc.
Maint. Facil.
Fuel Supply
Defense Mechanism


PDR BASE
Multi-purpose AVMI Docks
(opt.)
Pilings
Fuel Module
Defense Mechanism
1
2
3
4

c. Identification of SEABEE Functions and Tasks

1. Assemble and erect subassemblies of AMMI DOCKS according to need of total identity

2. Install pilings (if desired) divers are used to cut pilings if disassembly becomes necessary

3. Emplace fuel module and install pump for boat supply

4. Erect and install defensive mechanism

d. Identification of Other NAVFAC Responsibilities

1. Design functional AMMI DOCKS which have multi-use capabilities such as:

(a) billets

(b) mess hall

(c) dry dock with lifting apparatus

(d) maintenance facility

(e) communications

(f) first aid

(g) heli-pad

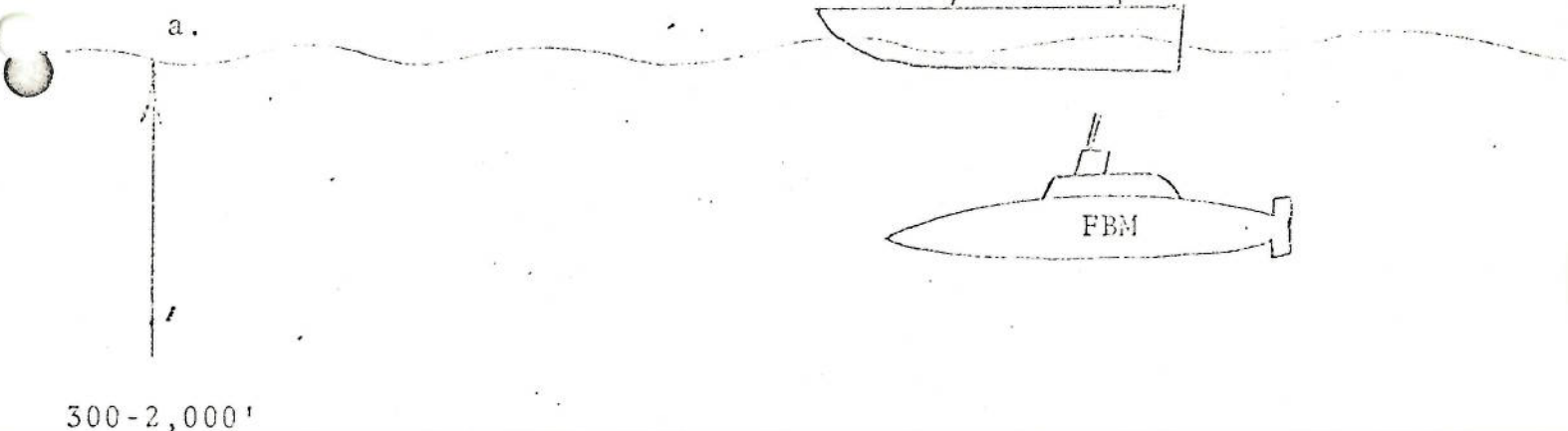
(h) etc.

2. None

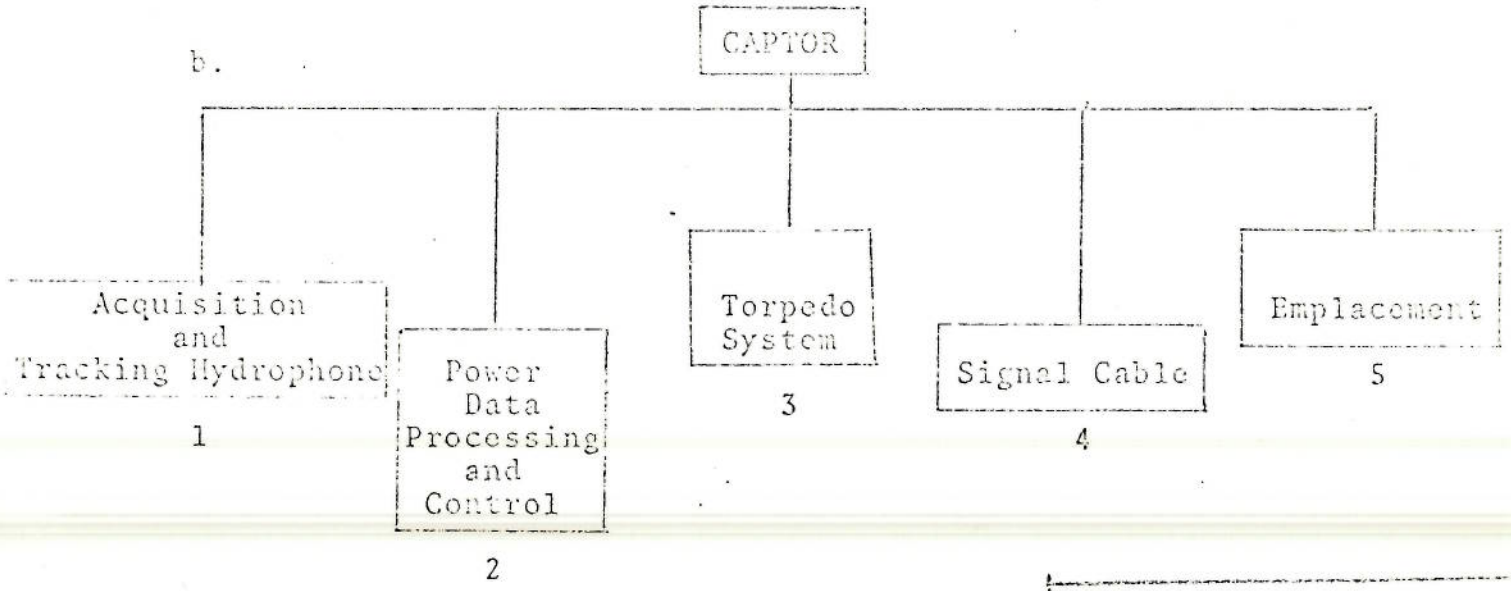
3. Design fuel module adaptable to AMMI DOCK system

4. Design defensive barrier

a.



b.



c. Identification of SEABEE Functions and Tasks

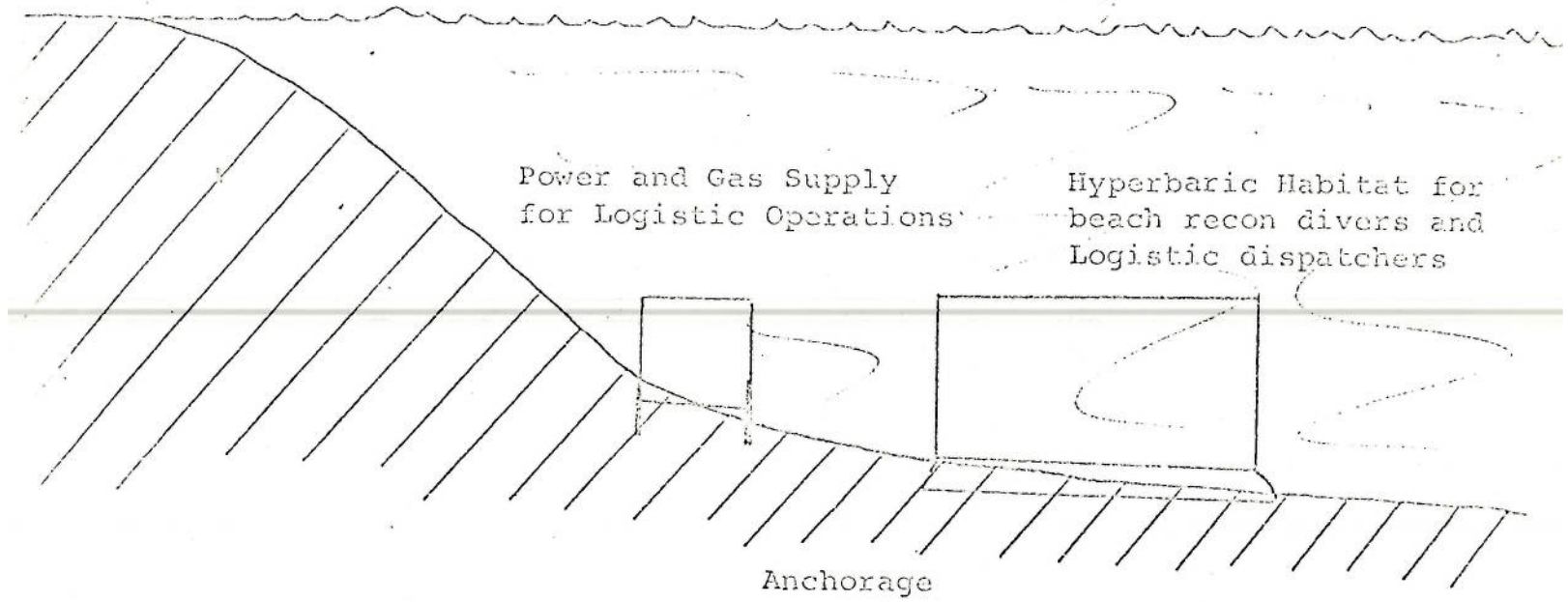
1. Install, perform site preparation and excavation
2. Install, perform site preparation and excavation
3. Install, perform site preparation and excavation
4. Make corrections
5. Perform emplacement, operate lifting equipment

d. Identification of other NAVFAC responsibilities

1. Perform liaison with NAVORD, develop excavation equipment
2. Perform liaison with NAVORD, develop excavation equipment
3. Perform liaison with NAVORD, develop excavation equipment
4. Perform liaison with NAVORD, develop excavation equipment
5. Prepare construction plan

RECON AND LOGISTICAL SUPPORT STATION

a.



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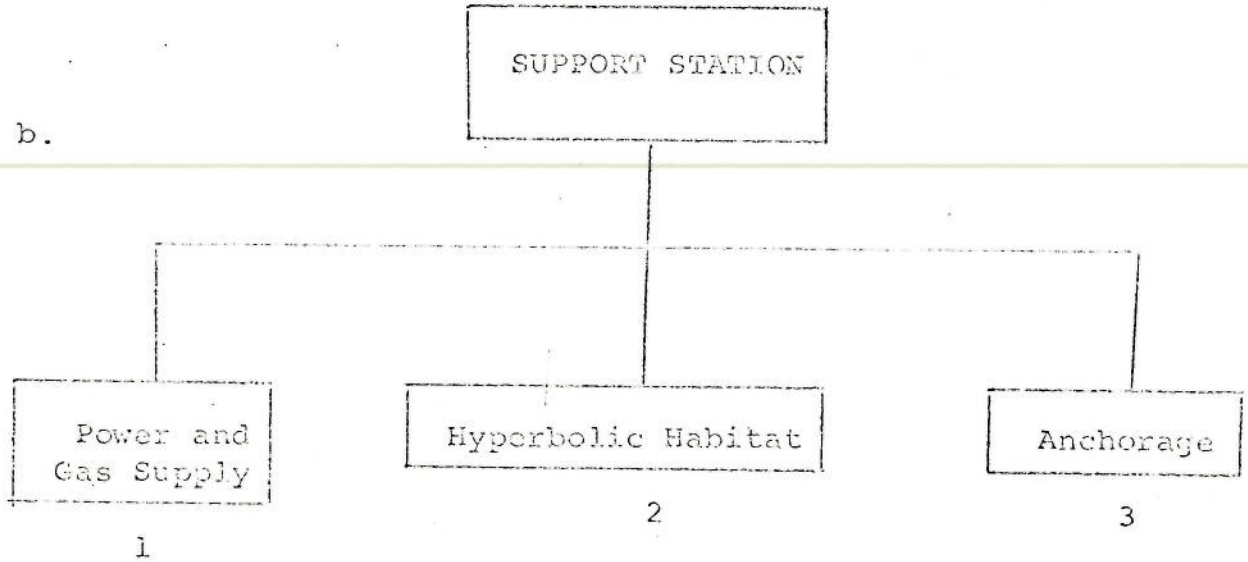


...information affecting the ... of the United States within ... of the Espionage Laws, title 18, ... 793 and 794, the transmission ... of which in any manner to an ... person is prohibited by law.

GROUP 3
Downgraded at 12-year intervals; not automatically declassified

Alef

c. Identification of SHARE Functions and Tasks

1. None

2. Provide logistic support

3. Install

d. Identification of other NAVFAC responsibilities

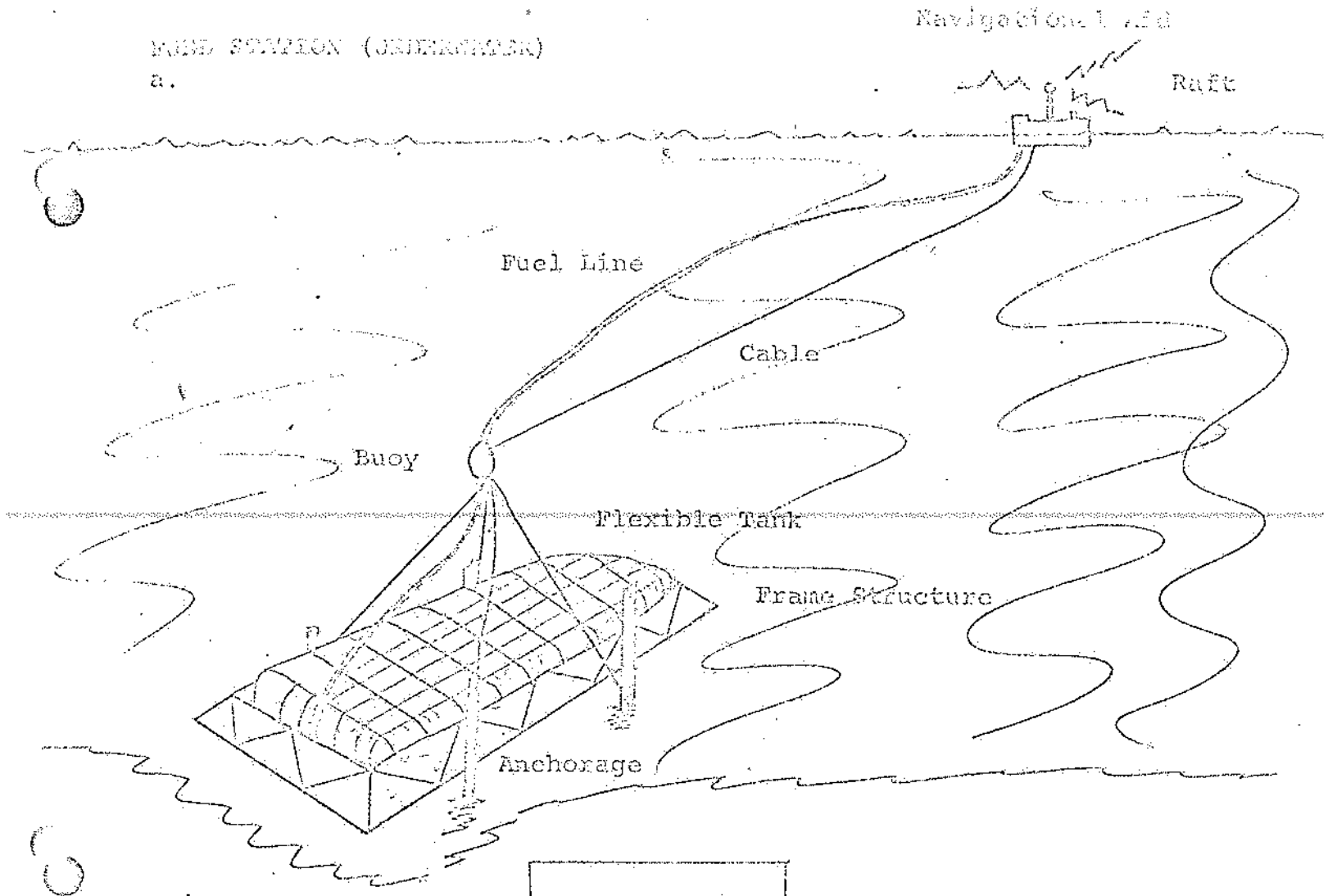
1. Design, and contract

2. Design , contract, maintain and inspect

3. Design

FUEL STATION (UNDERWATER)

a.



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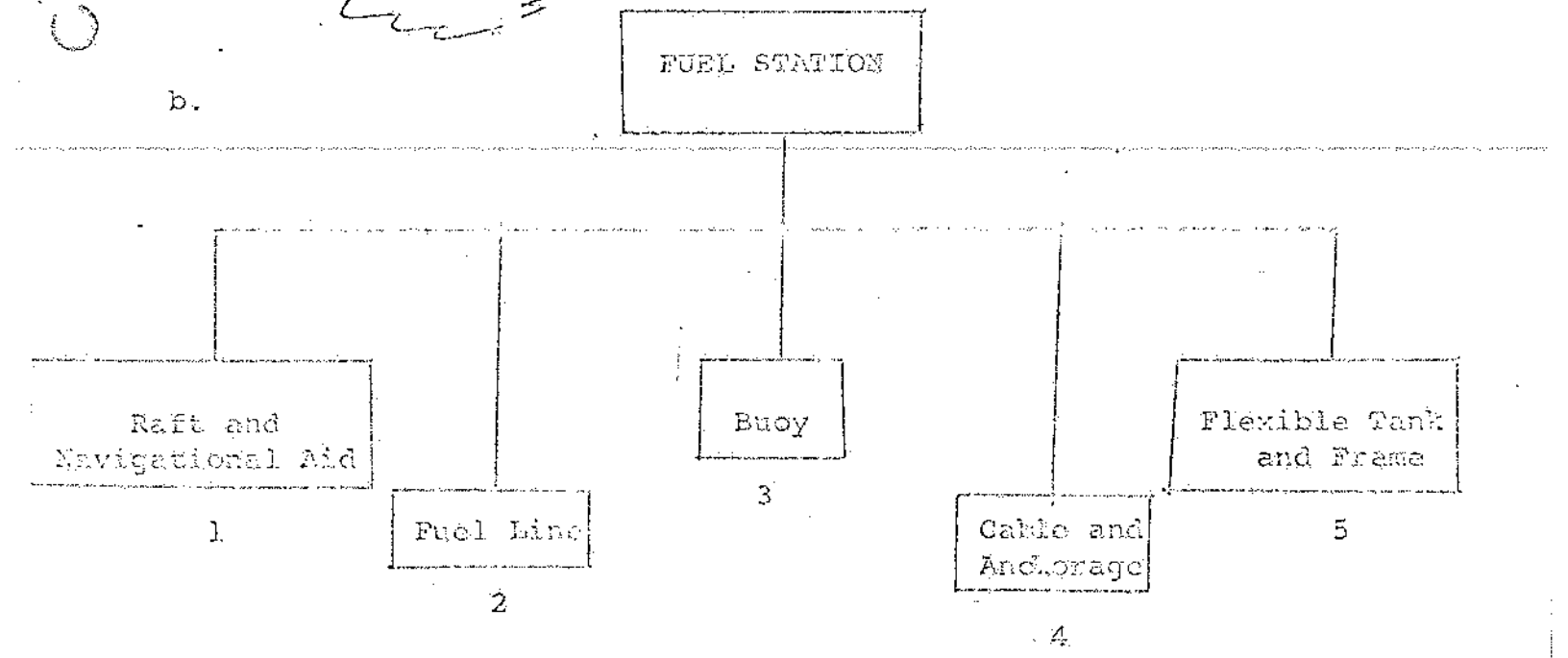


c. Identification of SHORE Functions and Tasks

1. Install

2. Install

3. Install

4. Install, drive pilings, core samples

5. Erect

d. Identification of other NAVFAC responsibilities

1. Design, contract, maintain and inspect

2. Design, contract, maintain and inspect

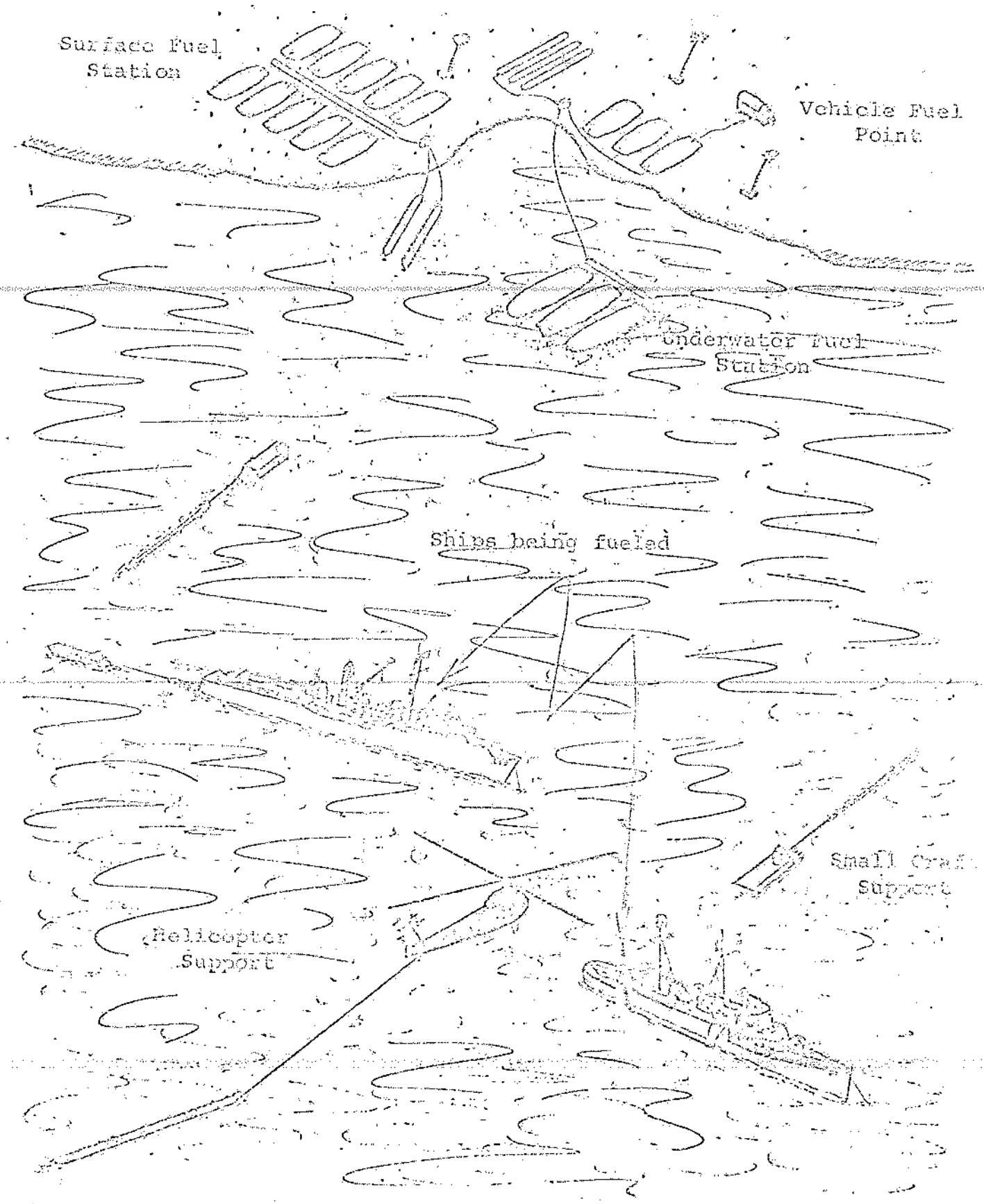
3. Design, contract, maintain and inspect

4. Design, contract, maintain and inspect

5. Design, contract, maintain and inspect

FUEL FARM AND REFUELING/DEFUELING SYSTEM

a.



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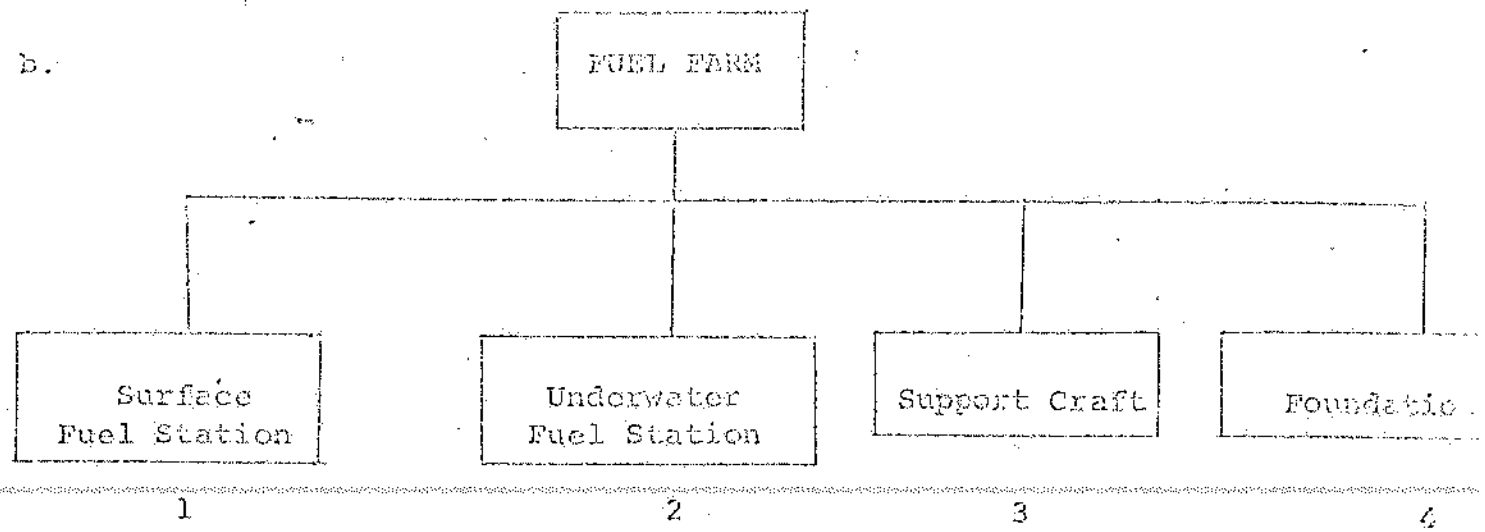


c. Identification of SEABEE Functions and Tasks

1. Install

2. Install

3. Operate small craft

4. Core samples

d. Identification of other NAVFAC responsibilities

1. Design

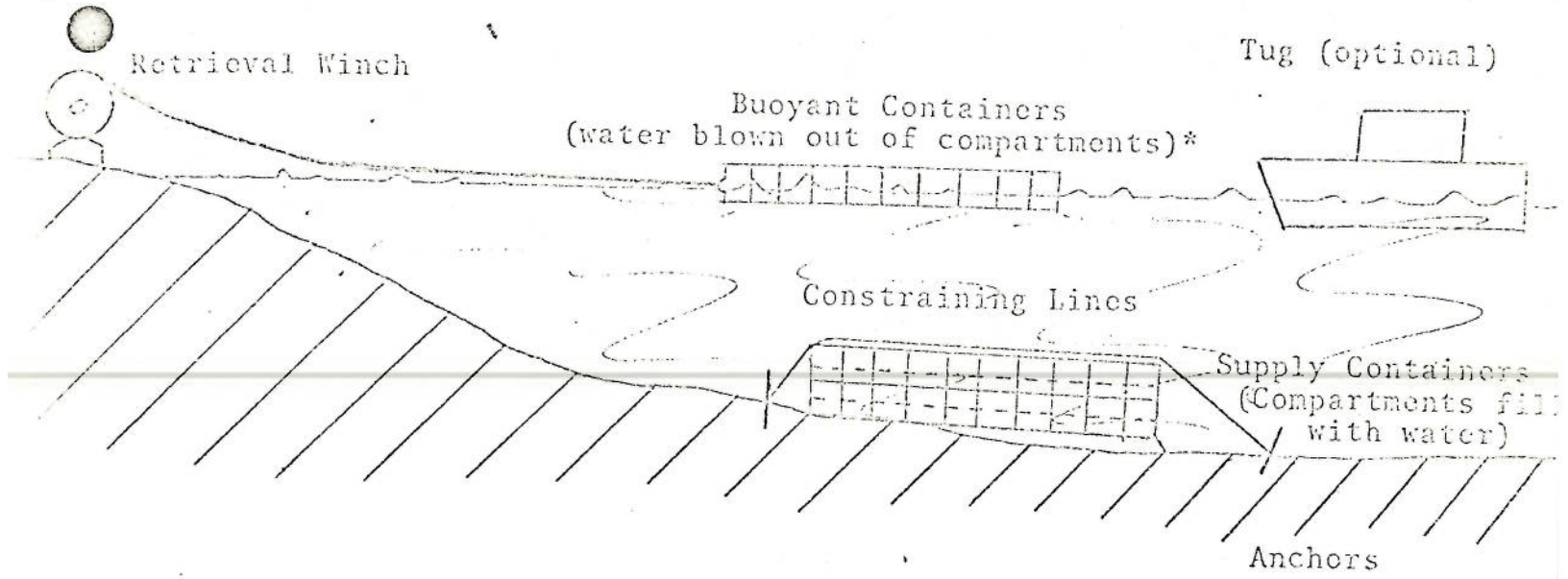
2. Design

3. Coordinate efforts

4. Core analysis, site survey

LOGISTIC MODULES (UNDERWATER)

a.



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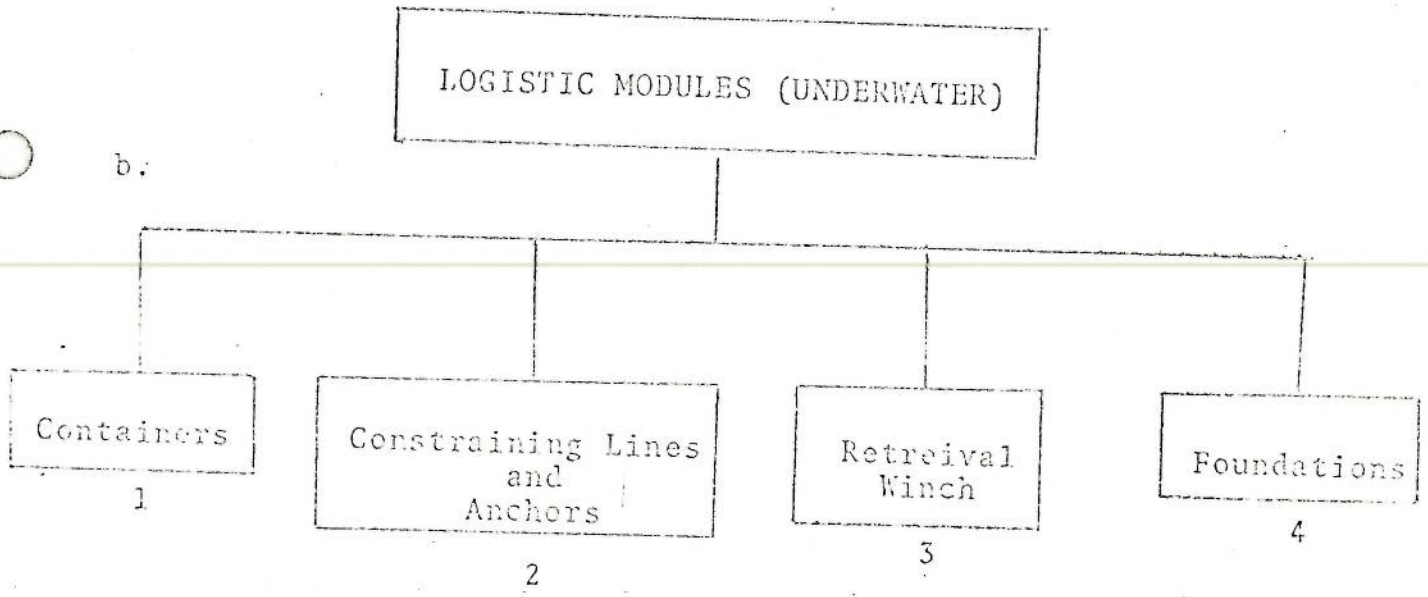


* Gas supply for blowing water out of compartments would be same as in recon station/logistic base habitat - See Design Concept

c. Identification of SUPSALV Functions and Tasks

1. Stack and tie-down, surface when directed by divers
2. Emplace
3. Operate
4. Perform excavation, collect site data, core samples

d. Identification of other NAVFAC responsibilities.

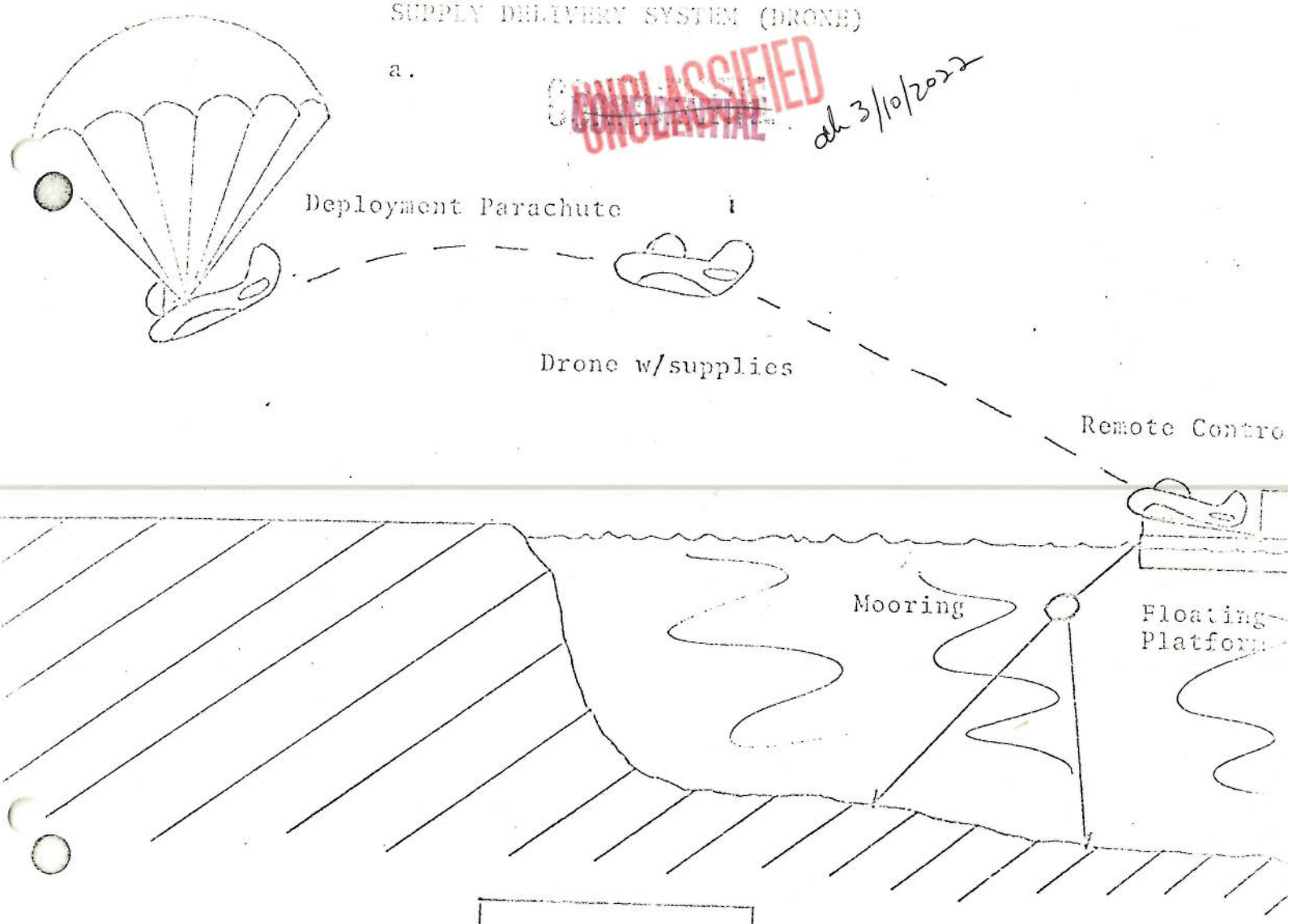
1. Design, contract, maintain and inspect
2. Design, contract, maintain and inspect
3. Contract for winch
4. Design, develop equipment for excavation and collecting site data, analyze site data

LOGISTICS BASE

The logistics base is a combination of the recon and logistical support station and the underwater fuel station and/or the underwater logistics modules. (See the Design Concepts of the three above mentioned requirements)

SUPPLY DELIVERY SYSTEM (DRONE)

a.



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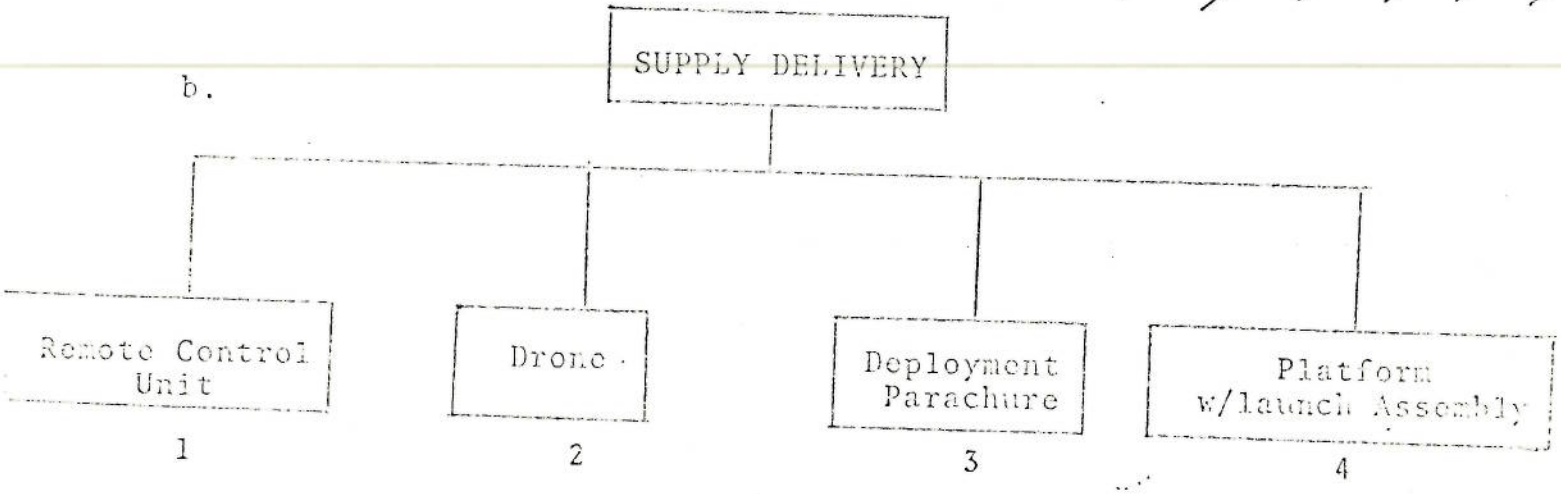


c. Identification of SEABEE Functions and Tasks

1. Hook-up
2. None
3. None
4. Install (See Surface Logistics and Work Platforms)

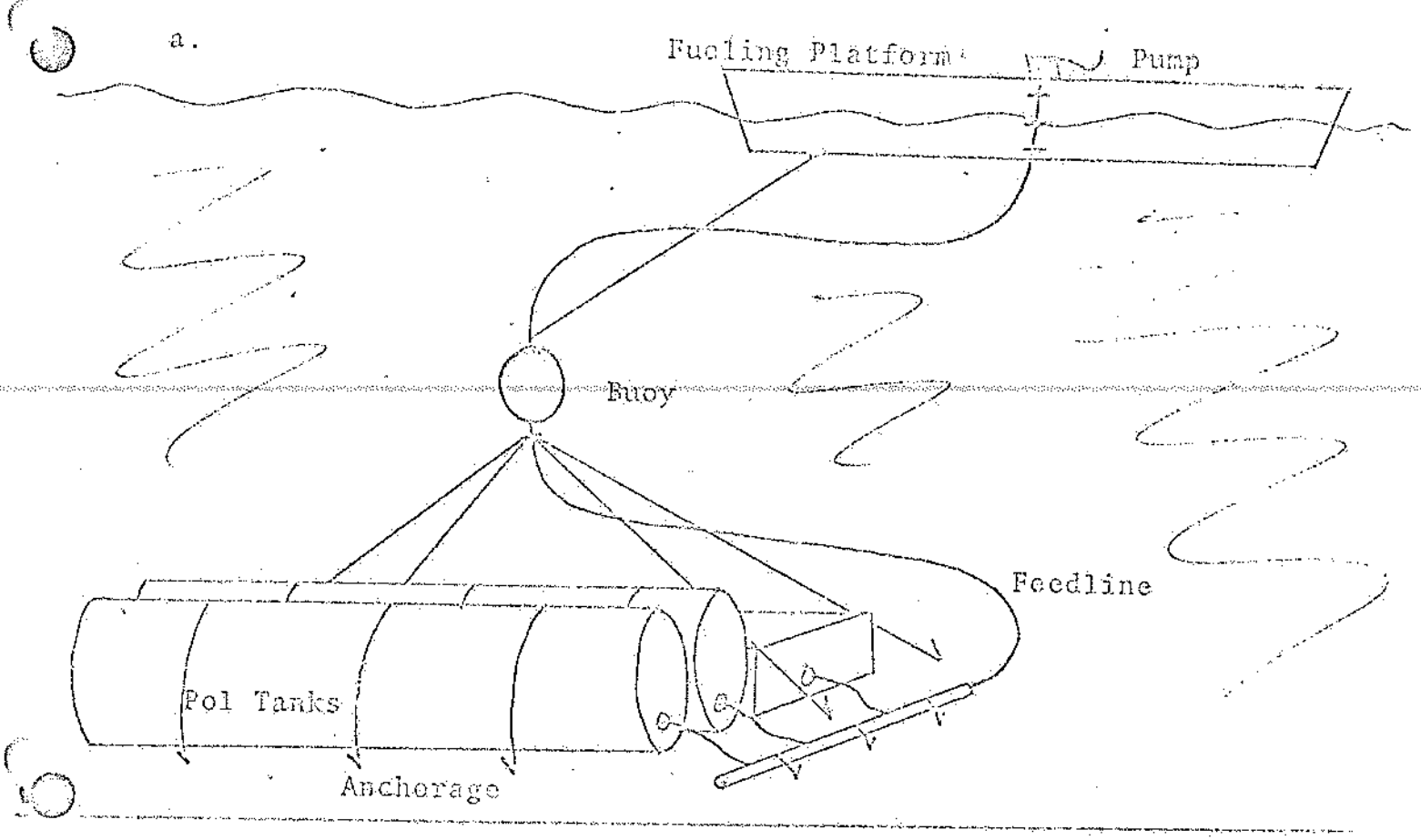
d. Identification of other NAVFAC responsibilities.

1. Design, contract, maintain and inspect
2. None
3. None
4. Design (See Surface Logistics and Work Platforms)

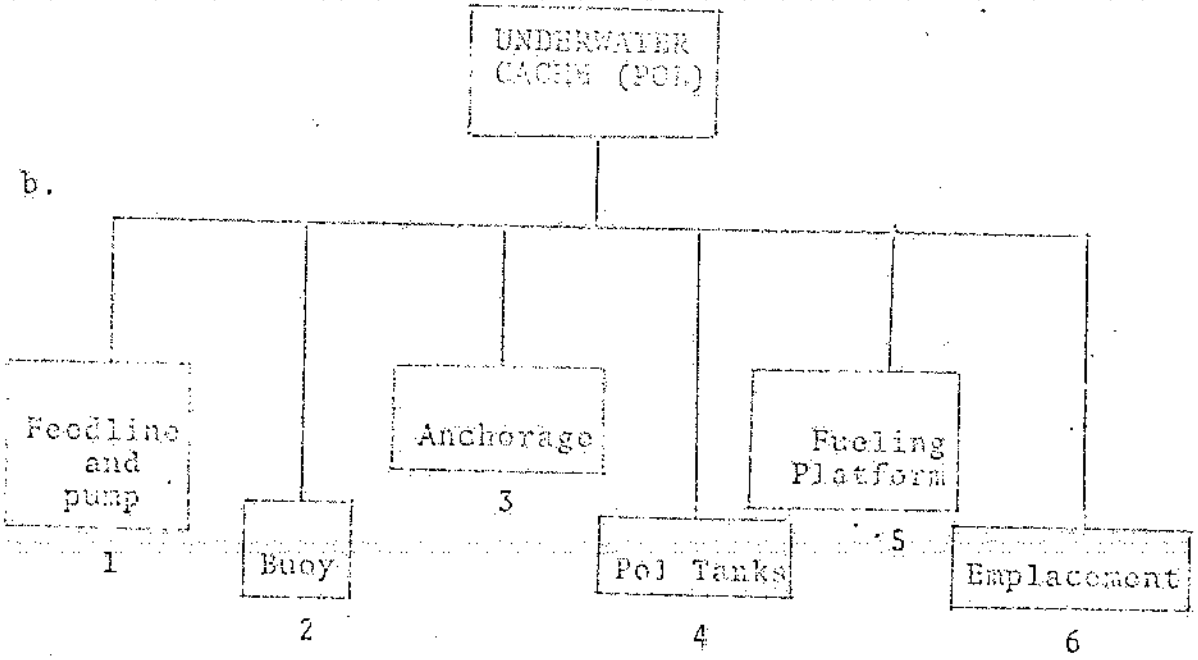
UNDERWATER CACHE (POL)

Concept 1 - Surface Fueling

a.



b.



UNDERWATER CACHE (POL)

Concept 1 - Surface Fueling

c. Identification of SEABEE Functions and Tasks

1. Install, maintain and inspect
2. Install, maintain and inspect
3. Install, maintain and inspect
4. Install
5. Construct
6. Perform emplacement

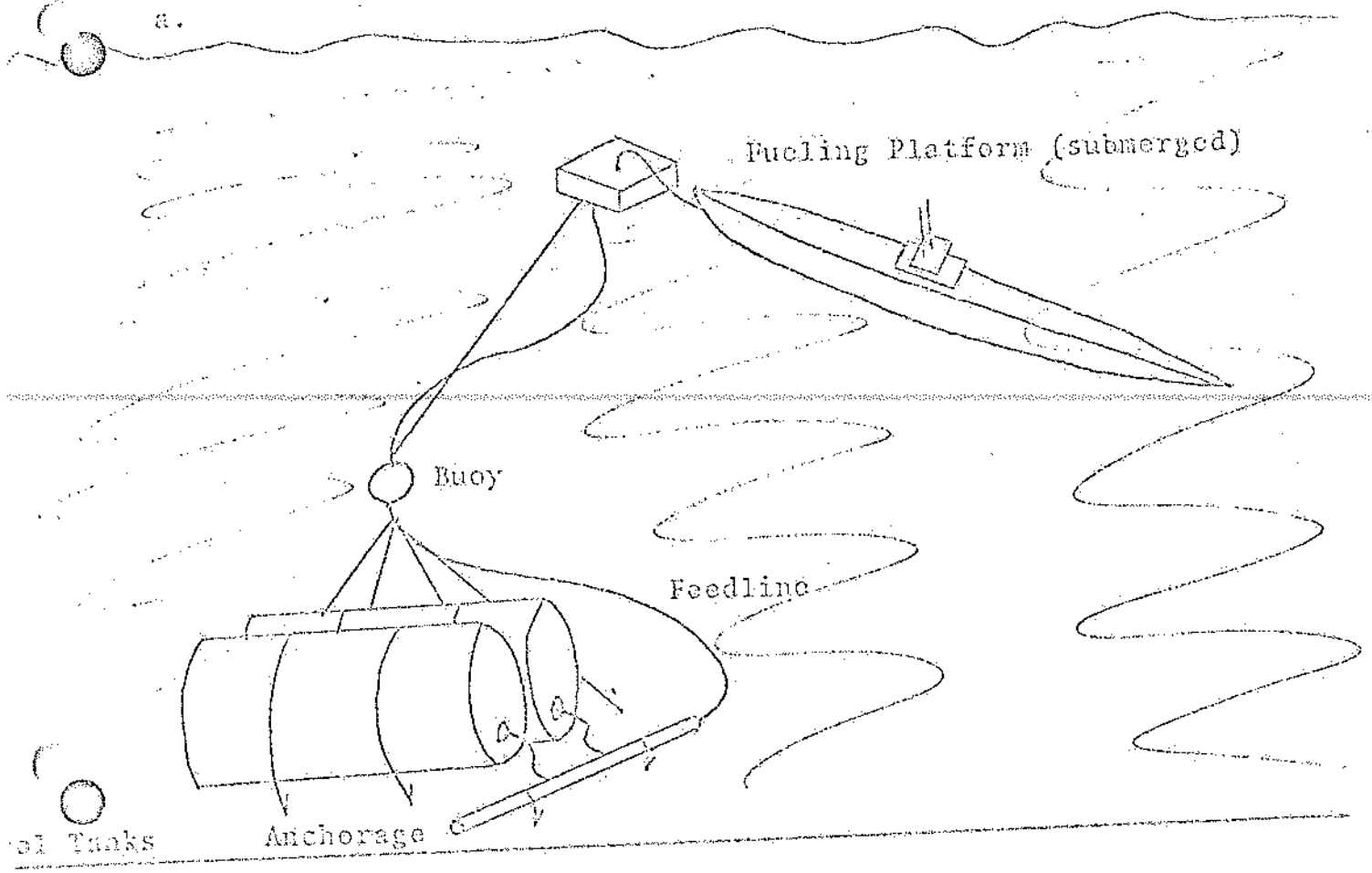
d. Identification of other NAVFAC responsibilities

1. Design, contract, maintain and inspect
2. Design, contract, maintain and inspect
3. Design, contract, maintain and inspect
4. Design, contract, maintain and inspect
5. Design, contract, maintain and inspect
6. Bottom survey, soil exploration, site selection, develop installation procedures and contract for lifting equipment.

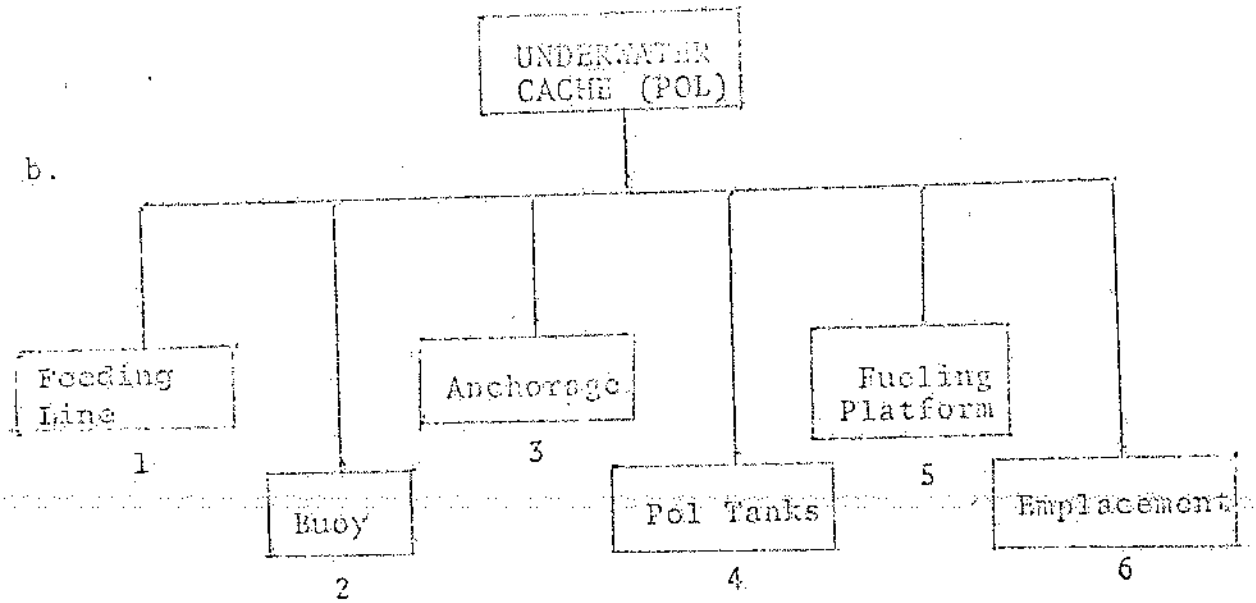
UNDERWATER CACHE (POL)

Concept 2 - Subsurface Fueling

a.



b.



UNDERWATER CACHE (POL)

Concept 2 - Subsurface Fueling

c. Identification of SEABEE Functions and Tasks

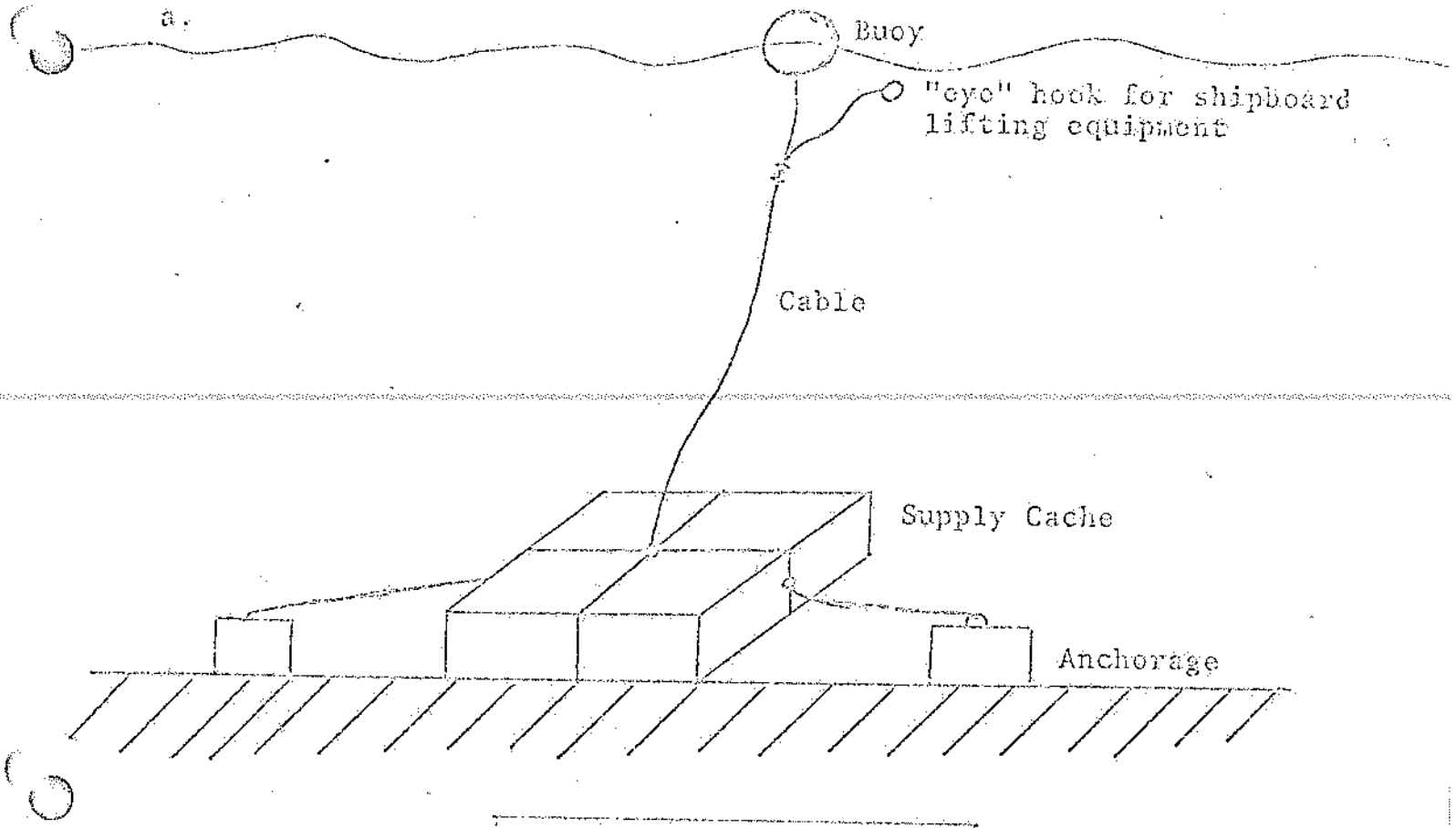
1. Install, maintain and inspect
2. Install, maintain and inspect
3. Install, maintain and inspect
4. Install, maintain and inspect
5. Construct
6. Perform emplacement

d. Identification of other NAVFAC responsibilities

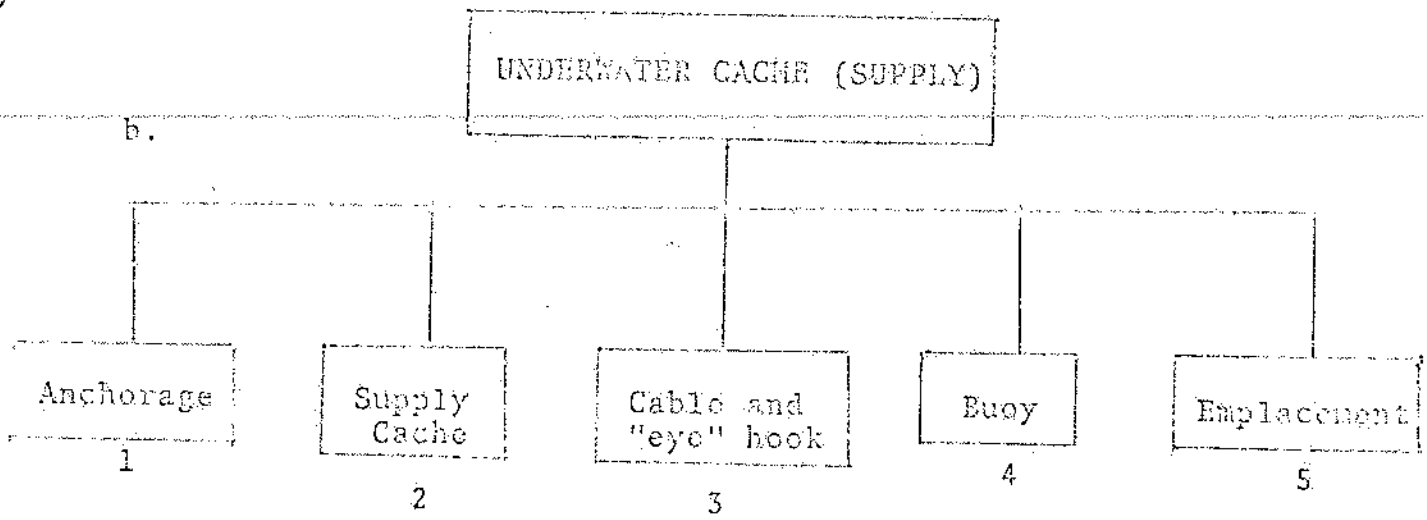
1. Design, contract, maintain and inspect
2. Design, contract, maintain and inspect
3. Design, contract, maintain and inspect
4. Design, contract, maintain and inspect
5. Design, contract, maintain and inspect
6. Bottom survey, soil exploration, site selection, develop installation procedures, contract for lifting equipment

UNDERWATER CACHE (SUPPLIES)

a.



b.



UNDERWATER CACHE (SUPPLIES)

c. Identification of SCARE Functions and Tasks

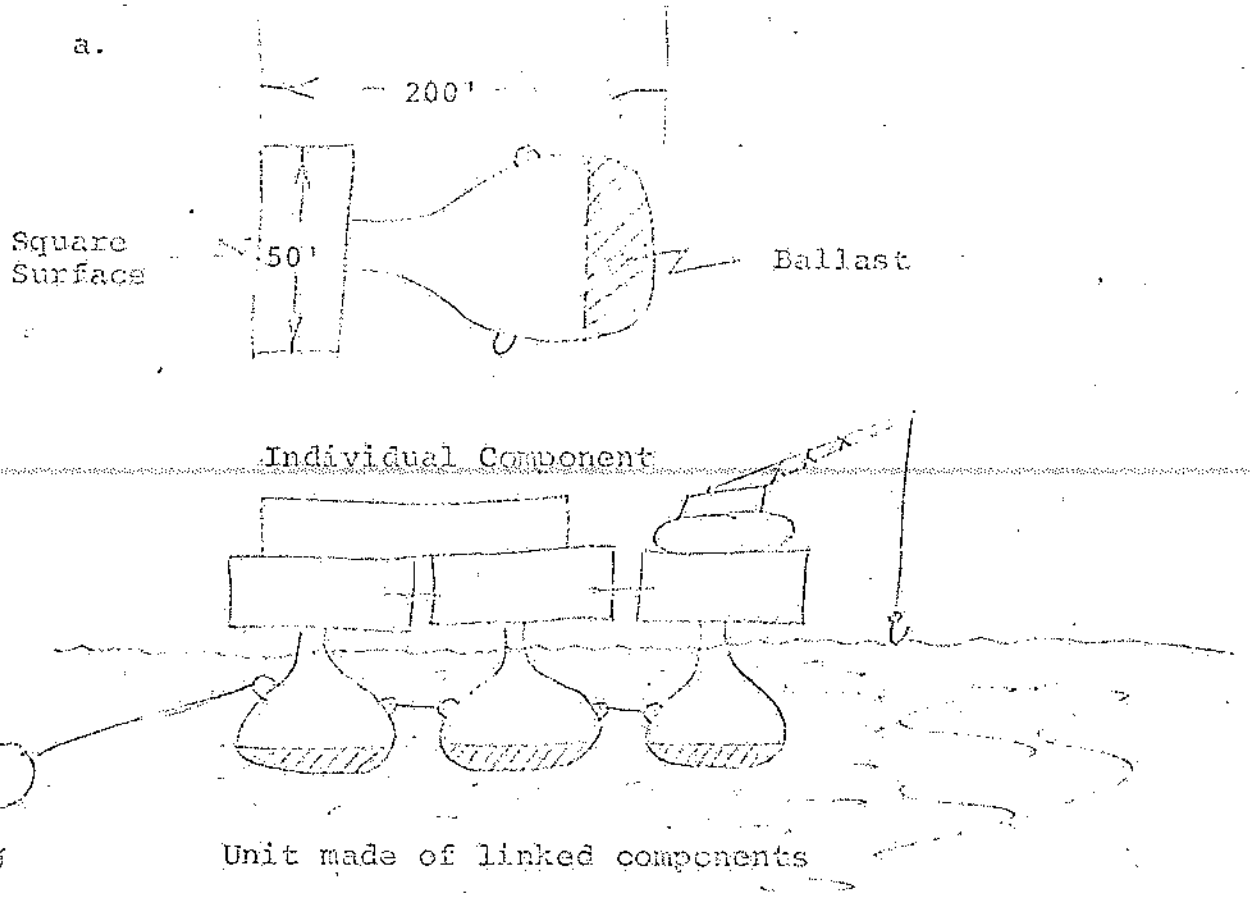
1. Install, maintain and inspect
2. Install, maintain and inspect
3. Install, maintain and inspect
4. Install, maintain and inspect
5. Operate lifting equipment

d. Identification of other NAVFAC responsibilities

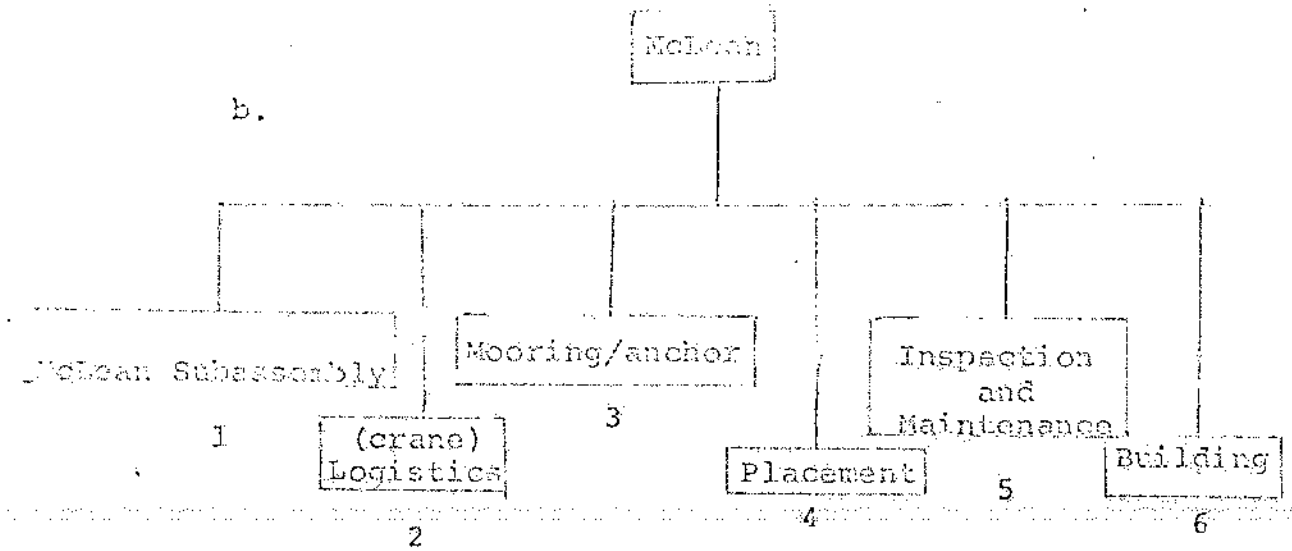
1. Design, contract, maintain and inspect
2. Design, contract, maintain and inspect
3. Design, contract, maintain and inspect
4. Design, contract, maintain and inspect
5. Bottom survey, soil exploration, site selection, contract lifting equipment and develop procedures for installation.

Concept 1 - Floating Platform (Linked Steel Buoys)

a.



b.



SURFACE LOGISTICS AND WORK PLATFORM

Concept 1 - Linked Steel Buoys

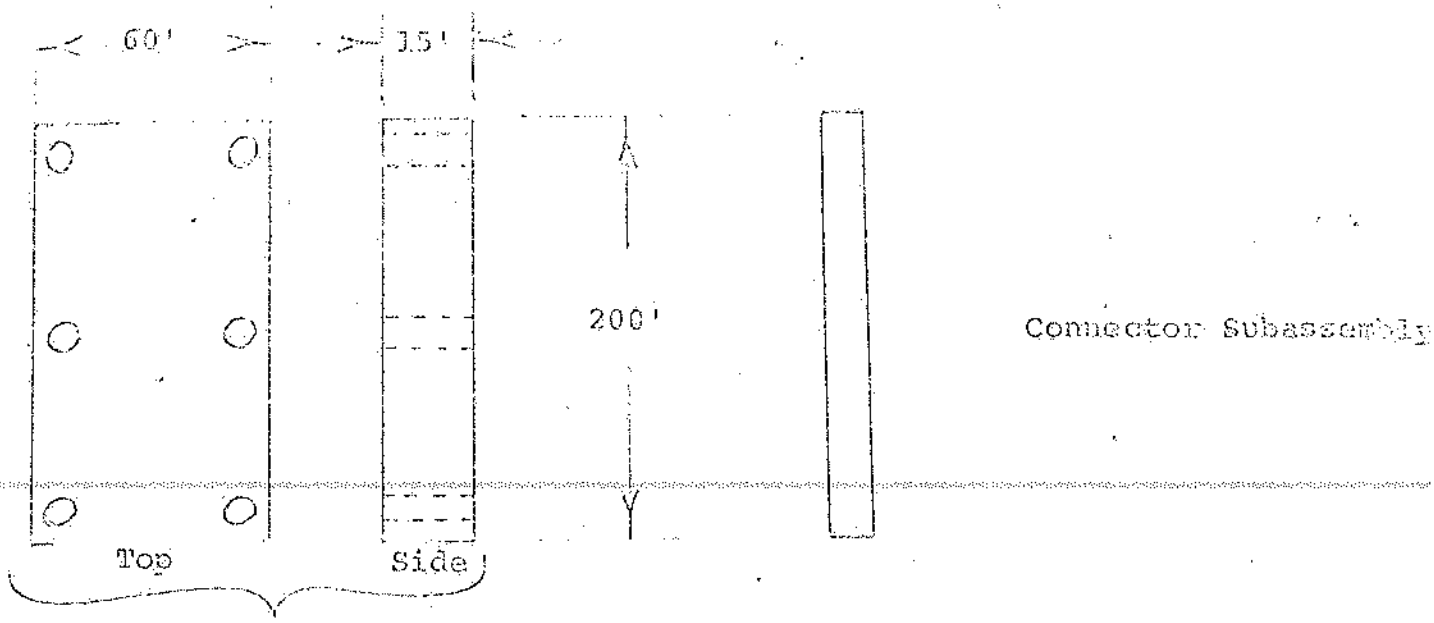
c. Identification of NAVFAC Functions and Tasks

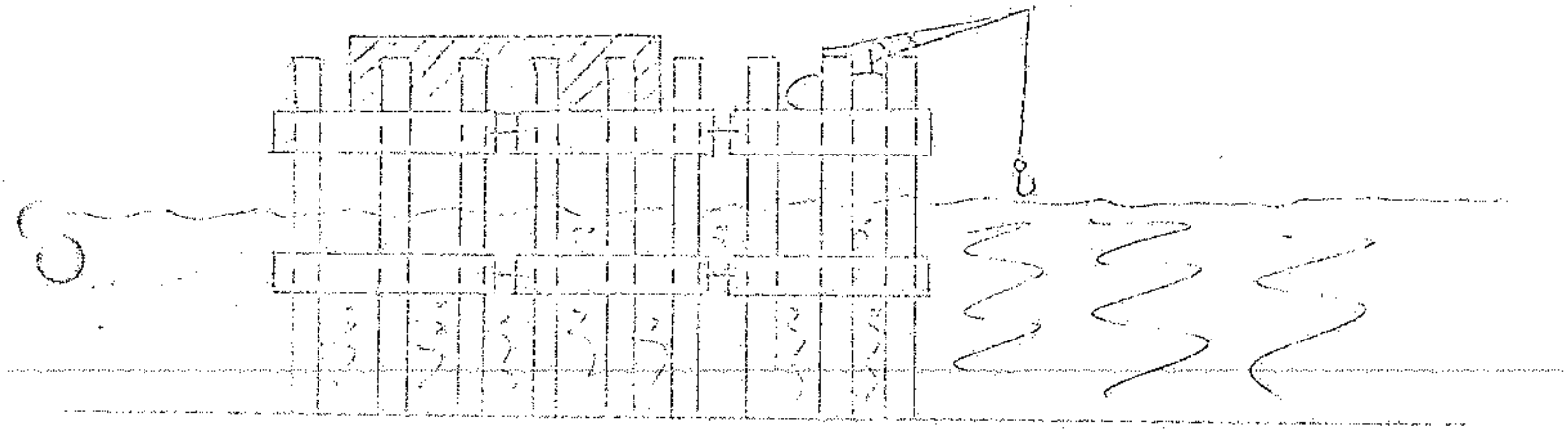
1. None
2. Provide logistic support to operating group
3. Prefabricate and install
4. Perform placement (Divers perform underwater connection
5. Divers perform necessary inspection/maintenance underwater
6. Prefabricate and install building

d. Identification of Other NAVFAC Responsibilities

1. Design cathodic protection
2. Contract/purchase of crane
3. Design of Mooring/anchor system (soil exploration for anchorage system), contract.
4. Provide emplantment procedure
5. Provide maintenance and inspection.
6. Design prefabricated building complete with electricity/water/heat facilities

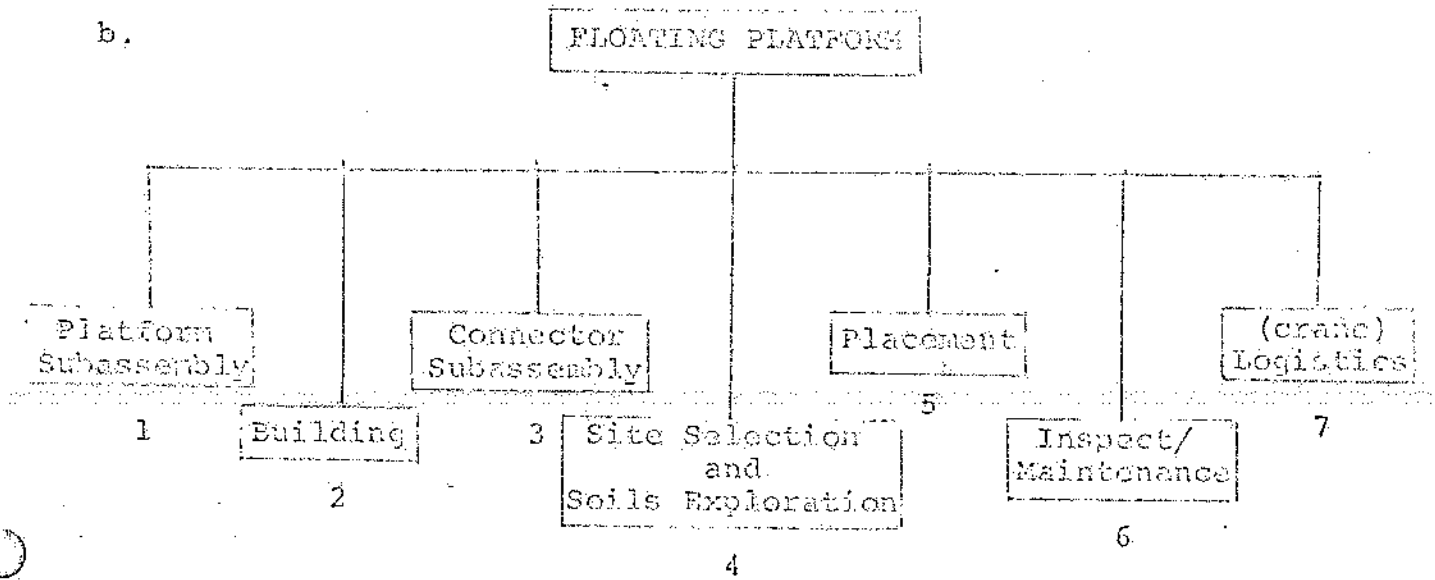
a. Concept 2 - Floating Platforms (Linked Barges)





Assembled Platform

b.



SURFACE LOGISTICS AND WORK PLATFORM

Concept 2 - Linked Barges

c. Identification of SEABEE Functions and Tasks

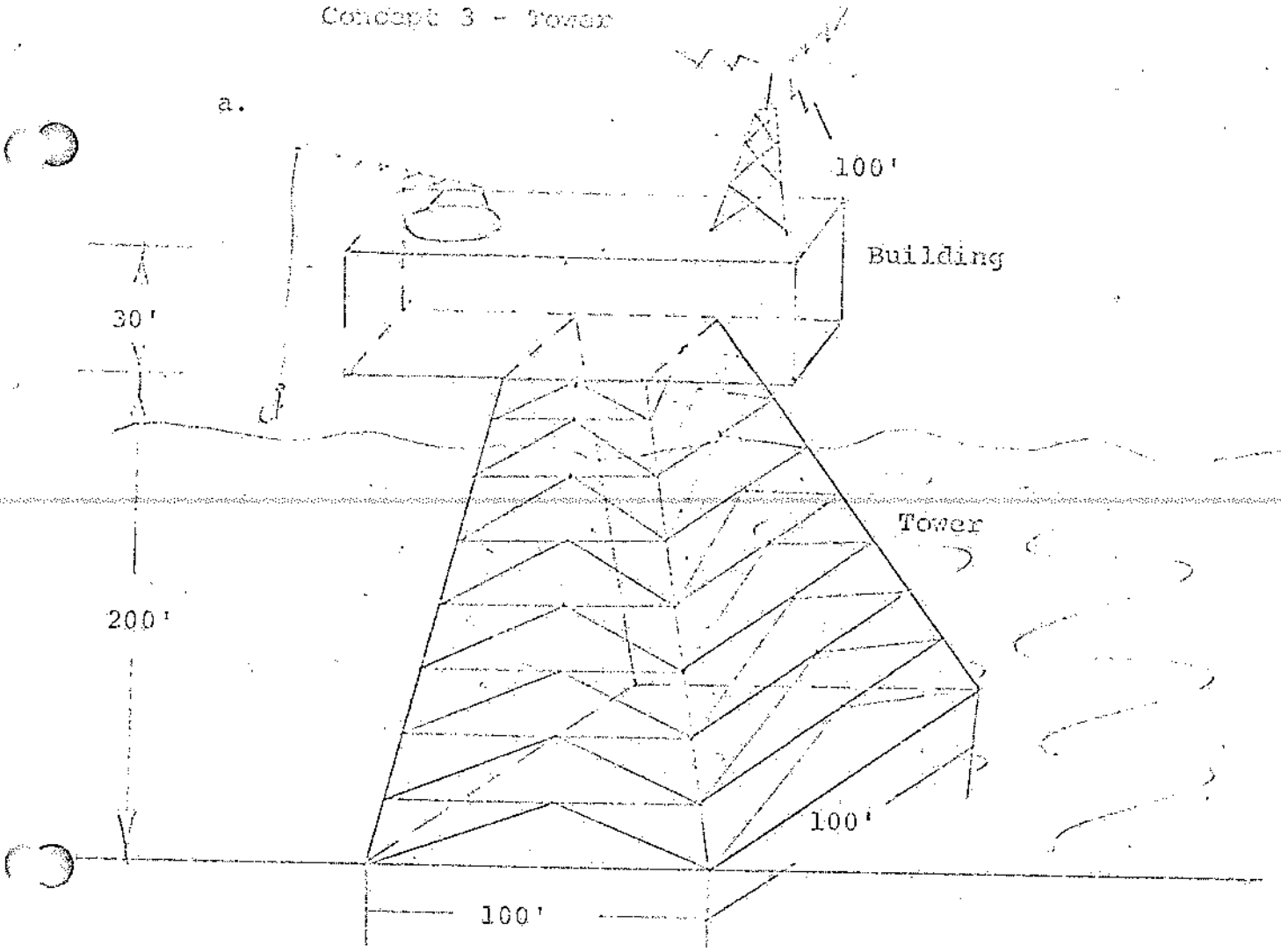
1. None
2. Prefabricate and install
3. None
4. Perform site survey and soils exploration
5. Perform placement (divers perform underwater connections)
6. Perform necessary inspections-maintenance Divers perform underwater work
7. Provide logistic support to operating group

d. Identification of Other NAVFAC Responsibilities

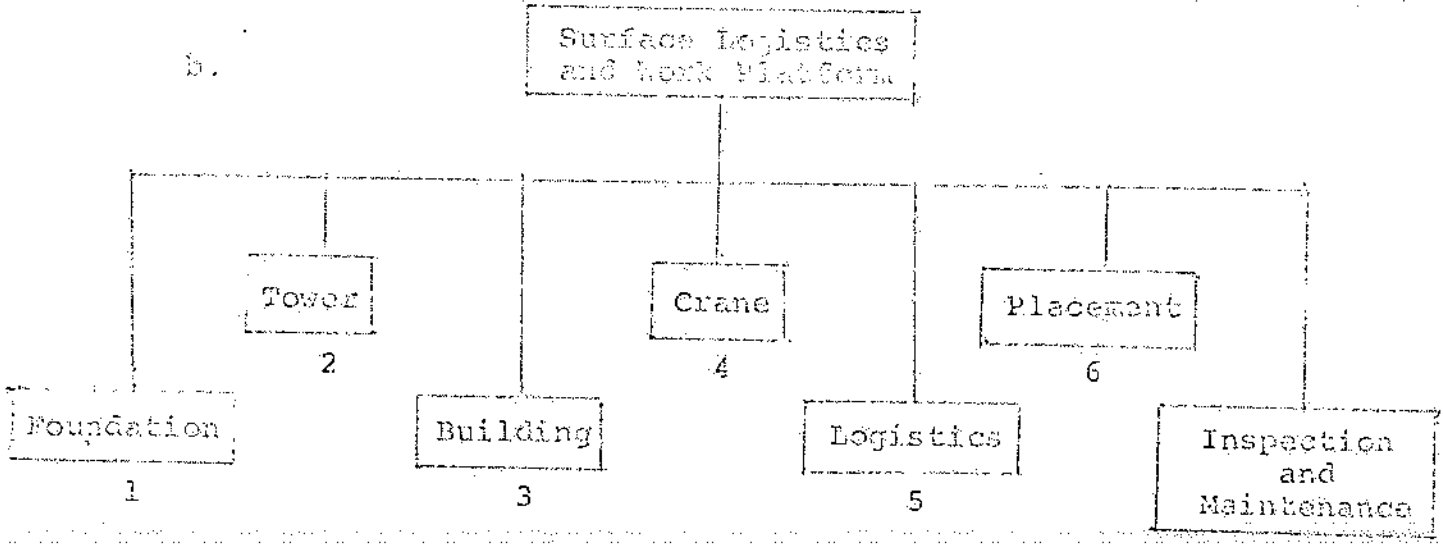
1. None
2. Design prefab building complete
3. None
4. Interpretation of soil borings
5. Provide procedures
6. Provide maintenance and inspection.
7. Contract/purchase of crane

Concept 3 - Tower

a.



b.



SURFACE LOGISTICS AND WORK PLATFORM

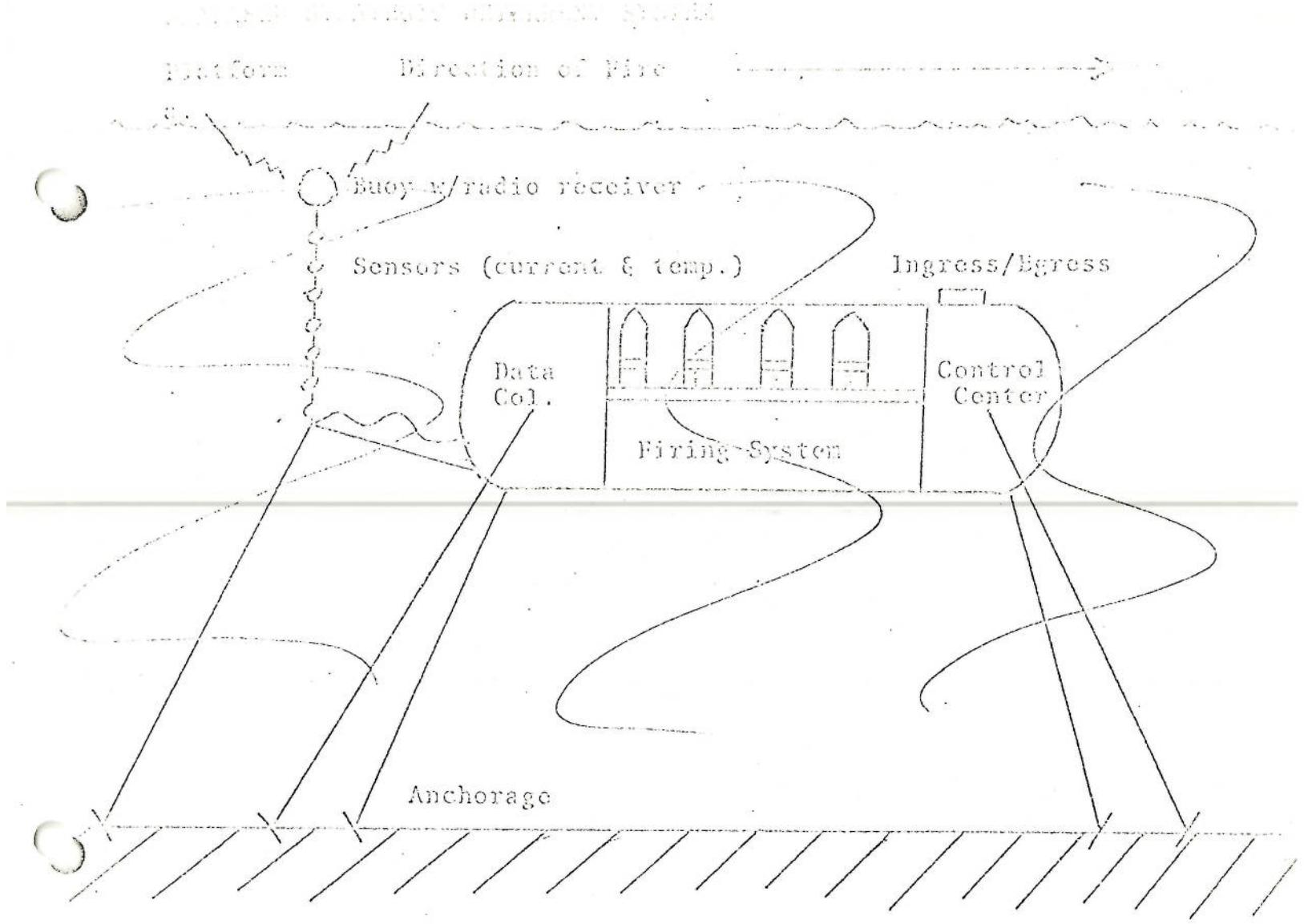
Concept 5 - Tower

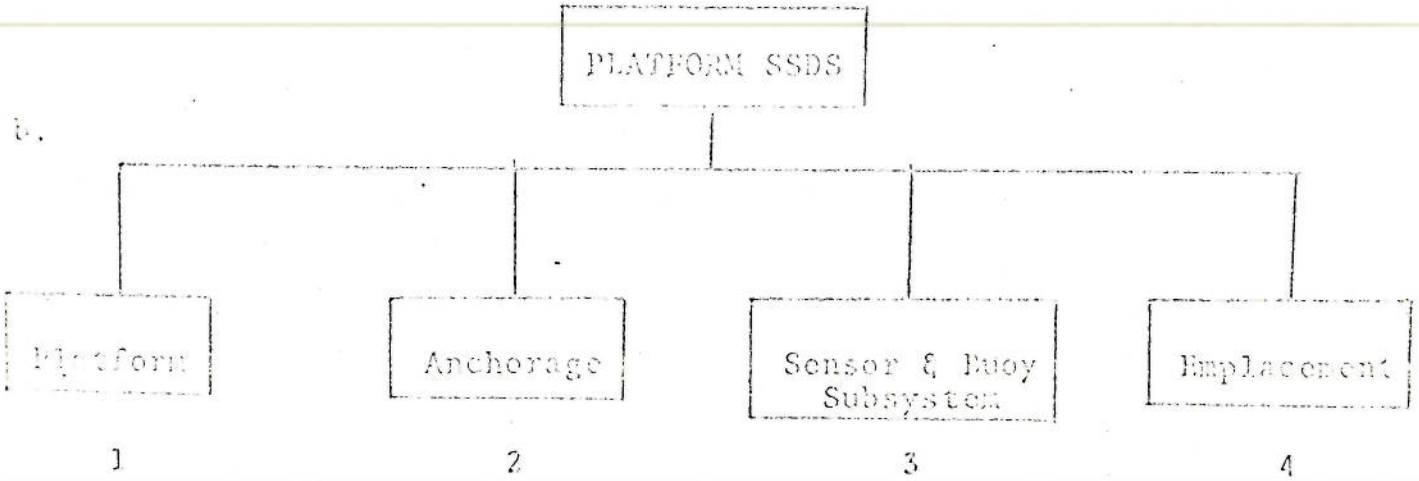
c. Identification of SEABEE Functions and Tasks

1. Install foundation
2. Prefabricate tower
3. Prefabricate building
4. Operate crane
5. Provide logistics support to operating group
6. Install tower and building
7. Inspect and maintain facility (Divers for underwater inspection and maintenance will be required)

d. Identification of Other NAVFAC Responsibilities

1. Design type of foundation (Bottom survey, site selection, soils exploration)
2. Design tower (cathodic protection, implantment procedure)
3. Design building (Structural, electrical and mechanical system)
4. Contract for a crane
5. None
6. Provide installation procedures.
7. Provide maintenance and inspection.





dl 3/10/2002

c. Identification of [illegible] Functions and Tasks

1. Make connections to sensors and anchorage
2. Install
3. Install
4. Operate lifting equipment, obtain core samples

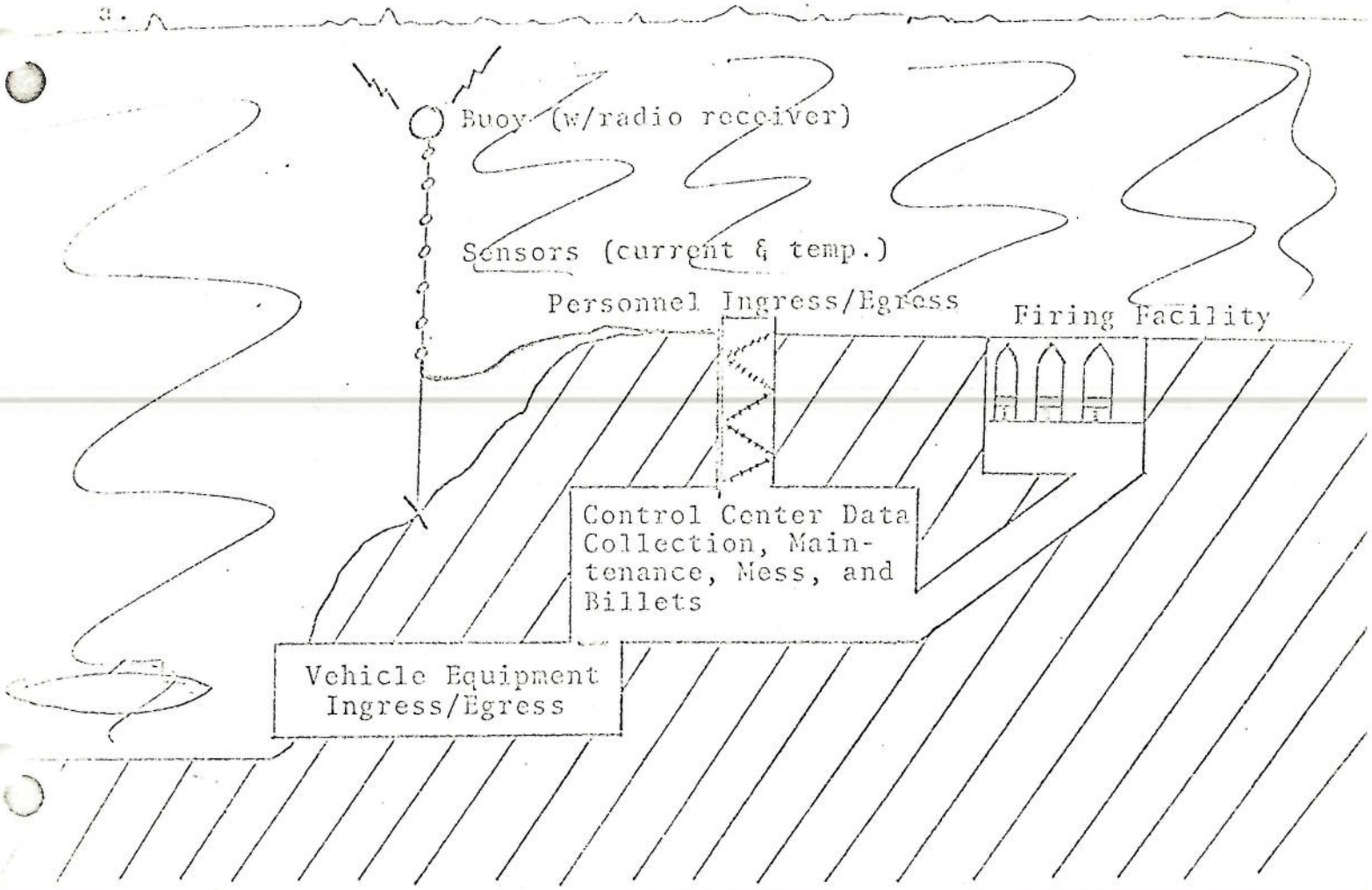
d. Identification of other NAVFAC responsibilities.

1. Design (life support, data collection, control center, mess, billets, personnel & munitions ingress/egress, forced air/water buoyancy system) - coordinate firing facility with NAVORD
2. Design and contract
3. Design (coordinate radio receiver with NAVELEX)
4. Contract lifting equipment, analyze core sample, site selection and survey, develop emplacement procedures.

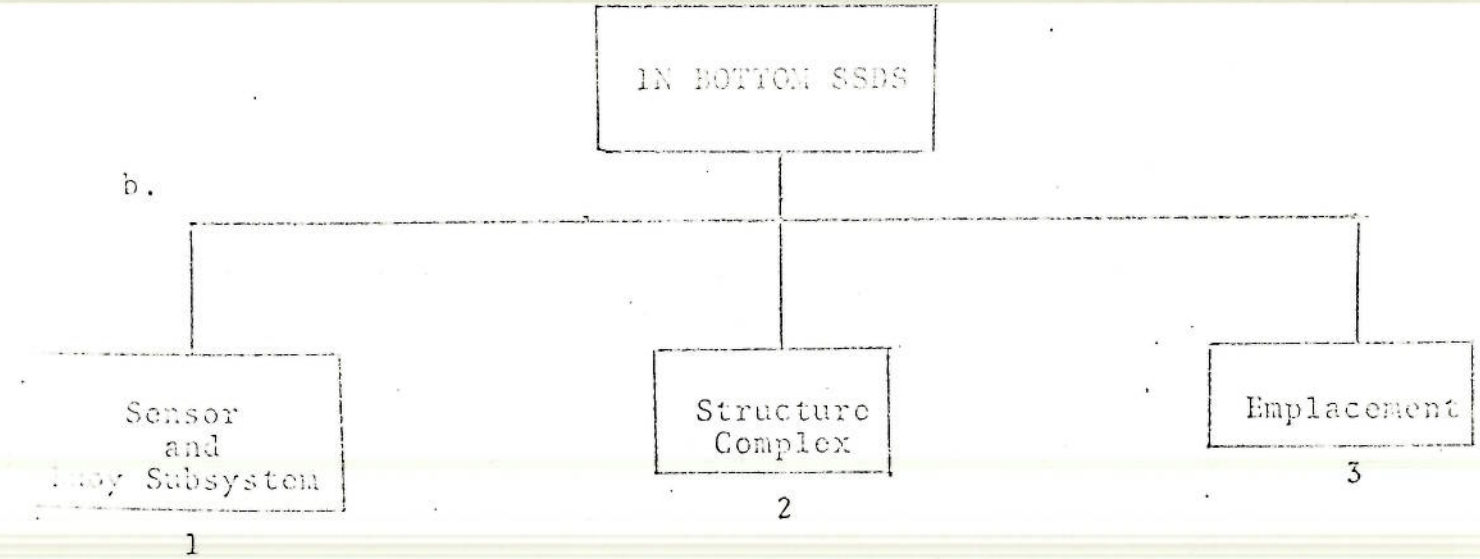
SEABASED STRATEGIC DETERRENT SYSTEM

In Bottom

a.



b.



c. Identification of [illegible] Functions and Tasks

1. Install, make connections

2. None

3. Perform excavation, drilling and weight handling

Obtain core samples and prepare site

d. Identification of other NAVFAC responsibilities.

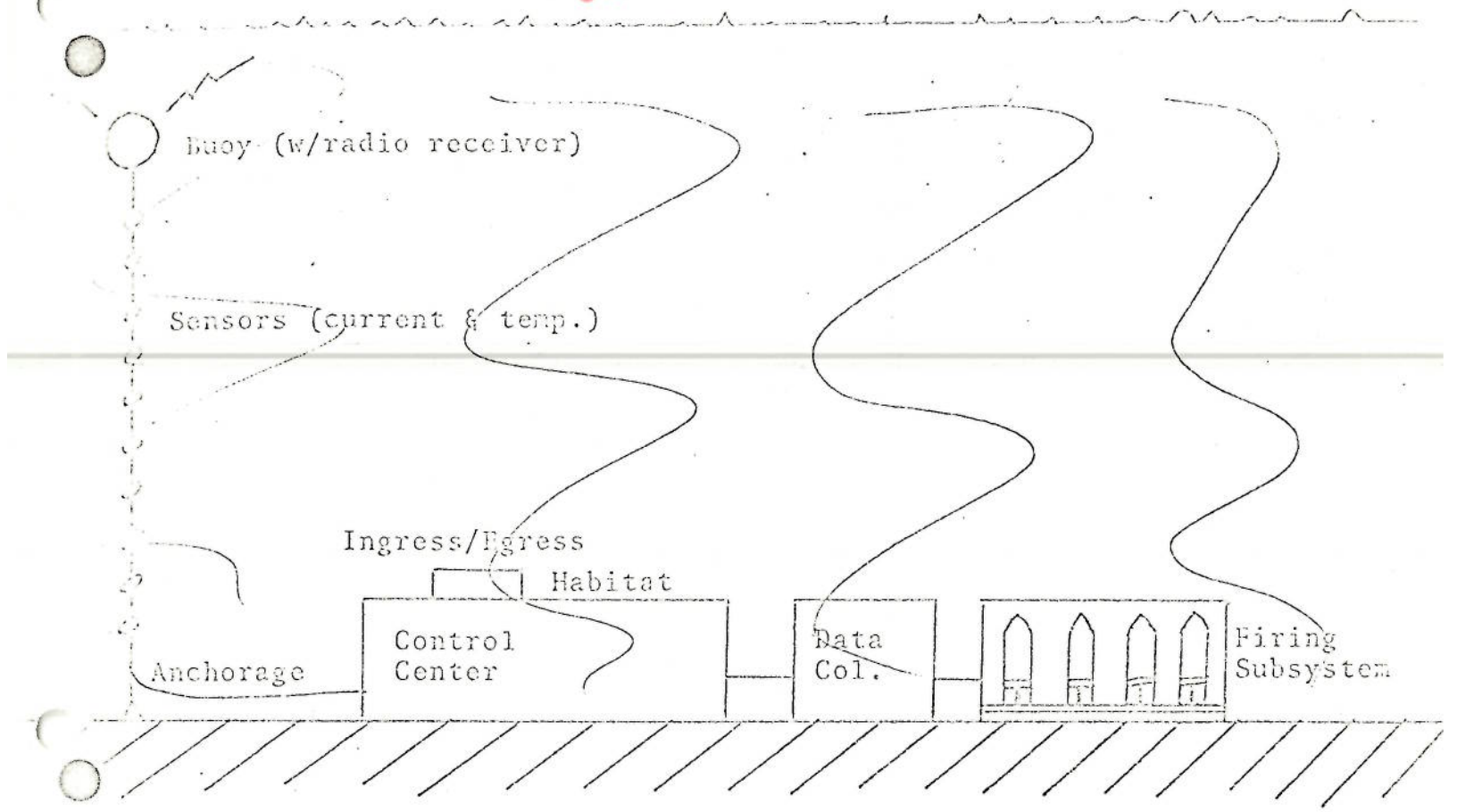
1. Design - coordinate radio receiver buoy with NAVELEX, contract, maintain and inspect.

2. Design (control center; vehicle, personnel and equipment ingress/egress; data collection; firing facility; maintenance; mess; billets; one atmosphere life support; nuclear power). Coordinate firing facility with NAVORD, contract, maintain and inspect.

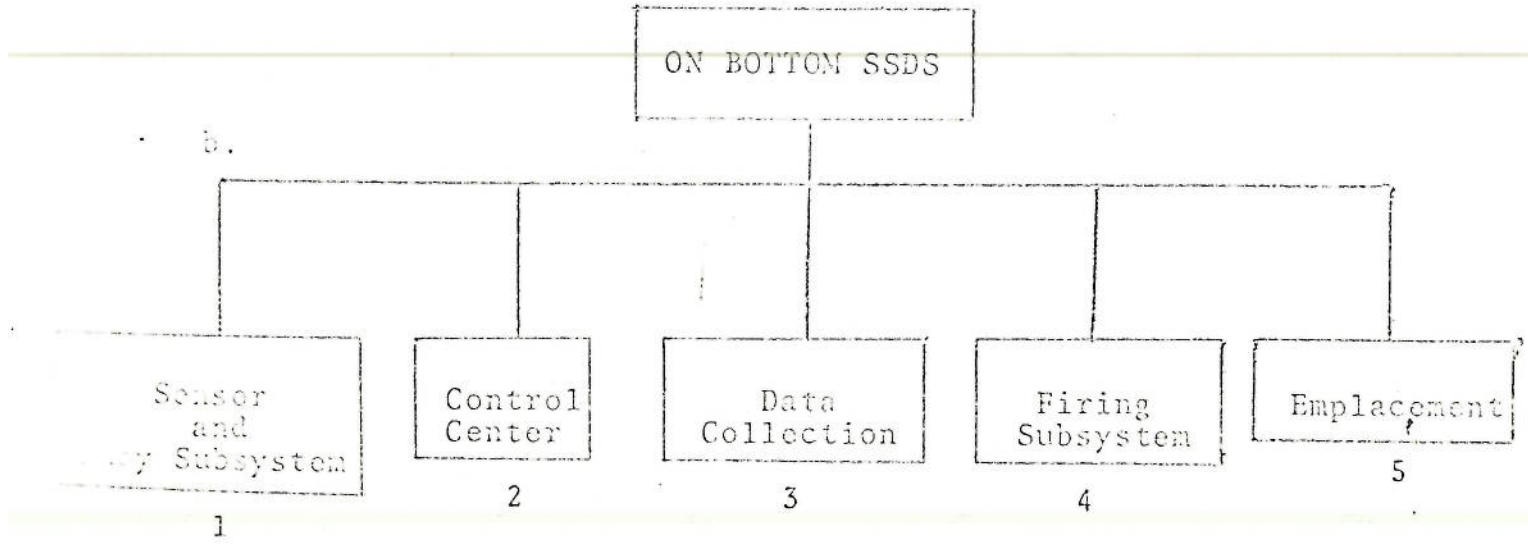
3. Contract for lifting equipment; develop emplacement procedures; analyze core samples, site selection and survey.

On Bottom

a.



b.

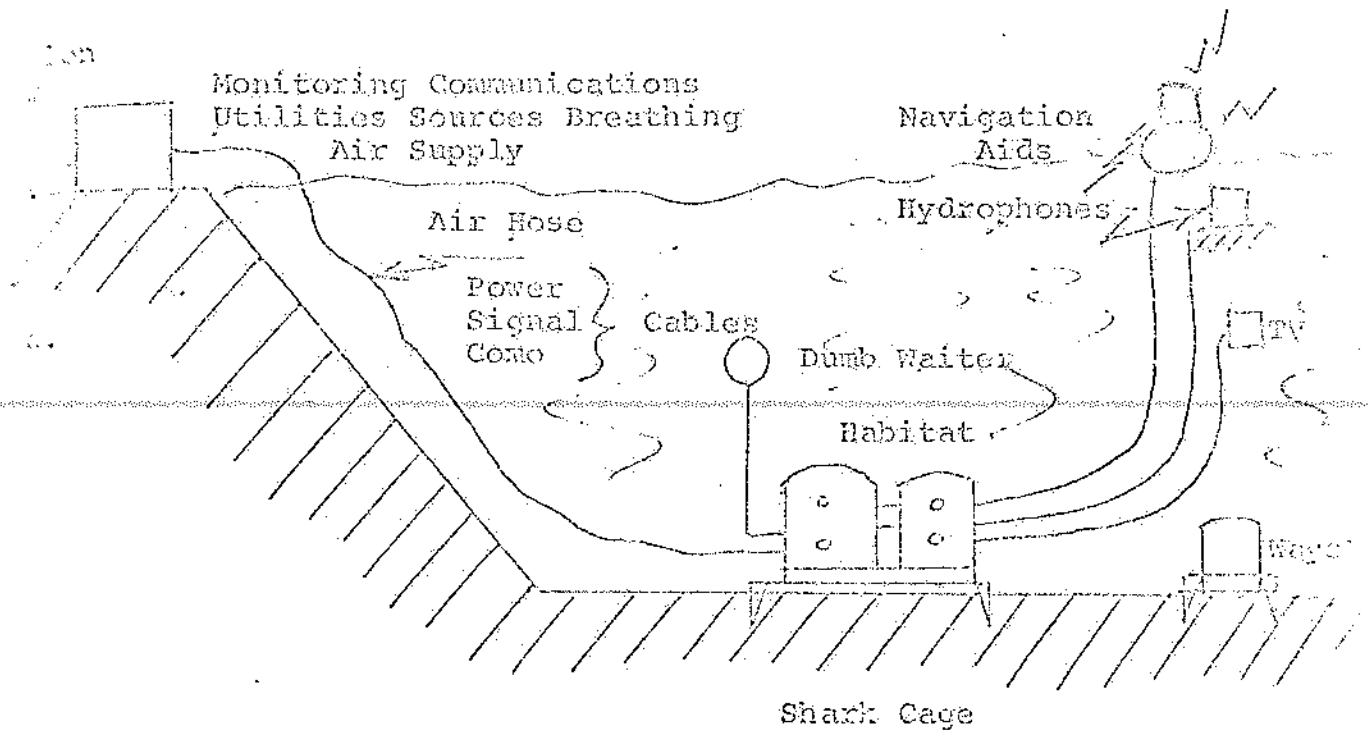


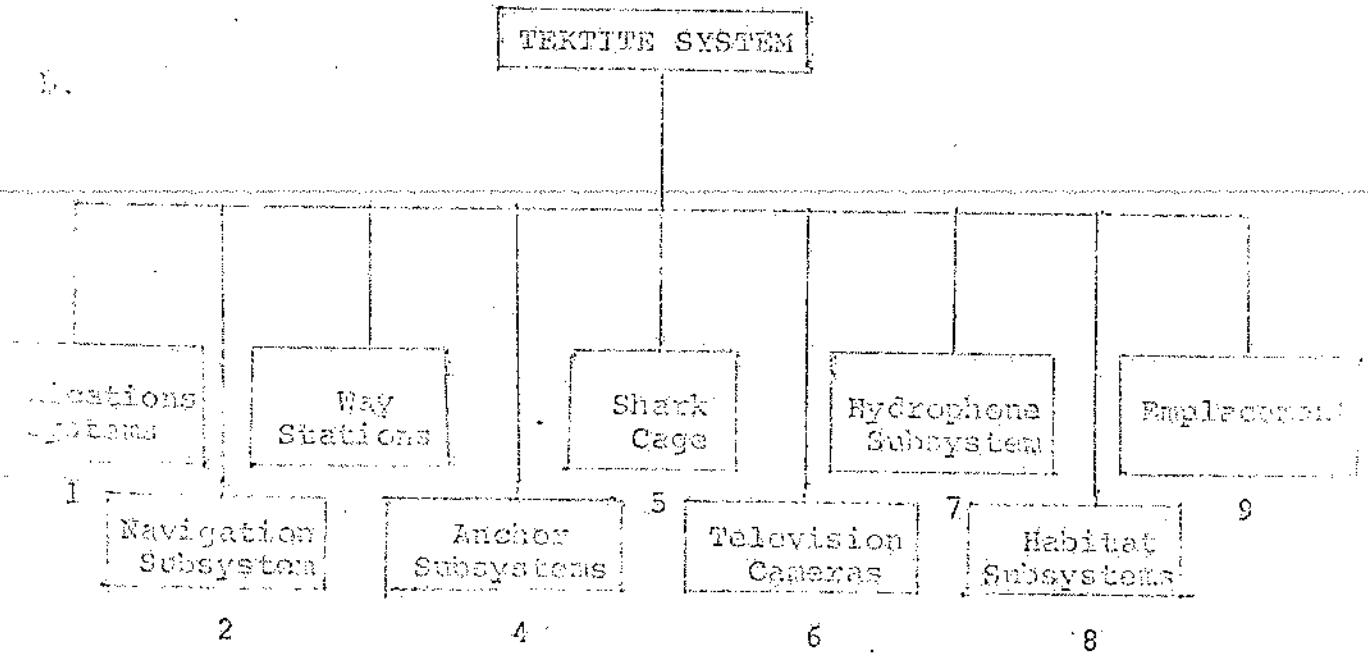
c. Identification of SEABEE Functions and Tasks

1. Install
2. Construct
3. Construct
4. Construct
5. Operate weight handling equipment, obtain core samples, provide emplacement as directed, excavate, construct.

d. Identification of other NAVFAC responsibilities.

1. Design (coordinate w/NAVELEX for radio receiver), contract, maintain, and inspect.
2. Design - one atmosphere life support and nuclear power, contract, maintain and inspect.
3. Design
4. Design (coordinate w/NAVORD)
5. Develop emplacement procedures, contract for weight handling equipment, analyze core samples, design.


Monitoring Communications
Utilities Sources Breathing
Air Supply
Navigation
Aids
Hydrophones
Air Hose
Power
Signal
Coax
Cables
Dumb Waiter
TV
Habitat
Shark Cage


TEKTITE SYSTEM
Way Stations
Shark Cage
Hydrophone Subsystem
Navigation Subsystem
Anchor Subsystems
Television Cameras
Habitat Subsystems
1
2
4
5
6
7
8
9

c. Identification of SEALAB Functions and Tasks

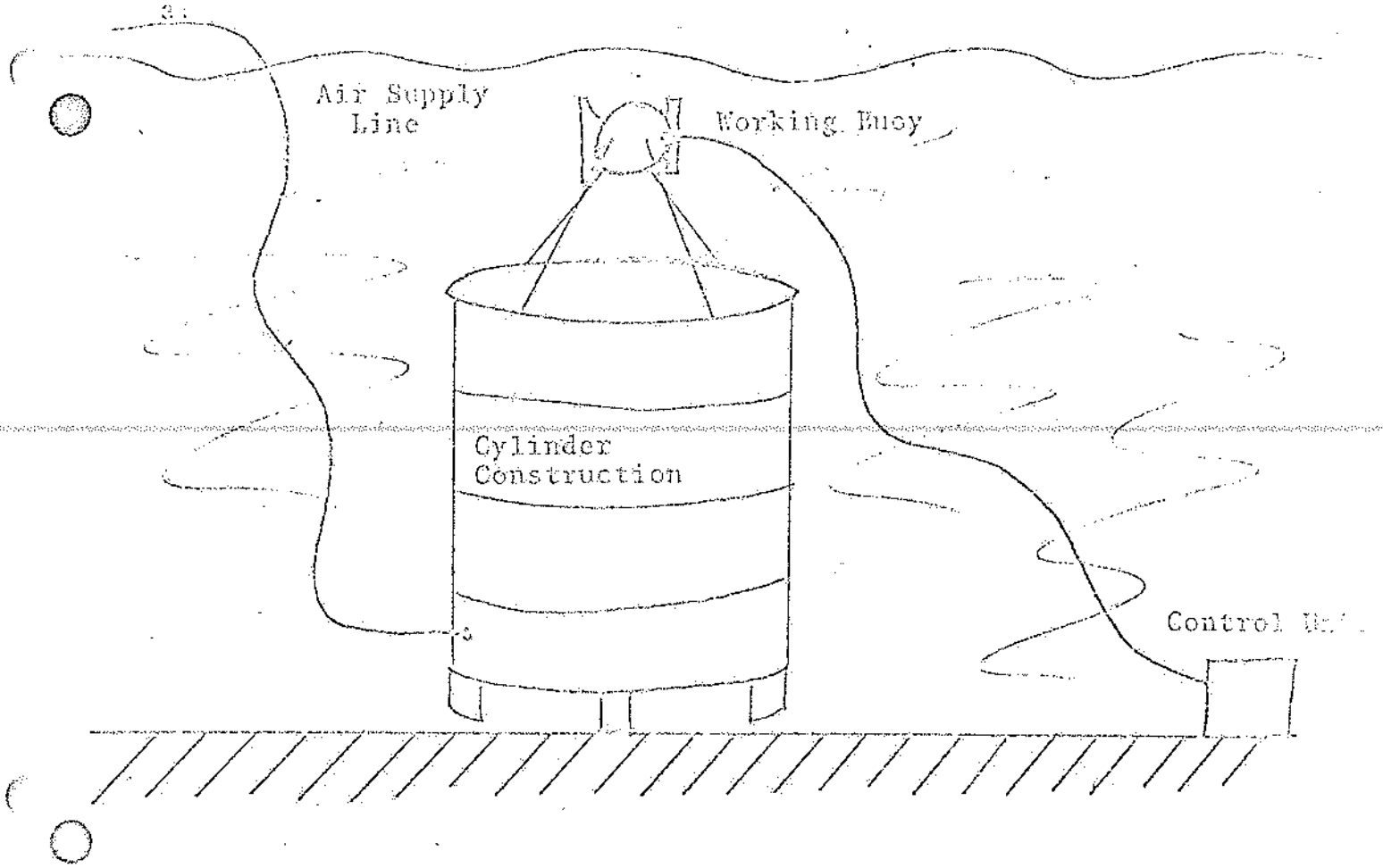
1. Install, checkout and maintain
2. Install, checkout and maintain
3. Install
4. Install and test
5. Install
6. Install, checkout and maintain
7. Install, checkout and maintain
8. Install, checkout and maintain habitat
   Install, checkout and maintain dumb waiter
   Install, checkout and maintain breathing air supply
   Install, checkout and maintain data collection system
   Install umbilical from shore facilities to habitat
9. Operate weight lifting equipment and barges

d. Identification of Other NAVFAC Responsibilities

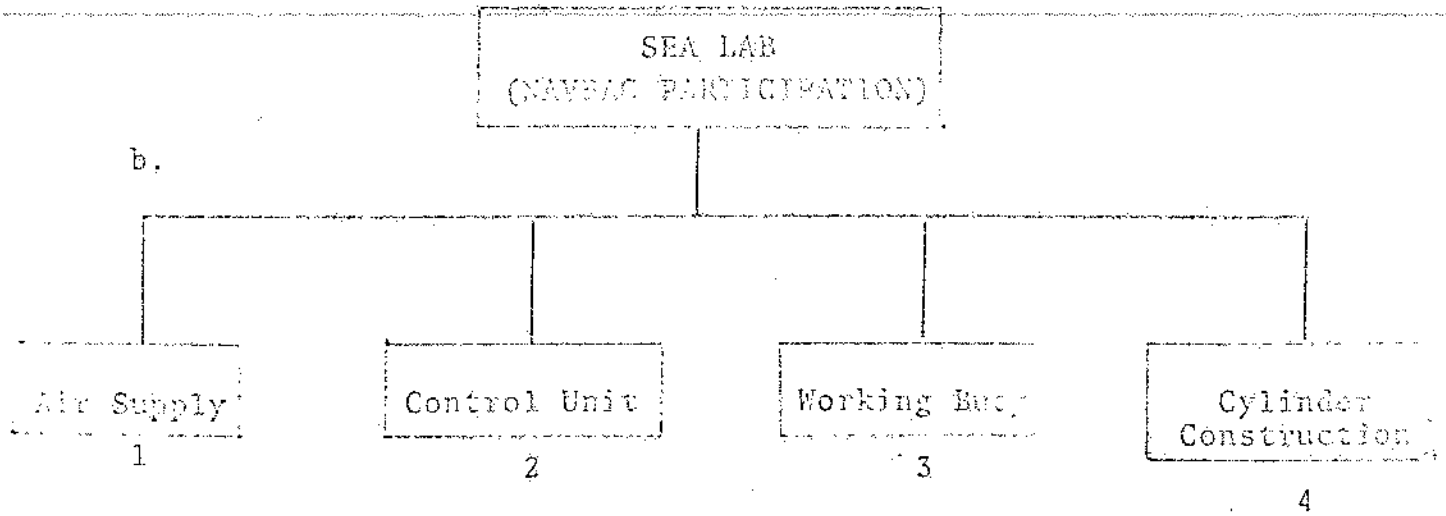
1. None
2. None
3. None
4. Design
5. None
6. None
7. None
8. Design improvements
9. Provide or contract for lifting equipment and barge

SEALAB (NAVFAC PARTICIPATION)

a.



b.



c. Identification of [illegible] Functions and Tasks

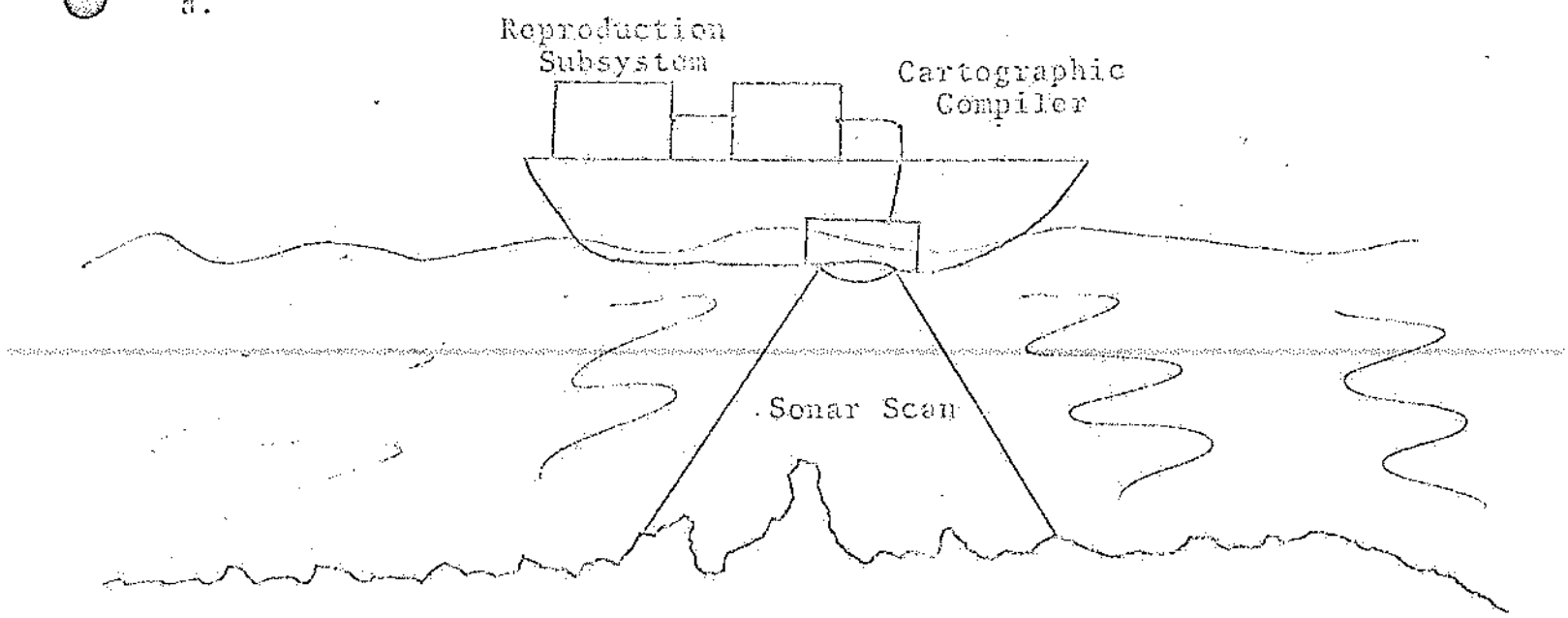
1. Install
2. Install and operate
3. Install
4. Construct

d. Identification of other NAVFAC responsibilities

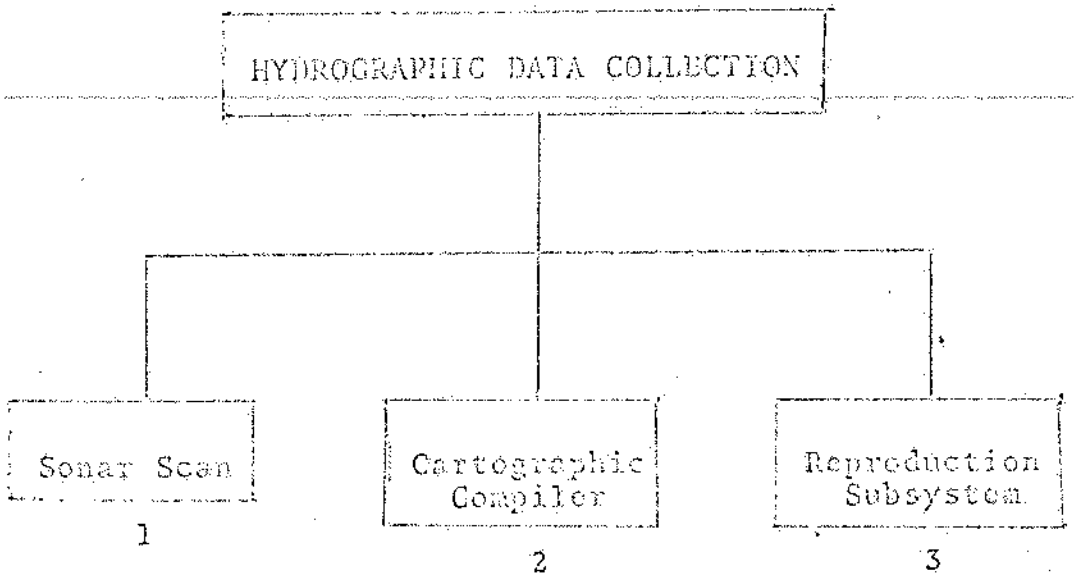
1. None
2. Design
3. Design
4. Design

HYDROGRAPHIC DATA COLLECTION

a.



b.



c. Identification of [illegible] Functions and Tasks

1. None

2. None

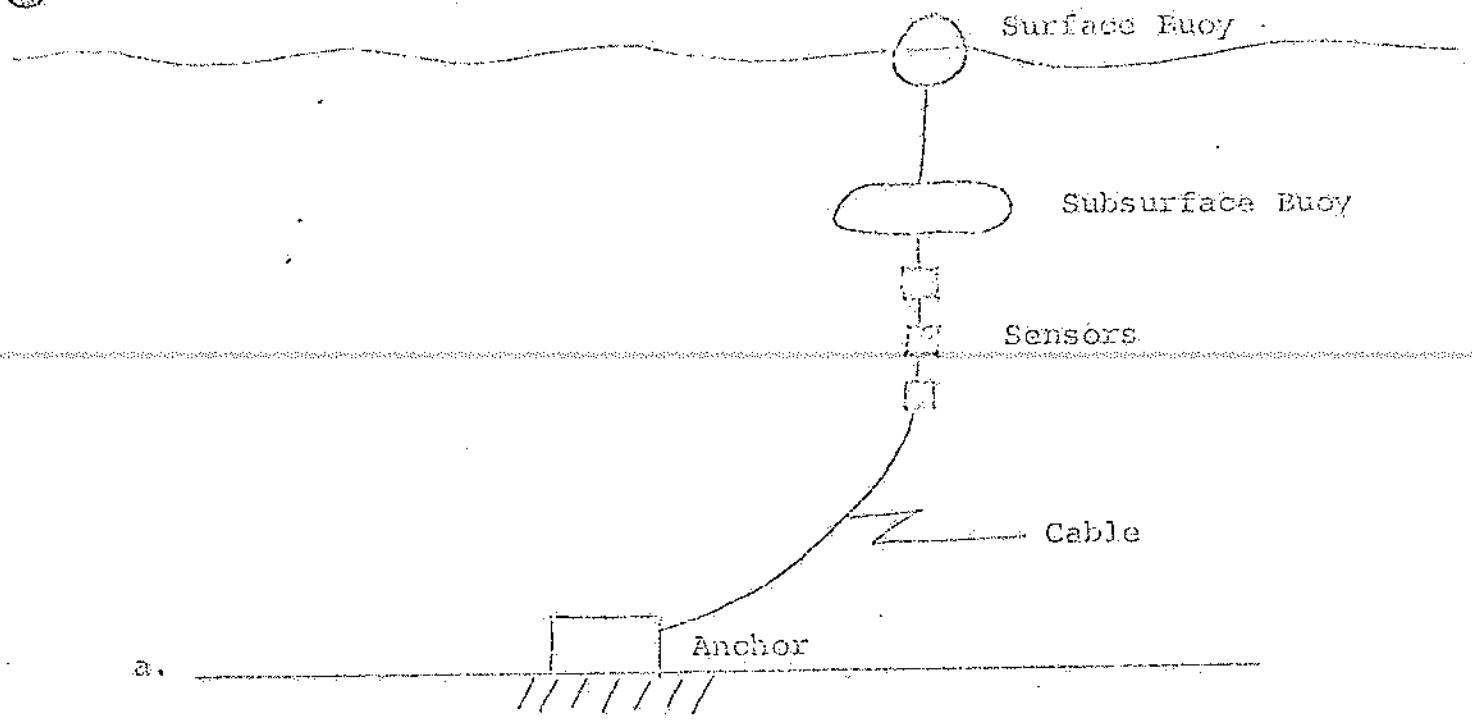
3. None

d. Identification of other NAVFAC responsibilities

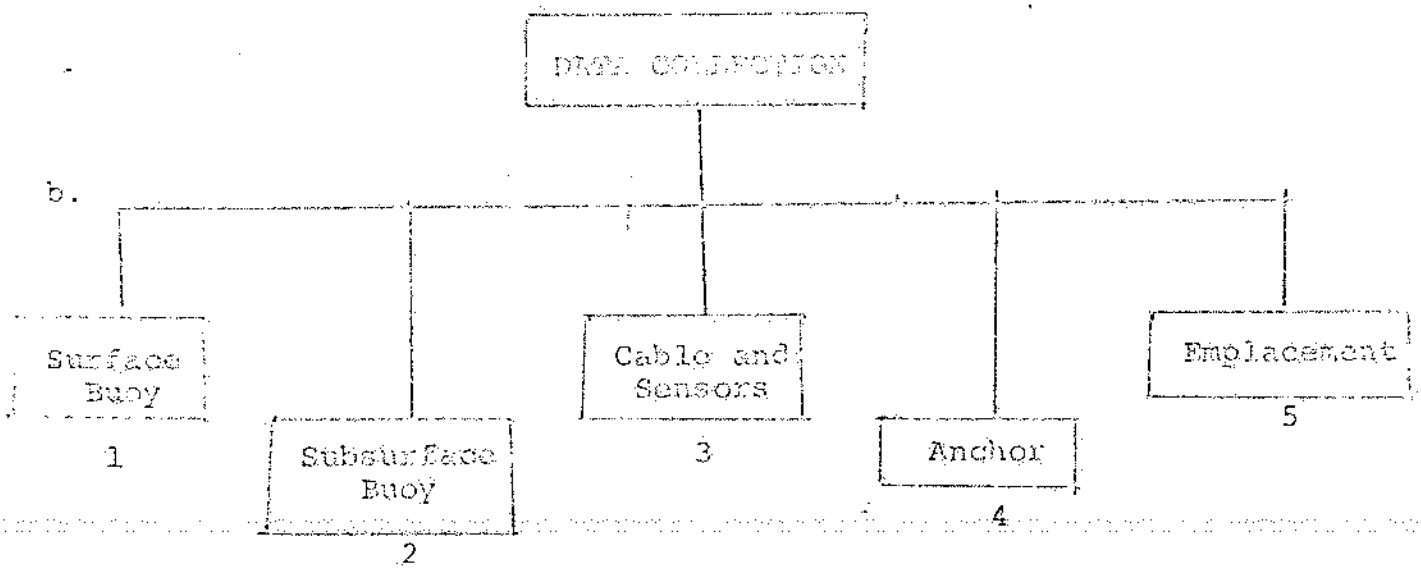
1. Provide liaison to NAVELEX

2. Provide liaison to NAVELEX

3. Provide liaison to NAVELEX


Surface Buoy
Subsurface Buoy
Sensors
Cable
Anchor

a.


DATA COLLECTION
Surface Buoy
1
Subsurface Buoy
2
Cable and Sensors
3
Anchor
4
Emplacement
5

b.

OCEANOGRAPHIC DATA COLLECTION

c. Identification of SEAFEE Functions and Tasks

1. Maintain and inspect.
2. Divers to check chafing and replace subsurface buoy.
3. None
4. Prefabricate anchors and connectors
5. Weight handling from surface

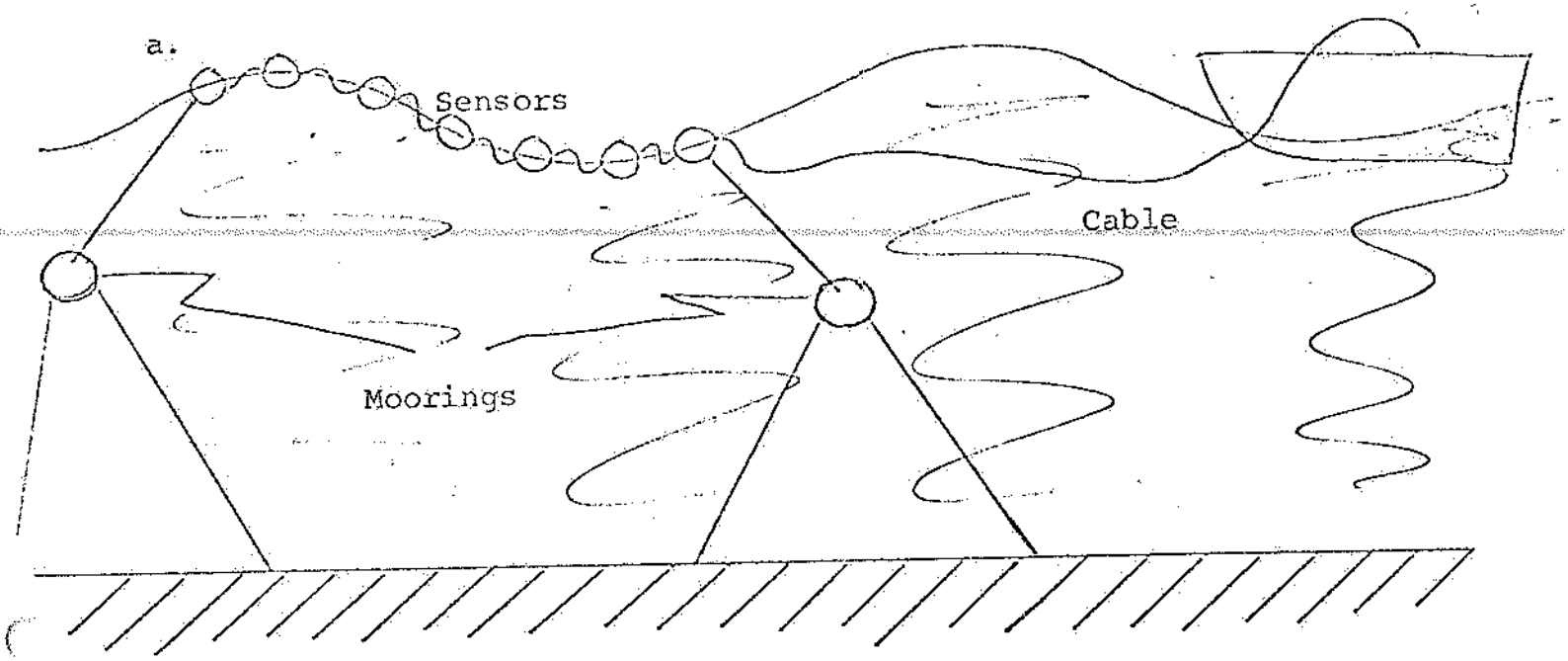
d. Identification of Other NAVFAC Responsibilities

1. Design, contract, maintain and inspect.
2. Design - (Power source must be provided)
3. Design
4. Design
5. Site selection and soil exploration.

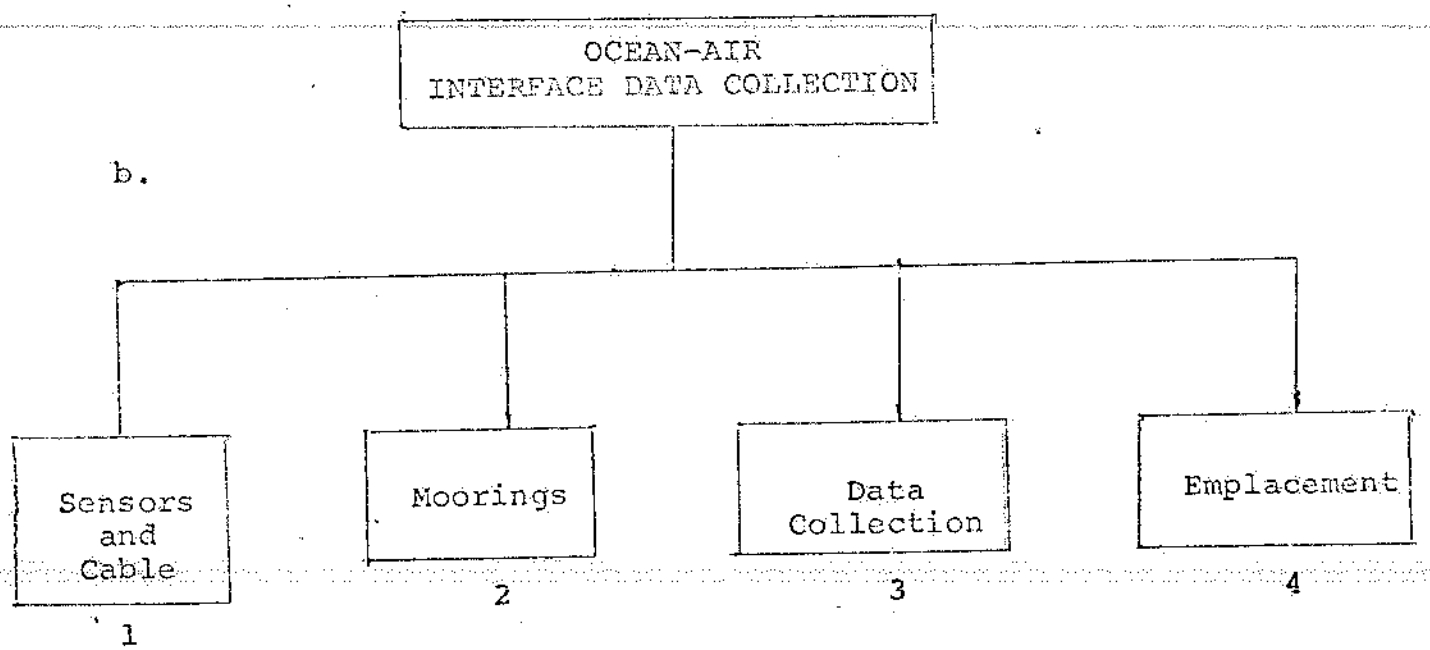
OCEAN-AIR INTERFACE DATA COLLECTION

Concept 1 - Floating Sensors

a.



b.



OCEAN-AIR INTERFACE DATA COLLECTION

Concept 1 - Floating Sensors

c. Identification of SWAPS Functions and Tasks

1. Install

2. Install

3. None

4. Perform emplacement

d. Identification of other NAVFAC Responsibilities

1. Contract for sensors

2. Design Moorings

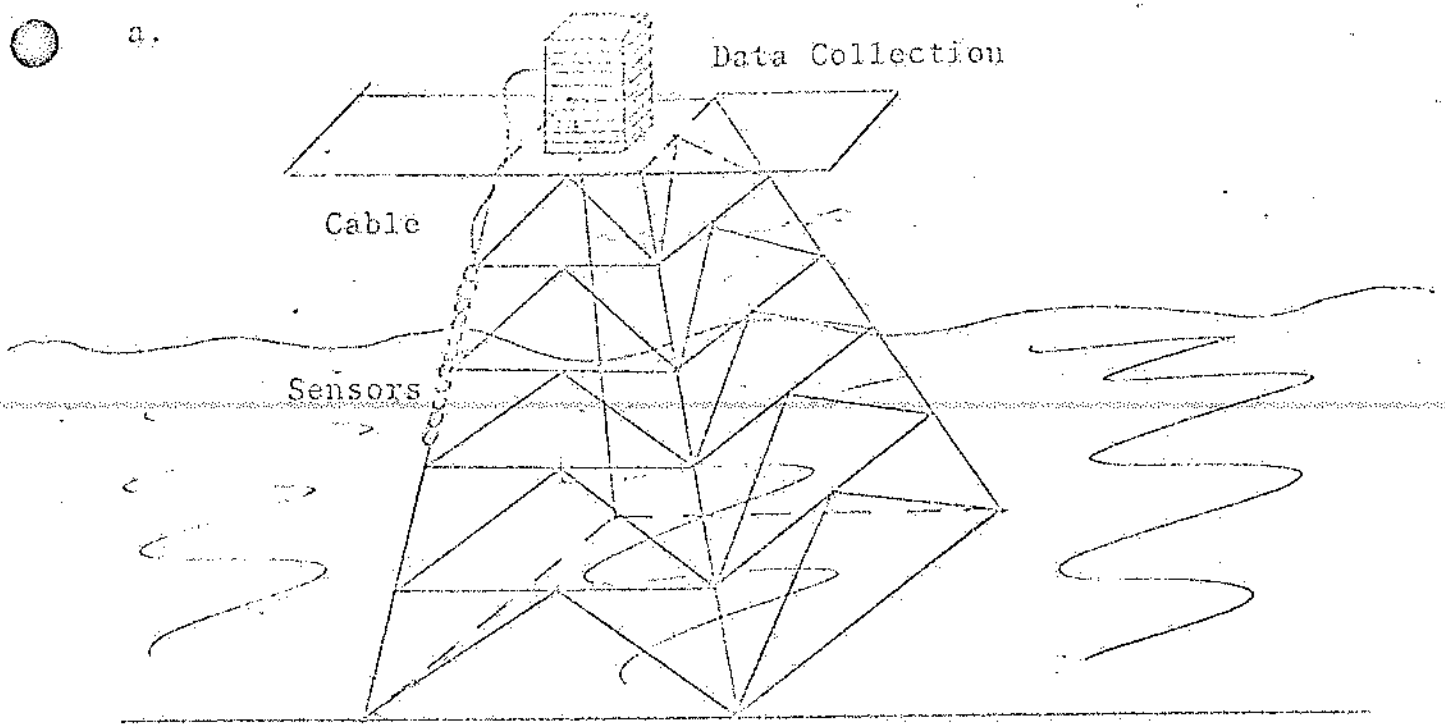
3. None

4. Emplacement procedures

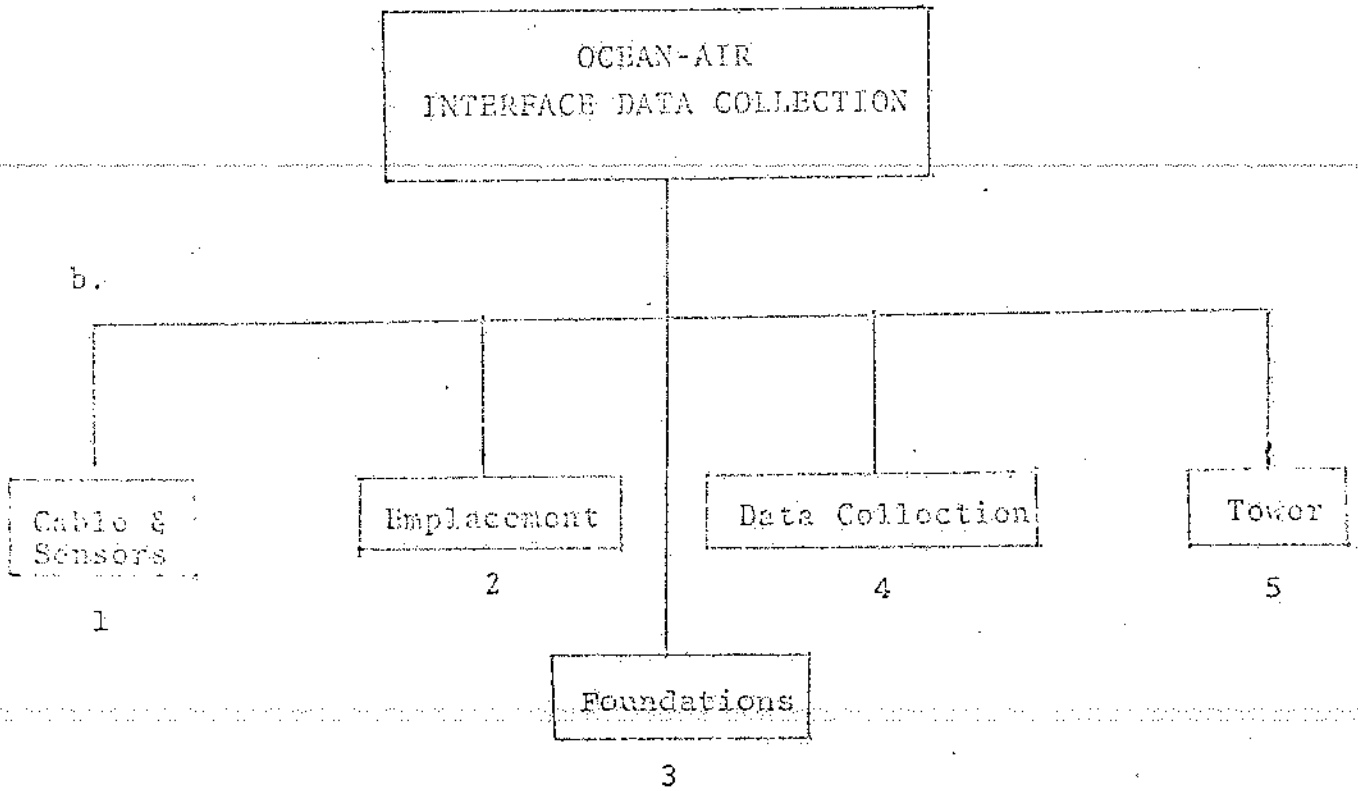
OCEAN-AIR INTERFACE DATA COLLECTION

Concept 2 - Tower

a.



b.



Concept 2 - Tower

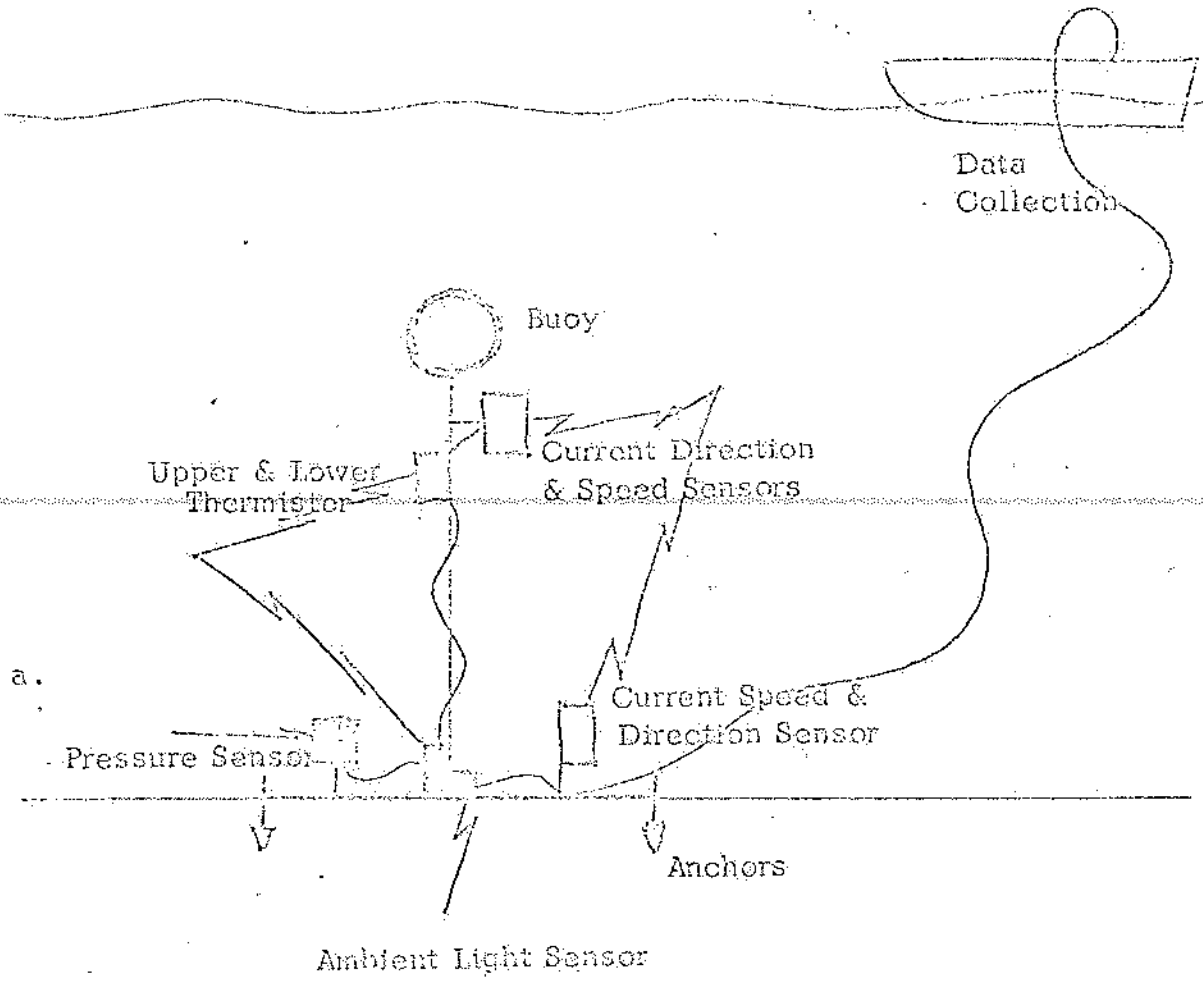
c. Identification of NAVFAC Functions and Tasks

1. Install, provide cathodic protection
2. Perform emplacement
3. Install
4. None
5. Prefabricate and construct tower

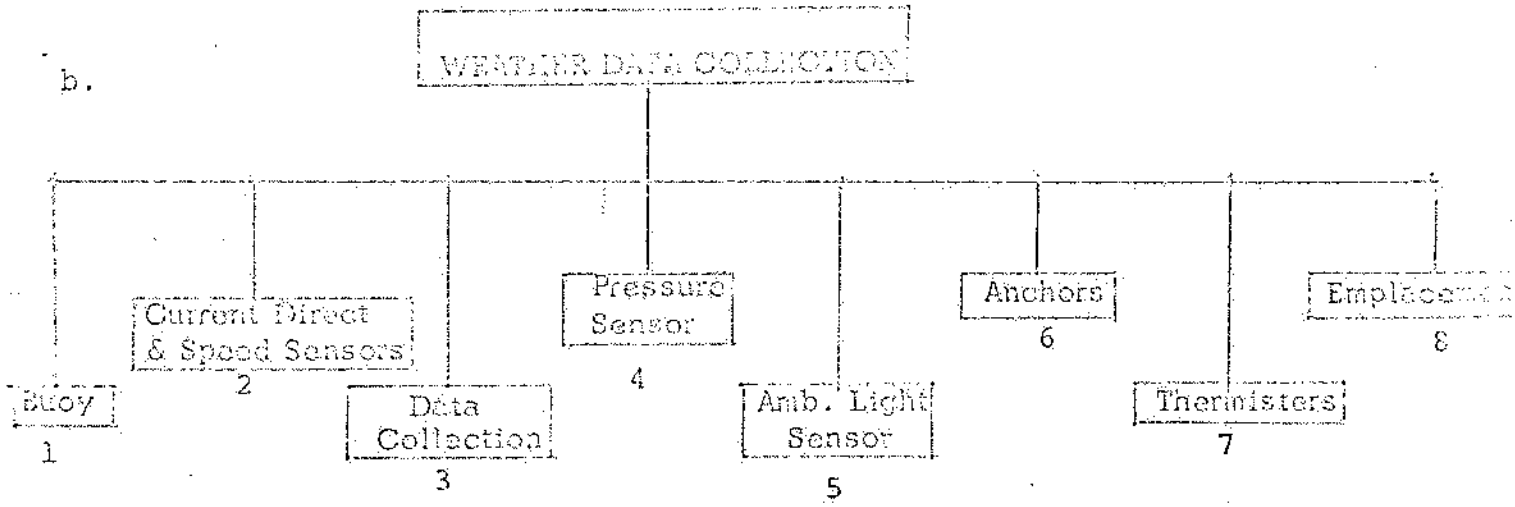
d. Identification of other NAVFAC responsibilities

1. Design
2. None
3. Design
4. None
5. Prefabricate, design, contract, maintain, and inspect.

a.


Data
Collection
Buoy
Upper & Lower
Thermistor
Current Direction
& Speed Sensors
Current Speed &
Direction Sensor
Pressure Sensor
Anchors
Ambient Light Sensor

b.


WEATHER DATA COLLECTION
Buoy
1
Current Direct
& Speed Sensors
2
Data
Collection
3
Pressure
Sensor
4
Amb. Light
Sensor
5
Anchors
6
Thermisters
7
8

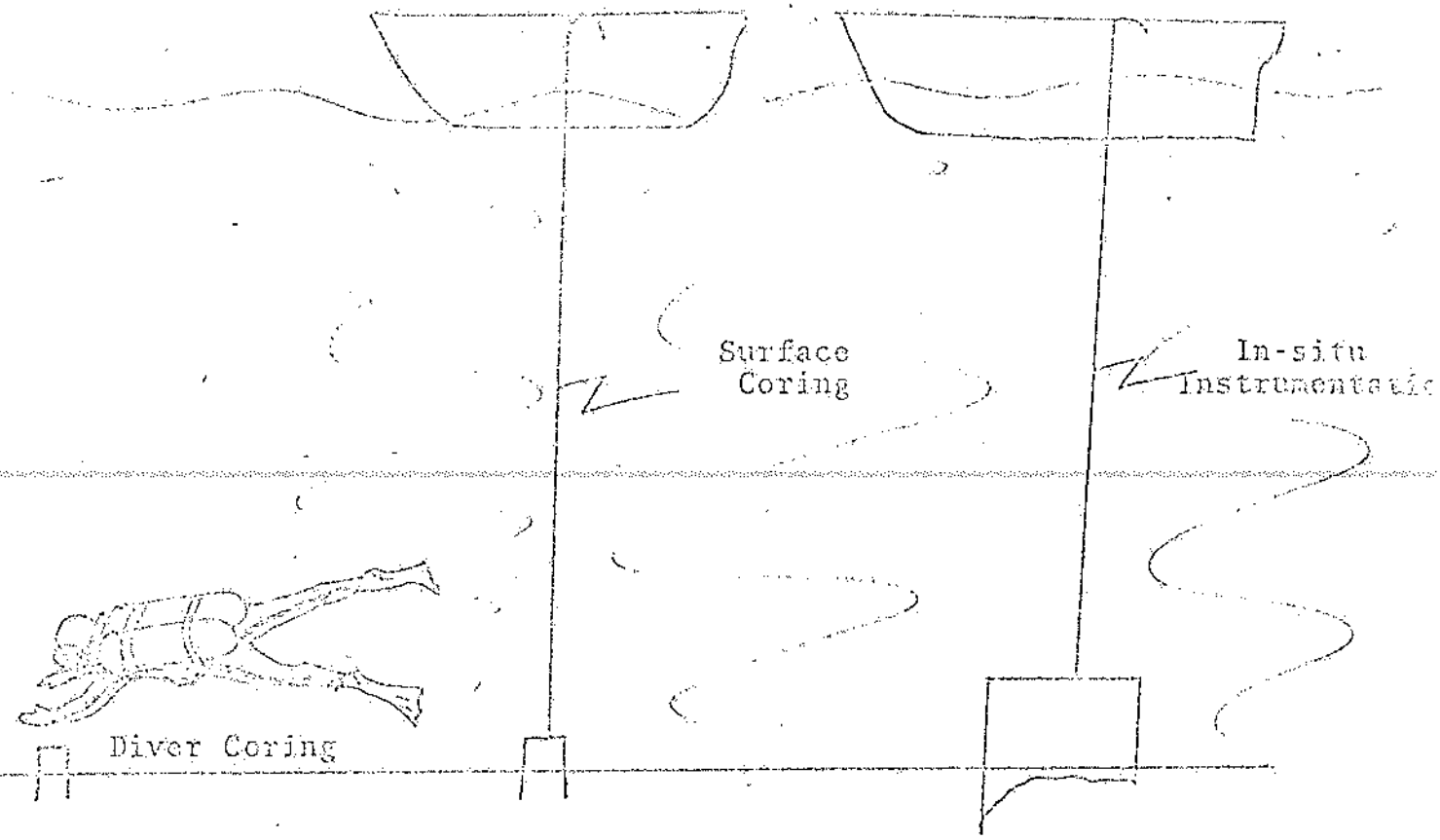
c. Identification of [illegible] Functions and Tasks

1. Install
2. Install
3. None
4. Install
5. Install
6. Install
7. Install
8. Operate barge and lifting equipment

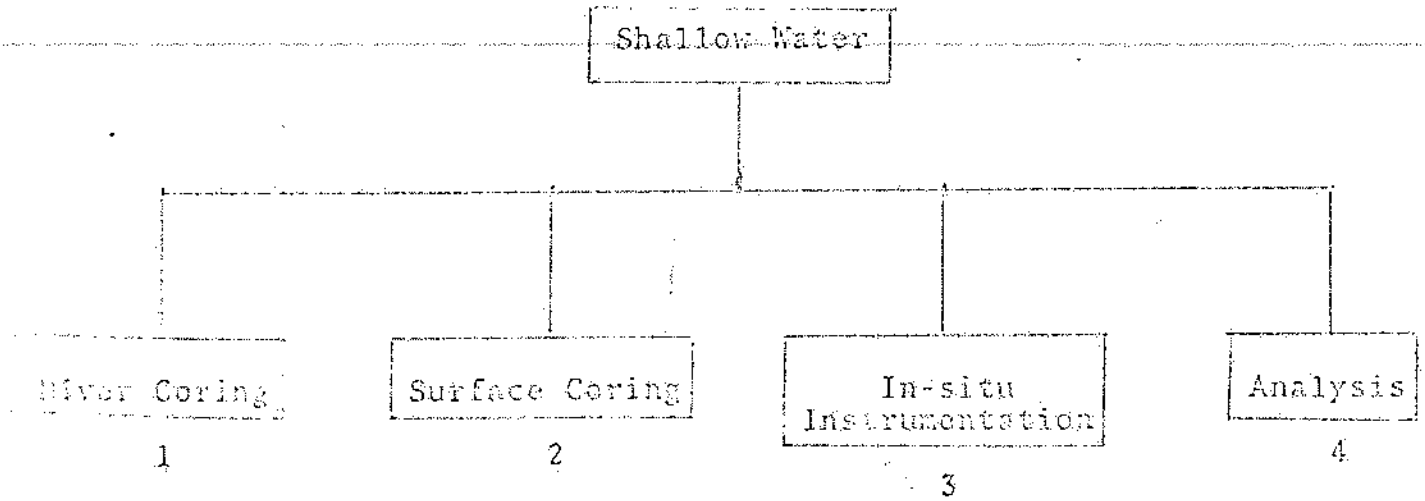
d. Identification of Other NAVFAC Responsibilities

1. Design buoy
2. None
3. None
4. None
5. None
6. Design anchorage
7. None
8. Contract lifting equipment

Concept 1 - Shallow Water



GEOLOGICAL DATA COLLECTION



GEOLOGICAL DATA COLLECTION

Concept 1 - Shallow Water

c. Identification of [illegible] Functions and Tasks

1. Divers perform coring operation
2. Operate coring equipment
3. Install
4. None

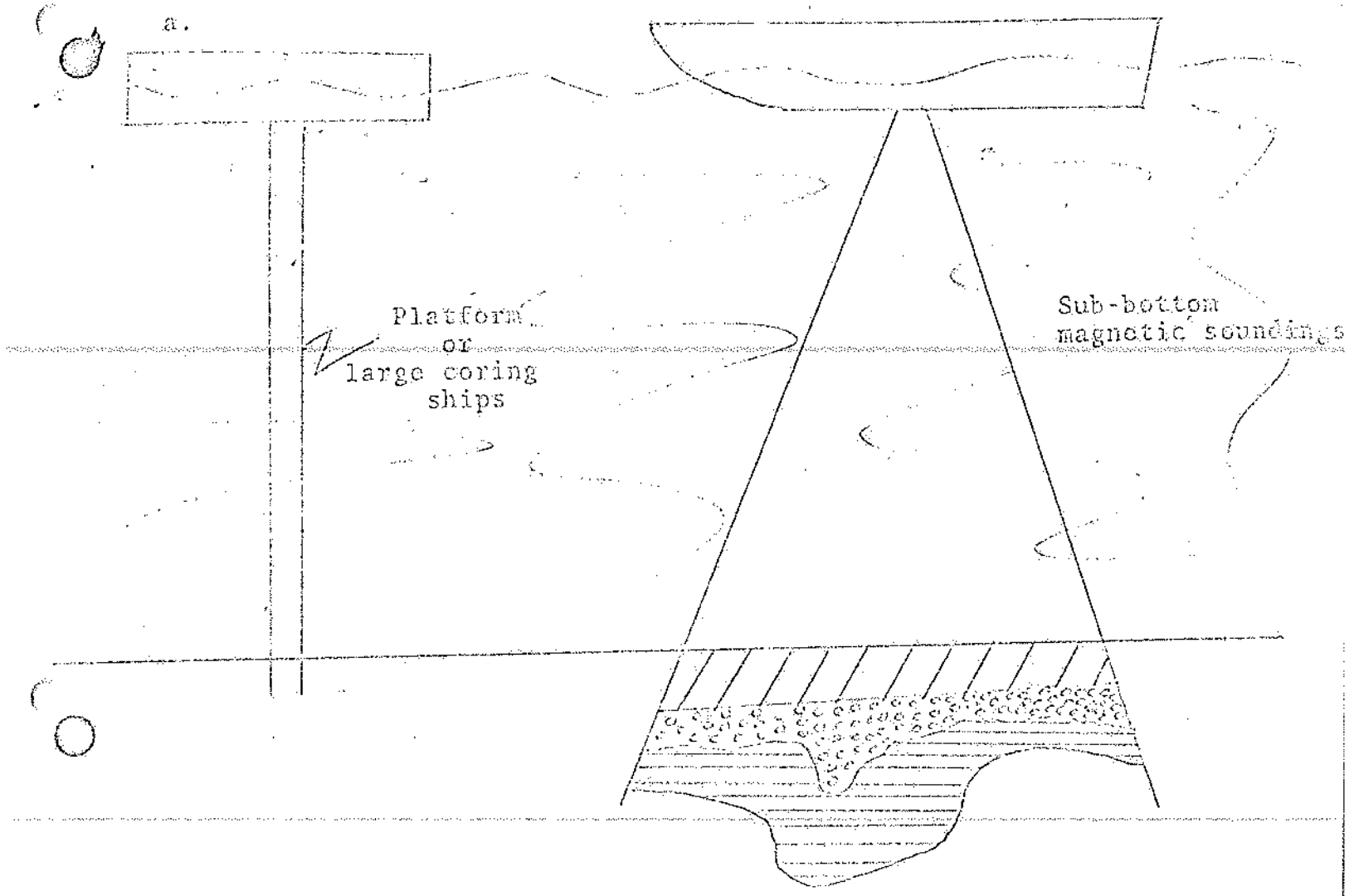
d. Identification of other NAVFAC responsibilities

1. None
2. Contract equipment
3. Design
4. Perform analysis

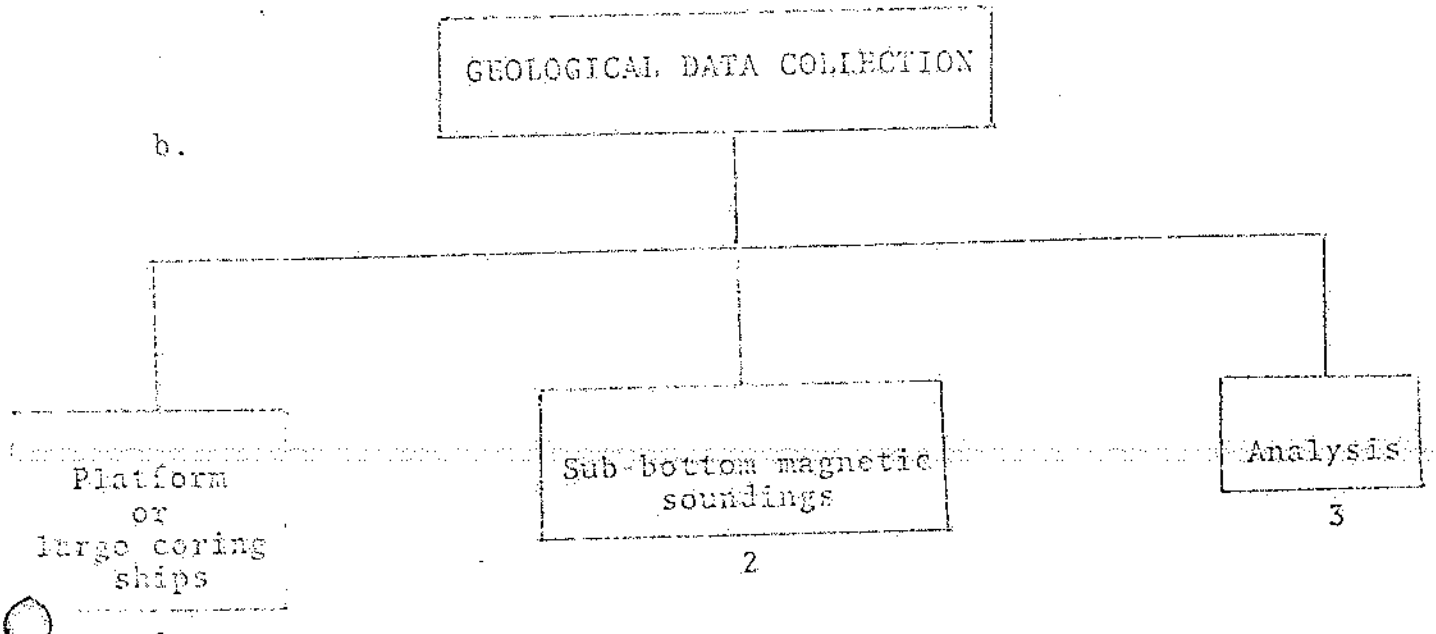
GEOLOGICAL DATA COLLECTION

Concept 2 - Deep Water

a.



b.



GEOLOGICAL DATA COLLECTION

Concept 2 - Deep Water

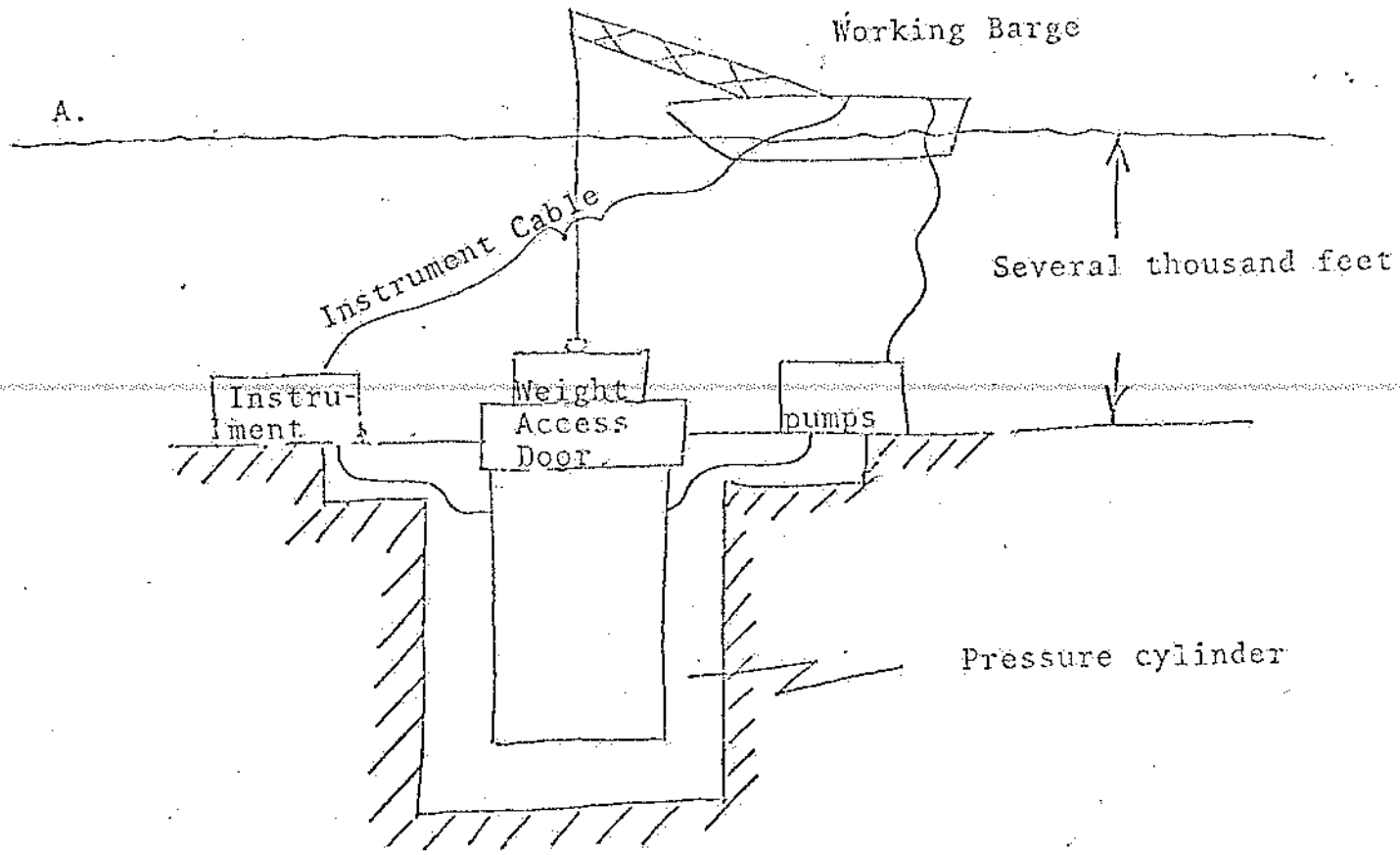
c. Identification of SEABEE Functions and Tasks

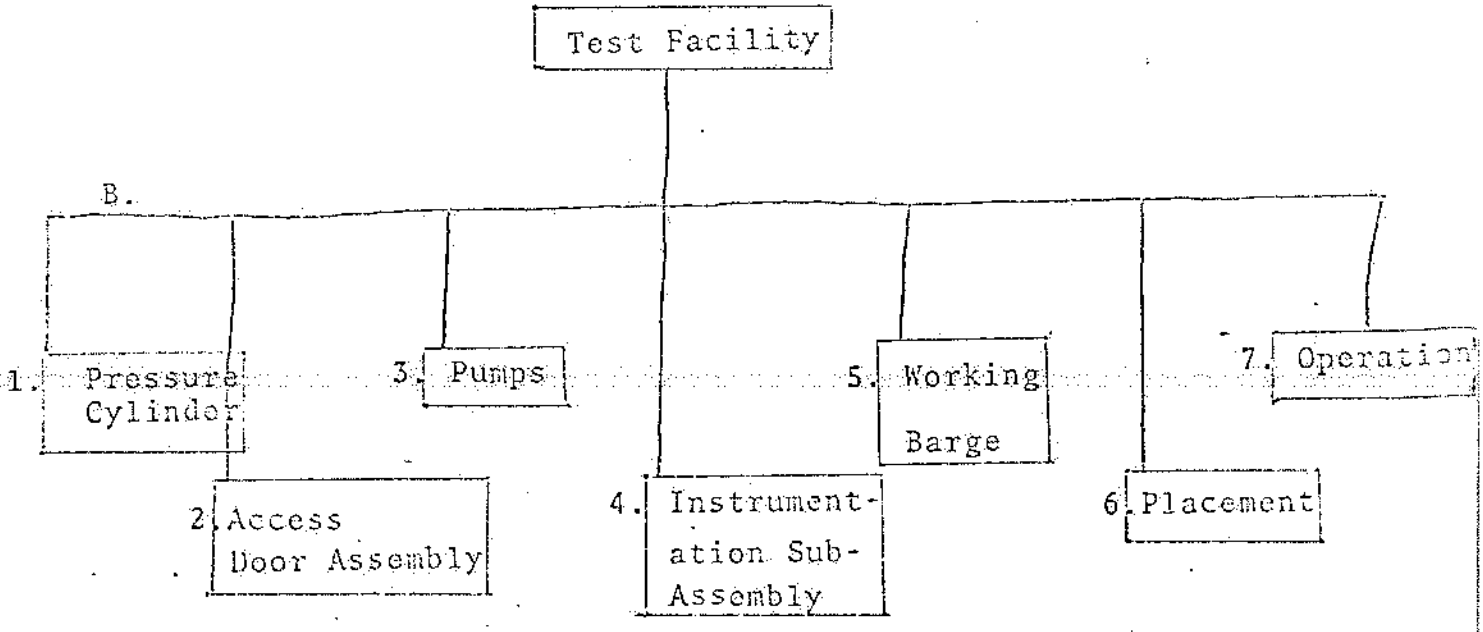
1. Operate equipment
2. None
3. None

d. Identification of other NAVFAC responsibilities

1. Design
2. Perform liaison with NAVELEX
3. Perform analysis

UNDERWATER PRESSURE TEST FACILITY





UNDERWATER PRESSURE TEST FACILITY

c. Identification of SEABEE Functions and Tasks

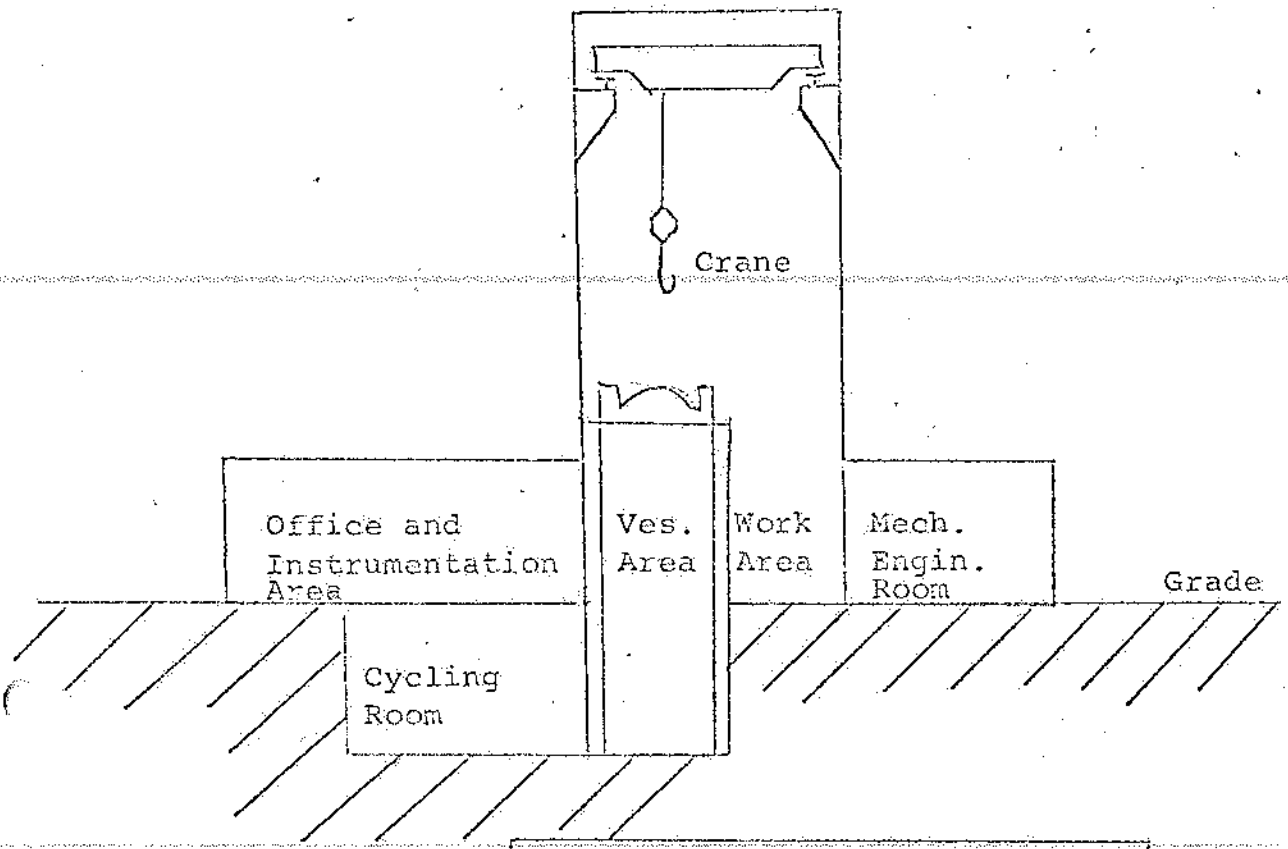
1. Prefabrication of pressure cylinder
2. Prefabrication of door and weight
3. None
4. Prefabrication of housing
5. None
6. Excavation, weight handling
7. None

d. Identification of Other NAVFAC Responsibilites

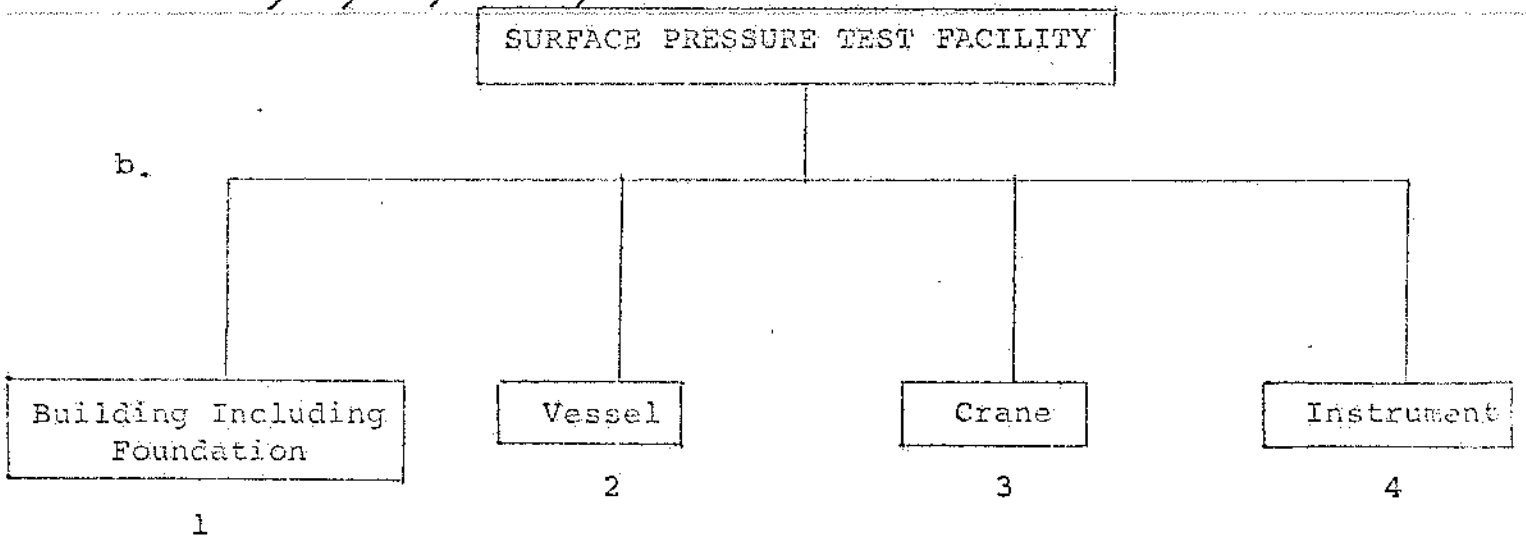
1. Design of pressure cylinder
2. Design of access door and weight
3. Design and provision of pumps, pipes, and connections
4. Design of housing, cables and connections
5. Weight handling technology
6. Site selection, soils evaluation, develop excavation procedures
7. None

SURFACE PRESSURE TEST FACILITY

a.



b.



c. Identification of SEABEE Functions and Tasks

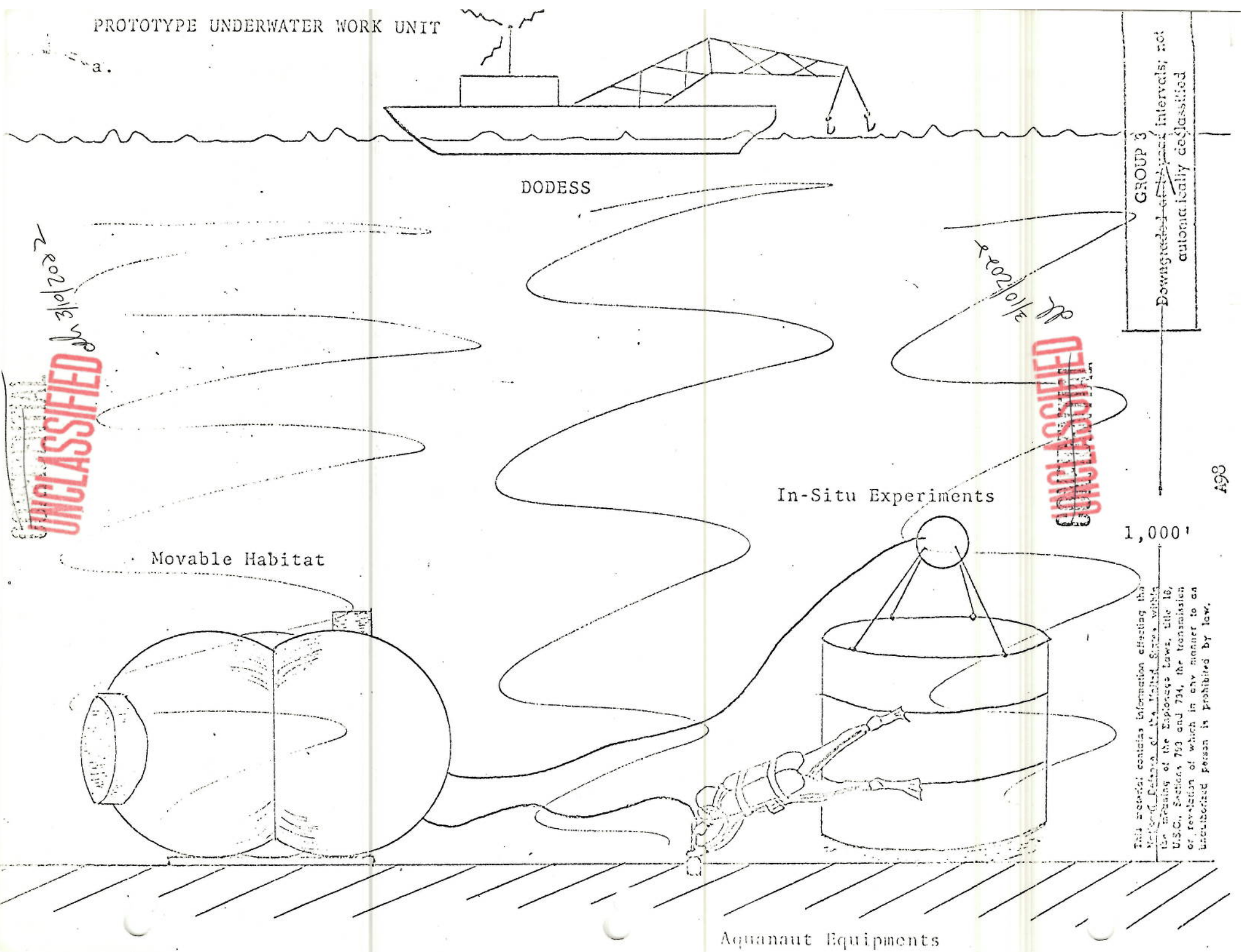
1. Site survey and core borings
2. None
3. Operate crane
4. None

d. Identification of other NAVFAC responsibilities

1. Interpretation of core borings design building and foundations
2. Design vessel including the mechanical and electrical systems
3. Specify and purchase crane
4. None

PROTOTYPE UNDERWATER WORK UNIT

a.



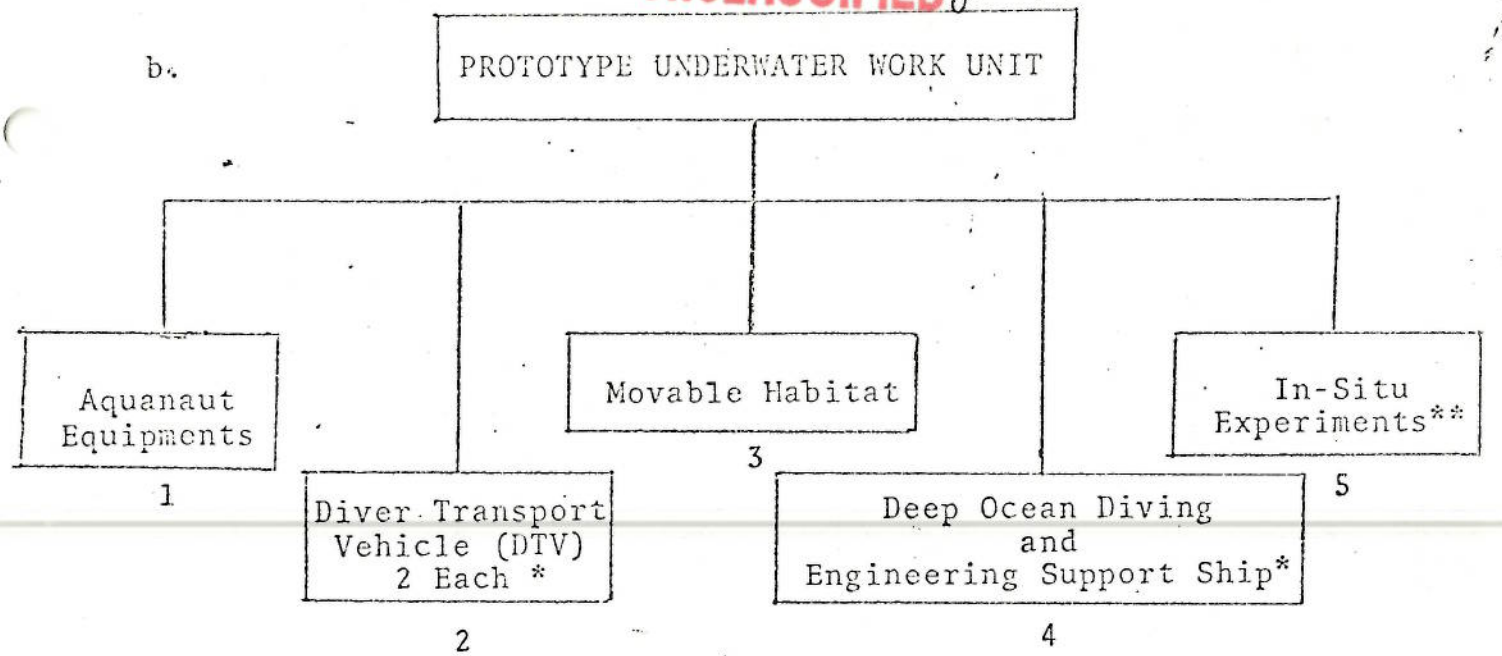
GROUP 3
Downgraded at 12 year intervals; not automatically declassified

UNCLASSIFIED

UNCLASSIFIED

498

b.

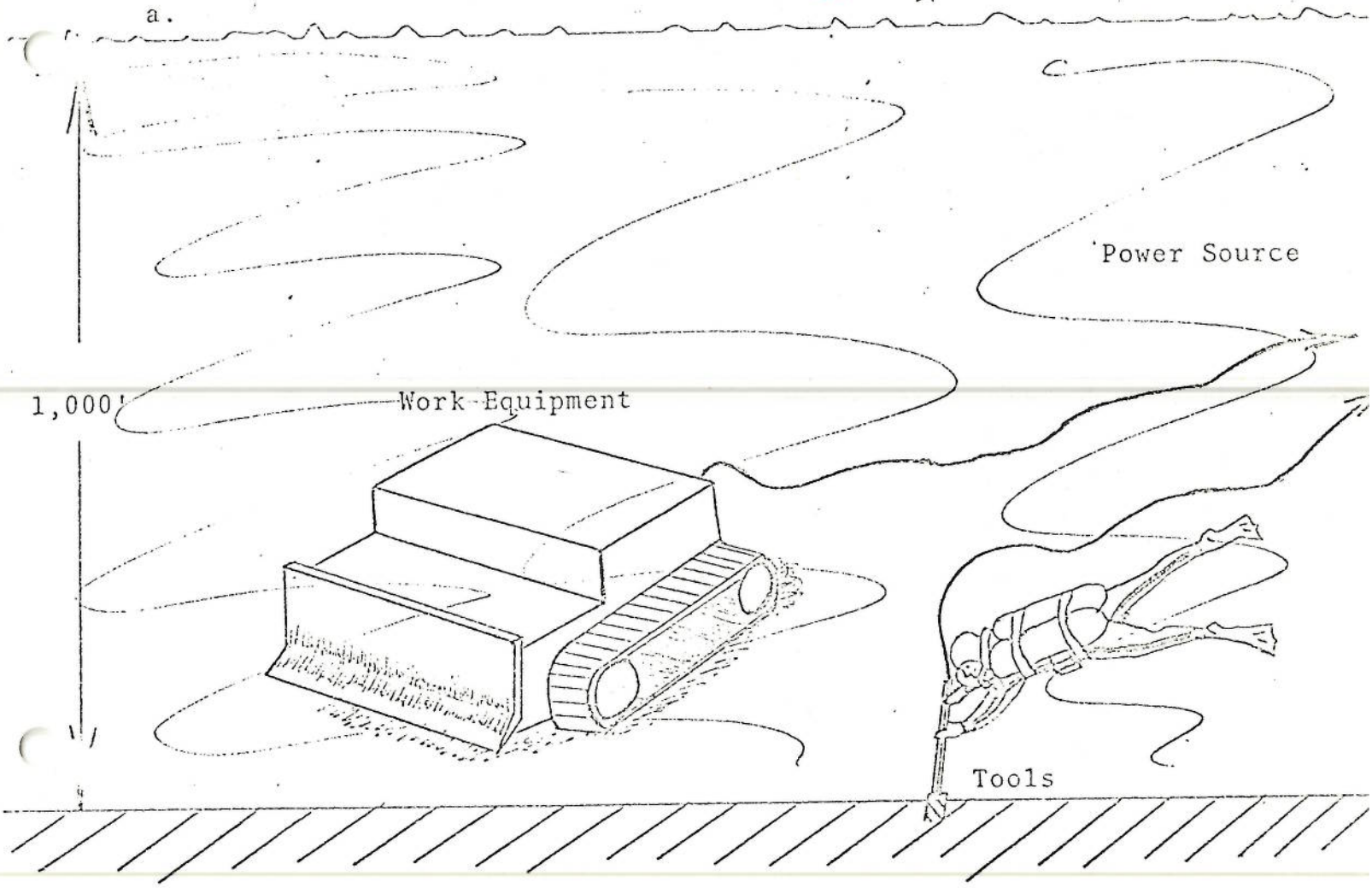


* PDA - NAVSHIPS (NAVFAC must maintain close liaison with NAVSHIPS to coordinate specific needs in transporting, handling and servicing the Manned Habitat (DODESS) as well as work tasks which should be performed by manipulators of DTVs.)

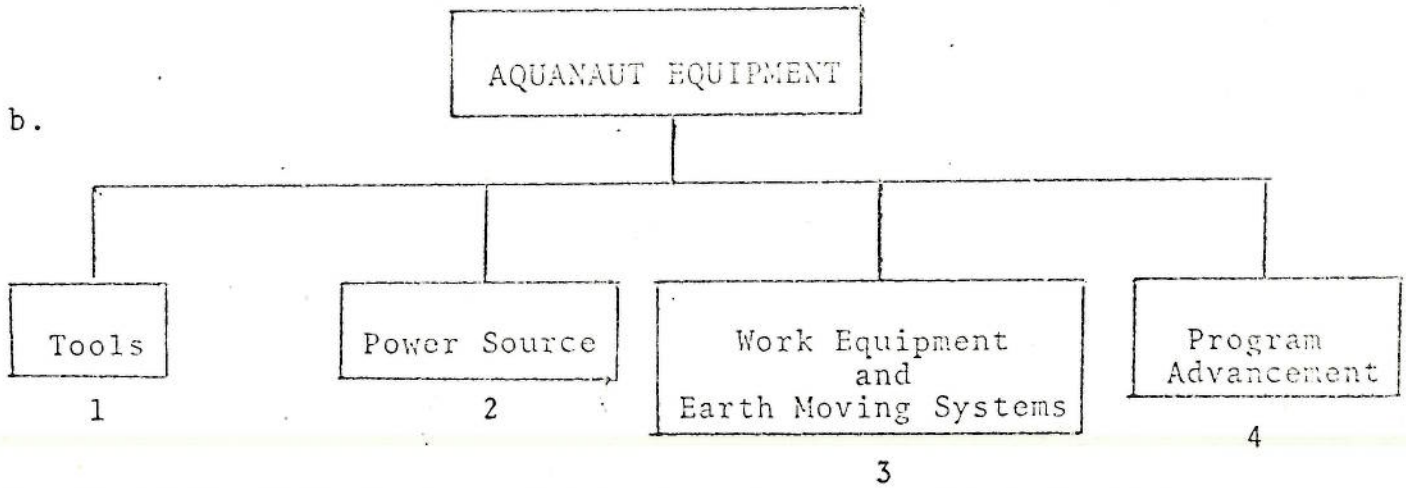
** Continuation of the SEALAB experiments (see Design Concept - SEALAB)

AQUANAUT EQUIPMENT

a.



b.



c. Identification of SEABEE Functions and Tasks

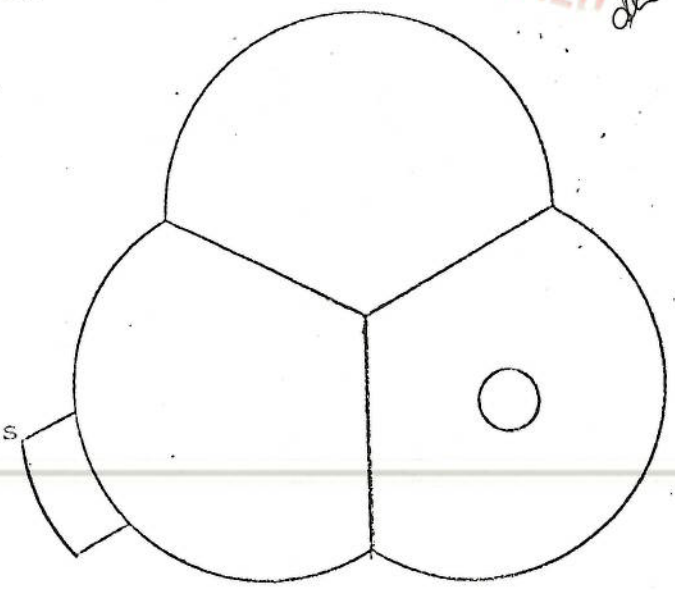
1. Coordinate diver capabilities w/tool design
2. Make connections
3. Coordinate diver capabilities w/equipment development
4. Maintain training programs

d. Identification of other NAVFAC responsibilities

1. Design tools (i.e.-reactionless torque wrenches, drills, grianders, power-driven taps and impact hammers, explosive stud guns, cutting and welding tools, etc.)
2. Design umbilical capability from movable habitat as well as portable power source
3. Design work equipment and earth moving systems (i.e.-fork lift, bulldozer, crane, drill, auger, etc.)
4. Maintain close liaison with Movable Habitat progress.

MOVABLE HABITAT

a.



Vehicle and Equipment Ingress/Egress

Personnel and Cargo Ingress/Egress

(From surface operated transfer capsule or submersible vehicle)

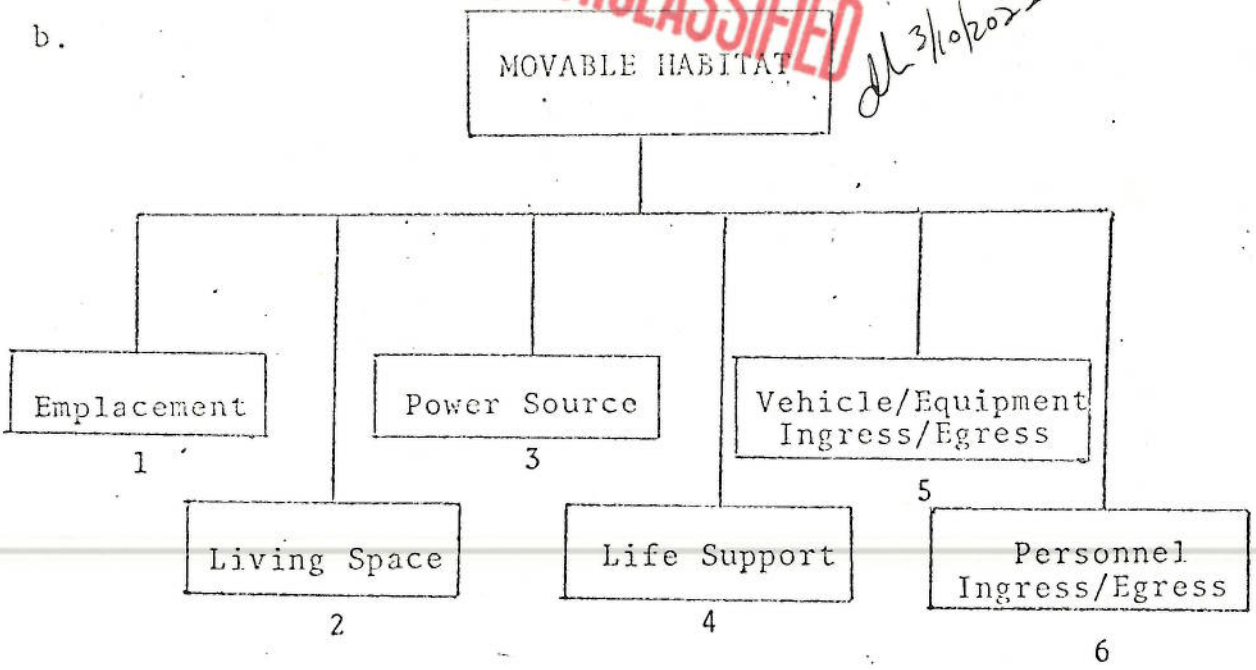
1,000'

Power Cable (from shore or DODESS)

(40-60 men)

Control Center, Home, Maintenance, Storage, Medical Support Facility and Laboratory

b.



c. Identification of SEABEE Functions and Tasks

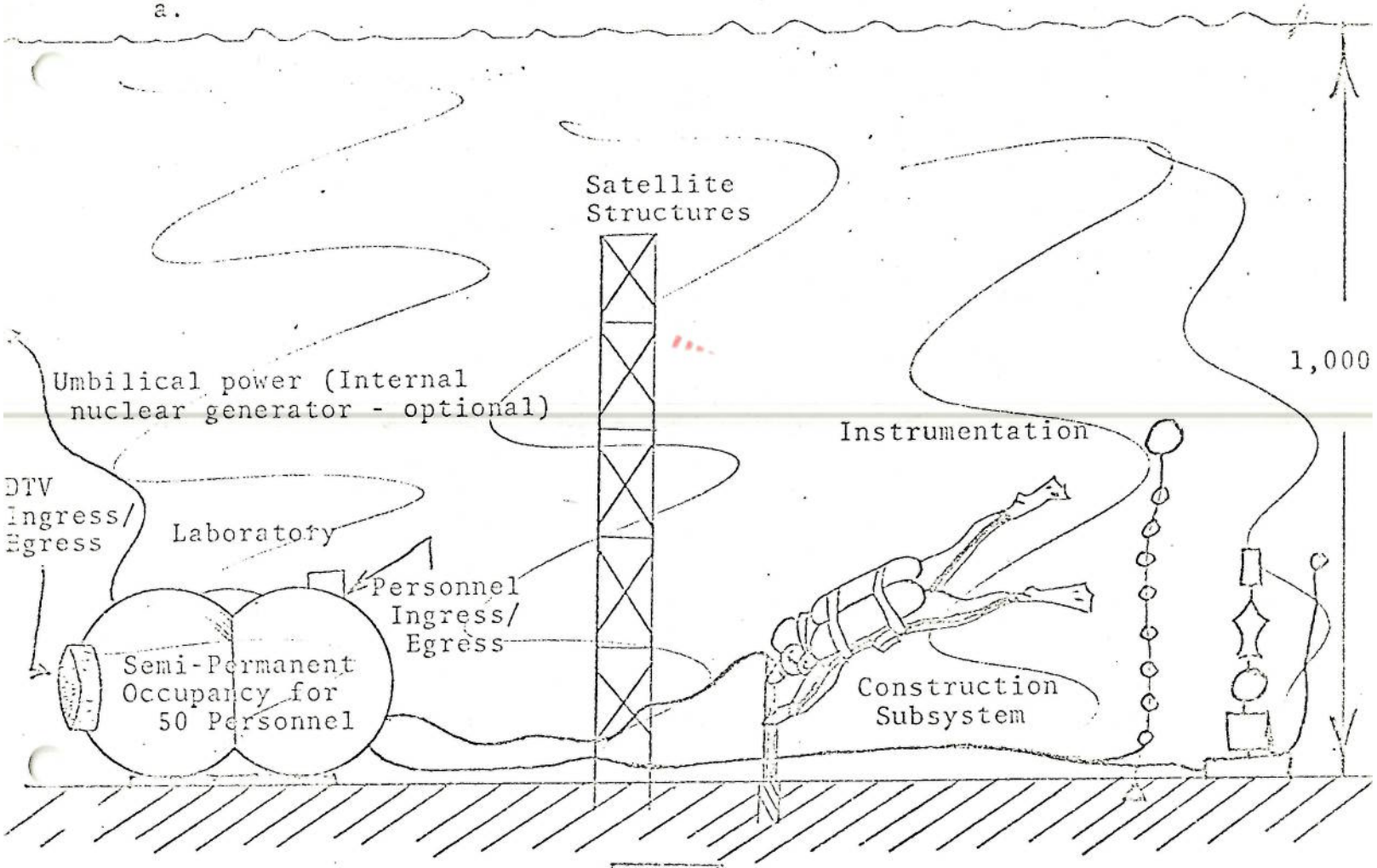
1. Perform emplacement
2. None
3. Make umbilical connections
4. None
5. None
6. None

d. Identification of other NAVFAC responsibilities

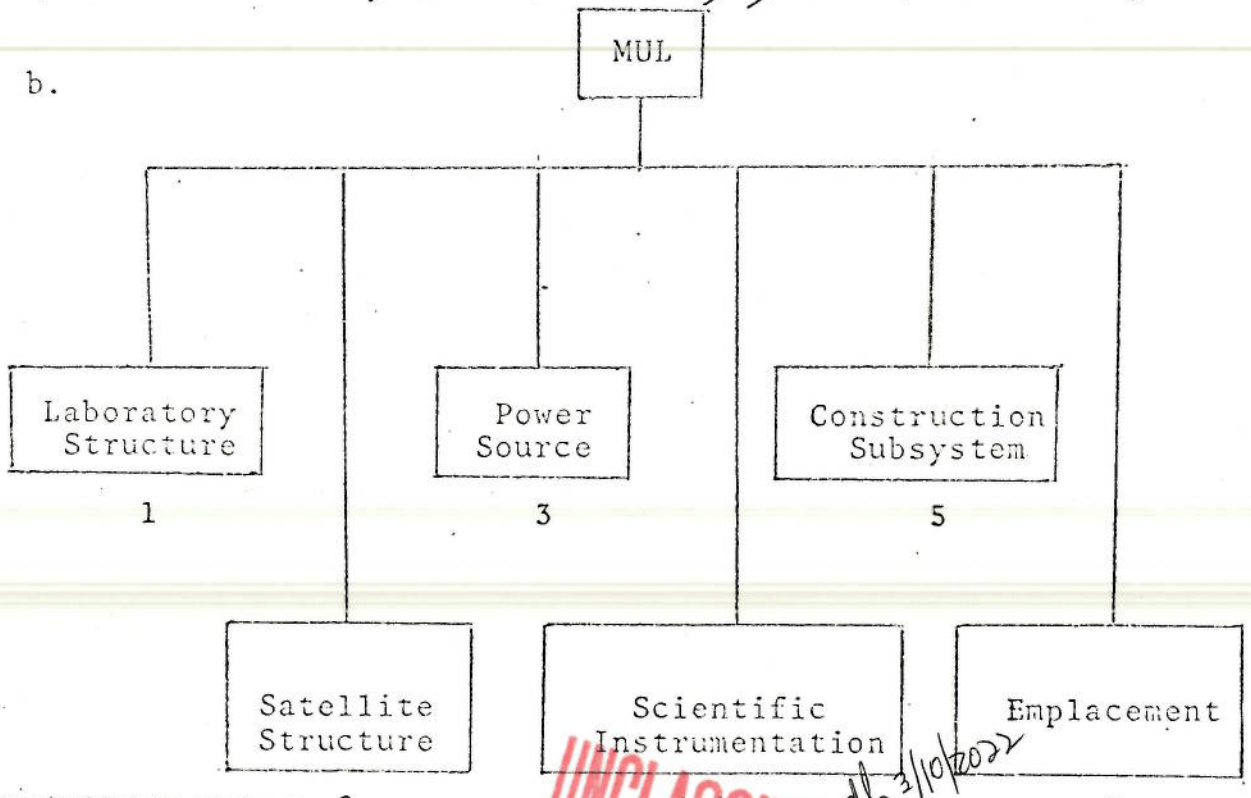
1. Coordinate design of habitat with DODESS development (NAVSHIPS)
2. Design space for laboratory control center, maintenance medical, mess and billets
3. Design nuclear power plant or umbilical power from shore or DODESS
4. Design one atmosphere and ambient compartments
5. Design 6. Design

MANNED UNDERWATER LAB

a.



b.



A10h

c. Identification of SEABEE Functions and Tasks

1. Install
2. Install
3. Install - make connections
4. Install
5. Coordinate diver capabilities with tool design
6. Obtain core samples, operate lifting equipment, perform emplacement

d. Identification of other NAVFAC responsibilities

1. Design (coordinate communication requirements with NAVELEX)
2. Develop capabilities to construct
3. Design
4. Develop techniques and design instrumentation for measuring soil mechanics parameters
5. Design
6. Analyze core sample, contract for lifting equipment, develop construction procedures and foundation requirements

MARINE COMMISSION

Fixed Continental Shelf Laboratory

SEE DESIGN CONCEPT

FOR

DS/OEPPG-MANNED UNDERWATER LAB

MARINE COMMISSION

Movable Habitat

SEE DESIGN CONCEPT

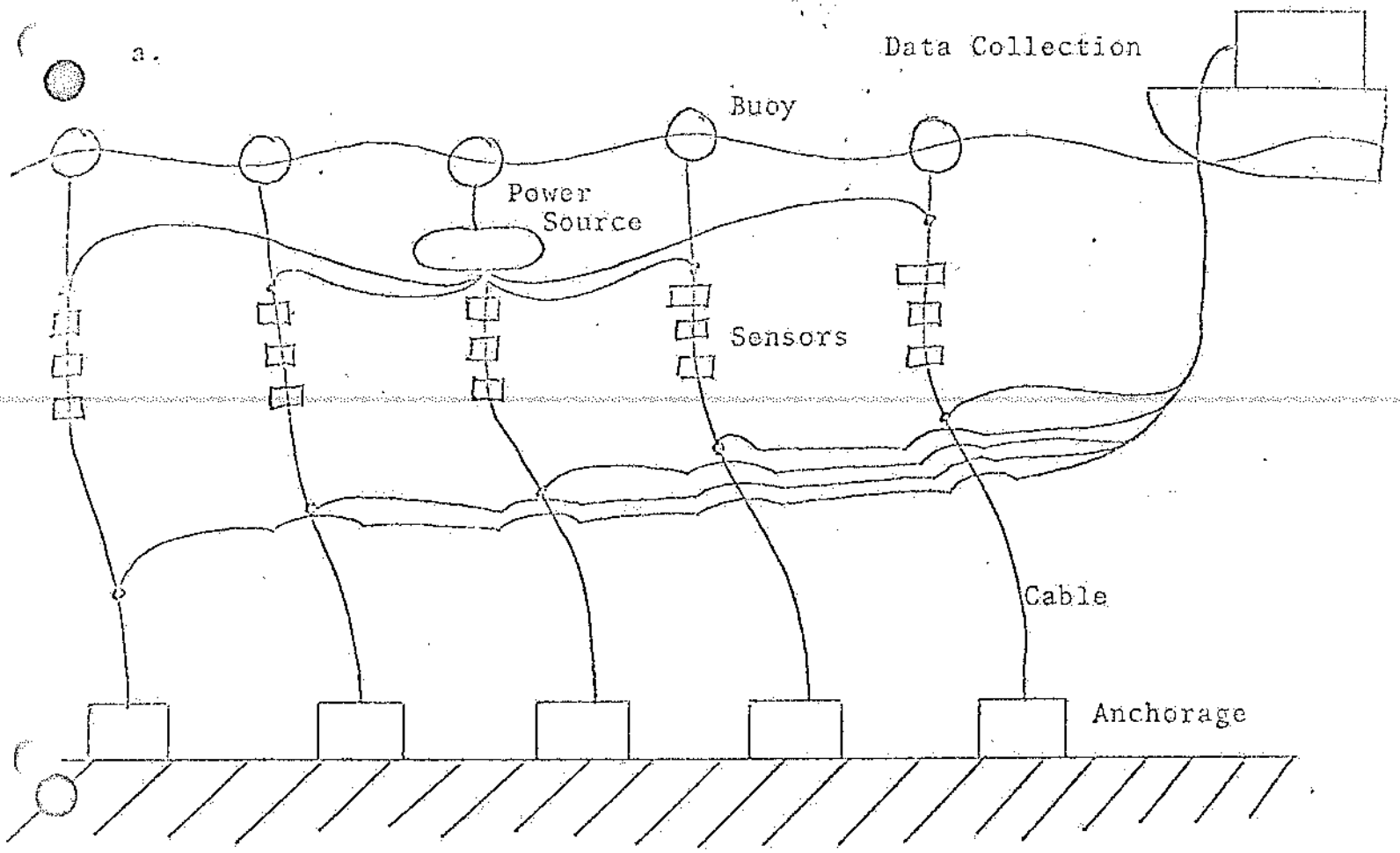
FOR

DS/OEPPG-MOVABLE HABITAT

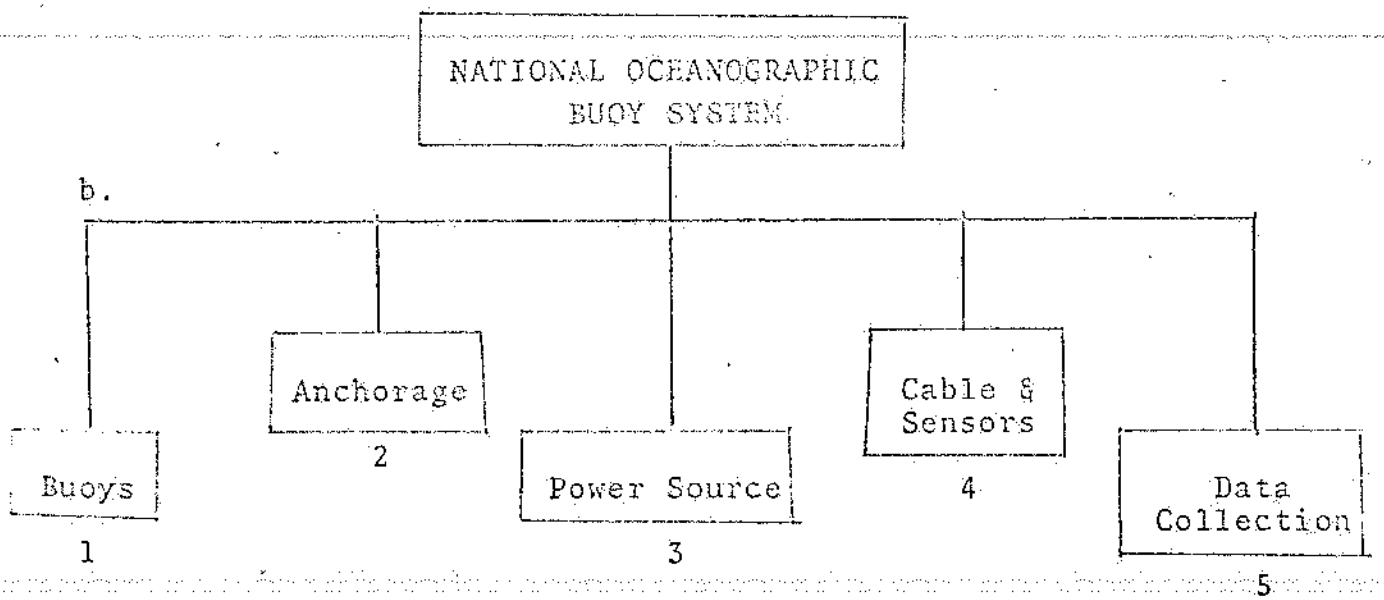
SEE DESIGN CONCEPTS FOR SURFACE LOGISTICS AND WORK PLATFORM

NATIONAL OCEANOGRAPHIC BUOY SYSTEM

a.



b.



NATIONAL OCEANOGRAPHIC BUOY SYSTEM

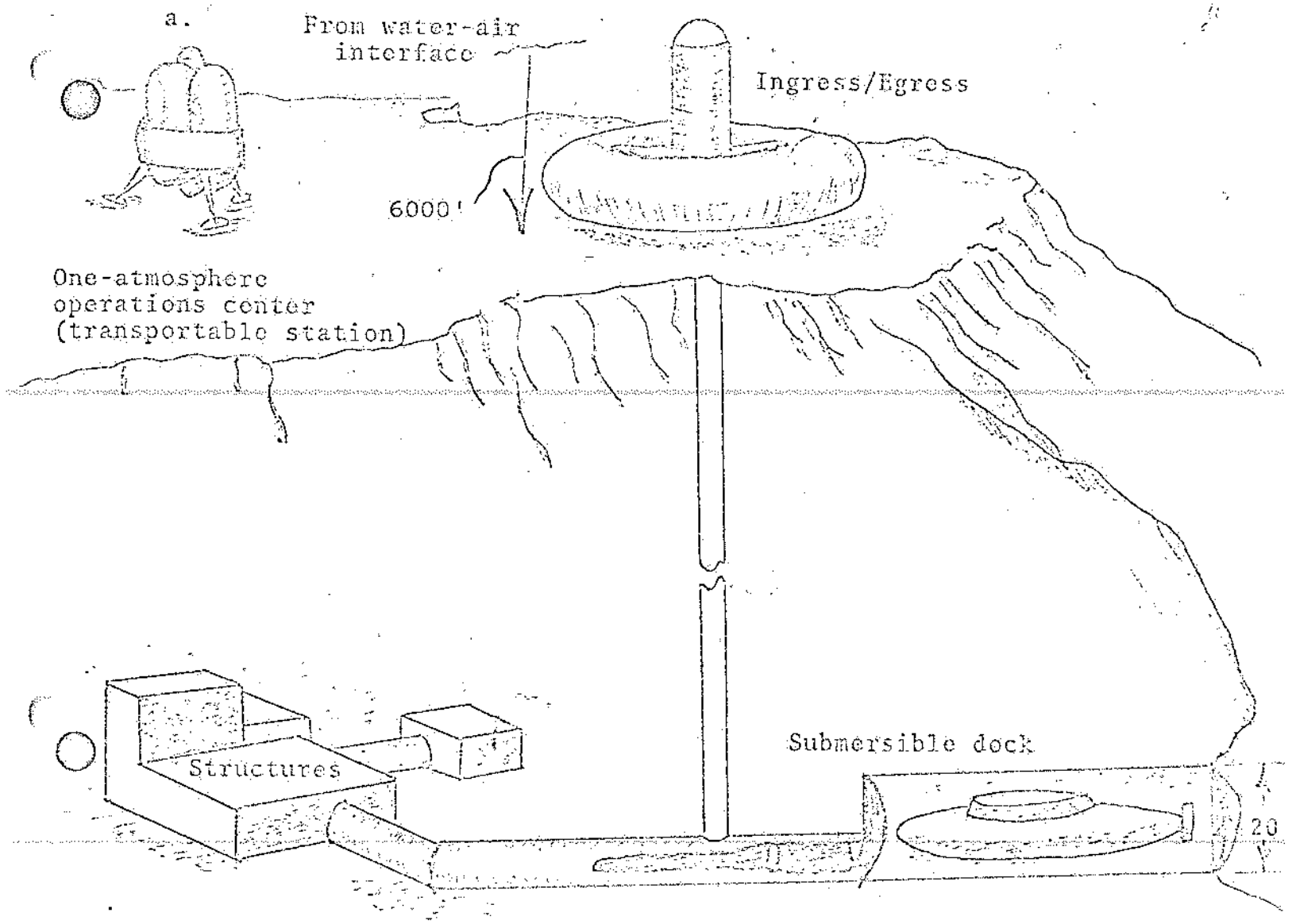
c. Identification of SEABEE Functions and Tasks

1. Maintain and inspect surface buoy; divers to check chafing of subsurface buoy.
2. Prefabricate anchors and connectors
3. None
4. None
5. None

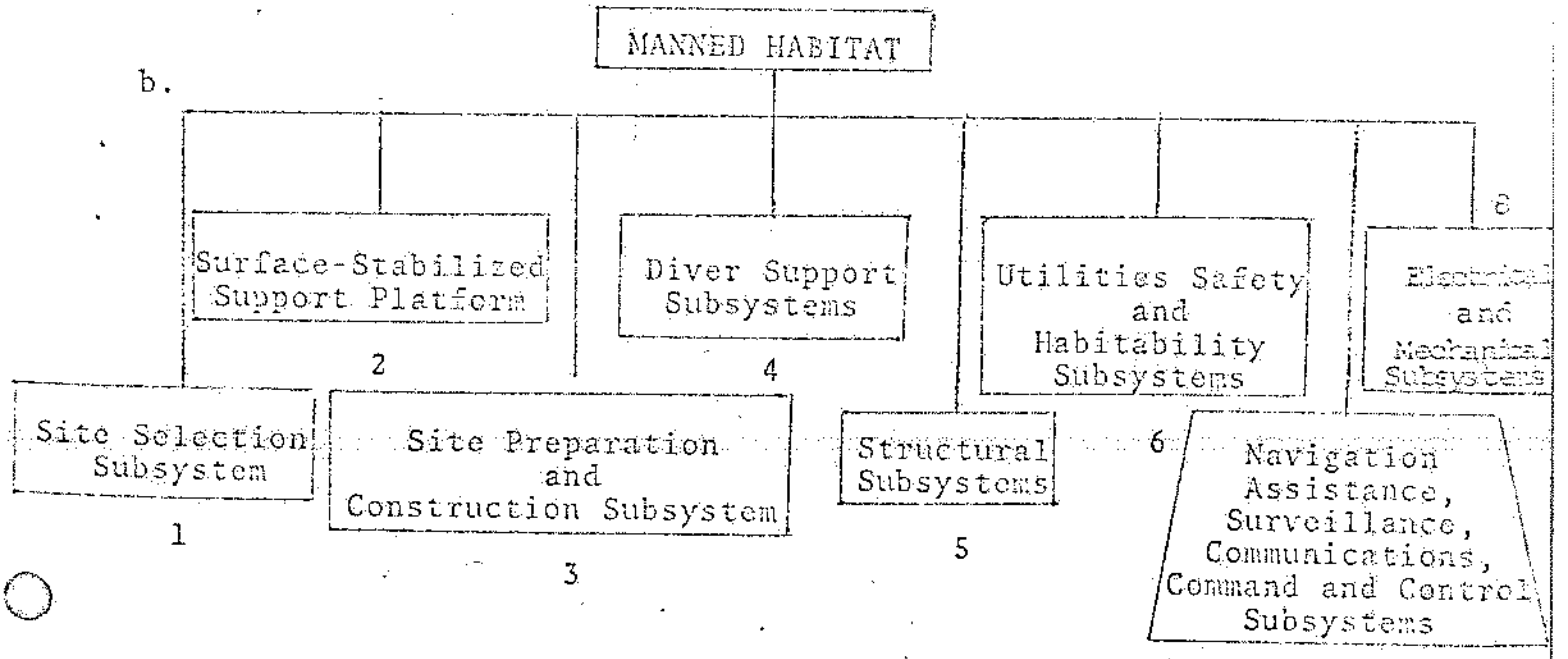
d. Identification of other NAVFAC responsibilities

1. Design, contract, maintain and inspect.
2. Design, contract, maintain and inspect.
3. Design, contract, maintain and inspect.
4. Design, contract, maintain and inspect.
5. None

a.


From water-air interface
Ingress/Egress
6000'
One-atmosphere operations center (transportable station)
Structures
Submersible dock
20

b.


MANNED HABITAT
Site Selection Subsystem
1
Surface-Stabilized Support Platform
2
Site Preparation and Construction Subsystem
3
Diver Support Subsystems
4
Structural Subsystems
5
Utilities Safety and Habitability Subsystems
6
Navigation Assistance, Surveillance, Communications, Command and Control Subsystems
7
Electrical and Mechanical Subsystems
8

MANNED HABITAT

c. Identification of SEABEE Functions and Tasks

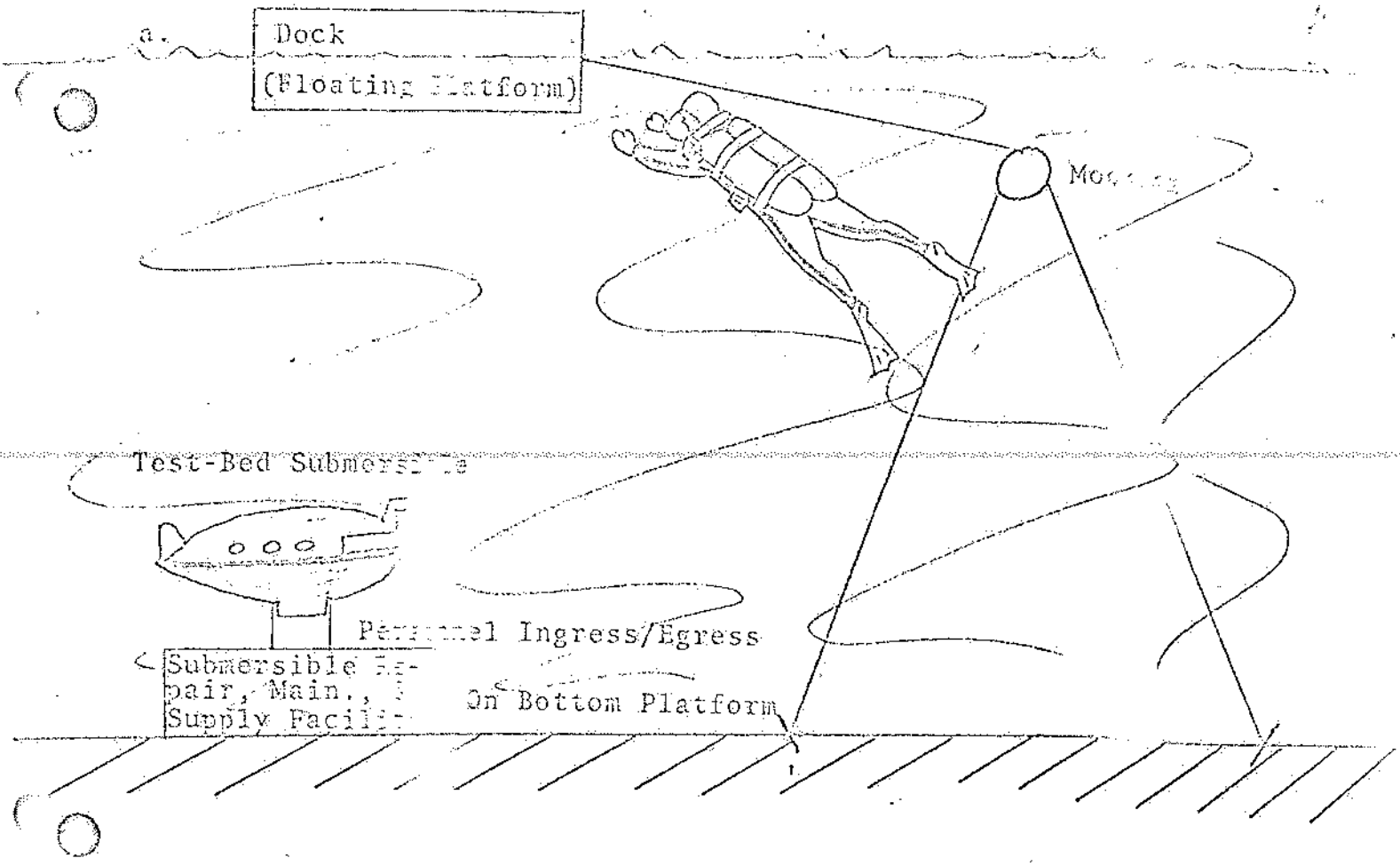
1. Provide cores
2. None
3. Perform earthmoving, drilling, excavation and lifting
4. Provide diver support
5. Construct
6. None
7. Install
8. None

d. Identification of other NAVFAC responsibilities

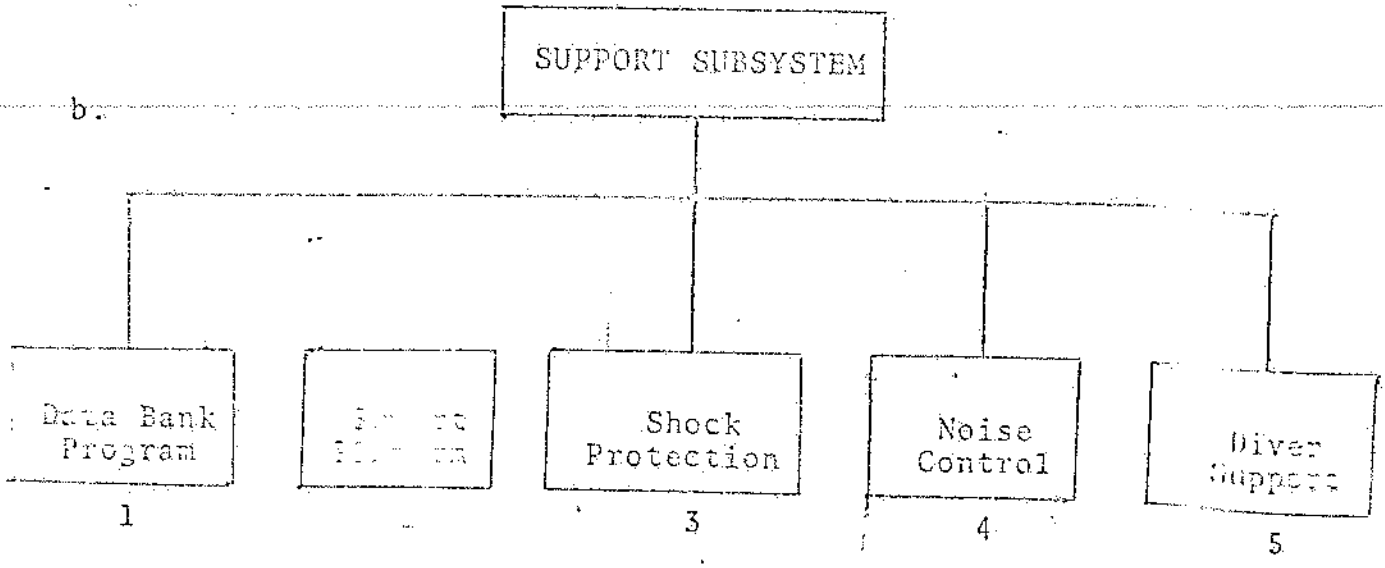
1. Site selection, bottom survey, analyze cores
2. Design, contract
3. Design equipment
4. Establish diver procedures
5. Design pressure resistant structures, ingress/egress
6. None
7. None
8. Design, contract, maintain and inspect

Support Systems

a.



b.



c. Identification of SEABEE Functions and Tasks

1. None
2. Construct platform
3. None
4. None
5. Provide diver support

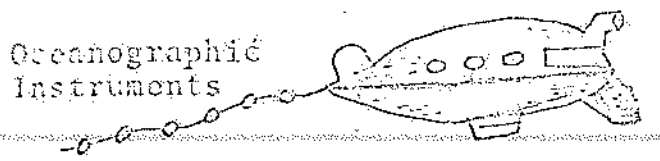
d. Identification of other NAVFAC responsibilities

1. None
2. Design, contract, maintain and inspect
3. None
4. None
5. Coordinate diver activities

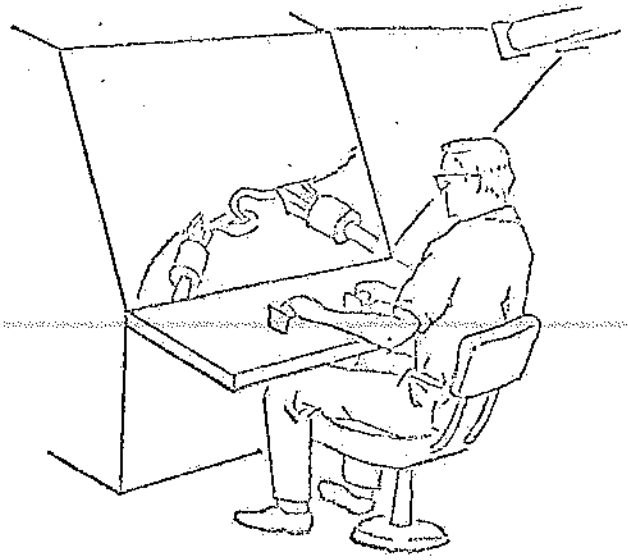
TEST-BED MANNED SUBMERSIBLE

Work/Test Subsystem

a.

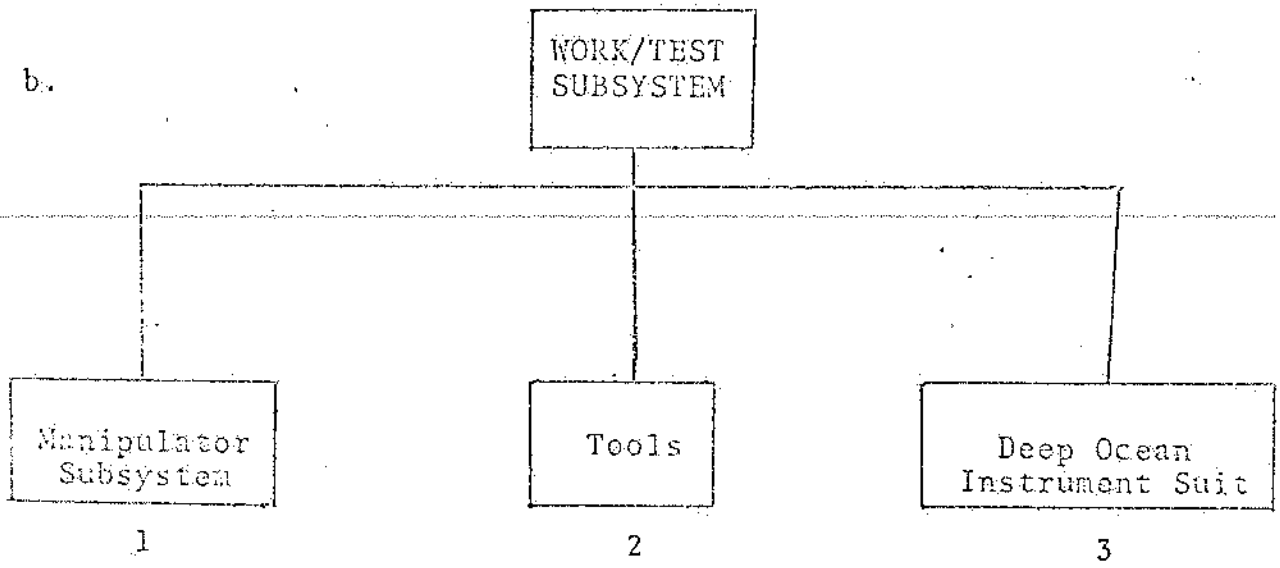


Test-Bed Manned
Submersible



Manipulator Subsystem

b.



c. Identification of SEABEE Functions and Tasks

1. None

2. None

3. None

d. Identification of other NAVFAC responsibilities.

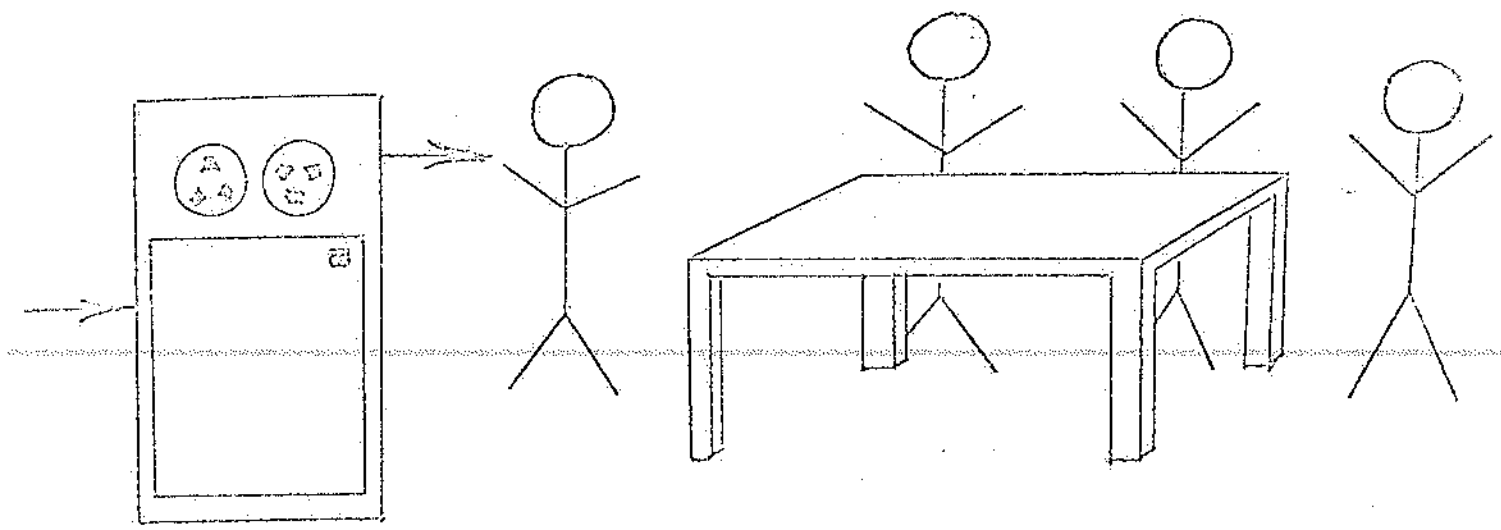
1. Coordinate development of tools and instrument suits with design of manipulator subsystem

2. Design for construction purposes

3. Design a combination suit of on-board and towed oceanographic instruments; design a construction support instrument suit for support of botom construction projects

ANCILLARY DEVELOPMENT

a.



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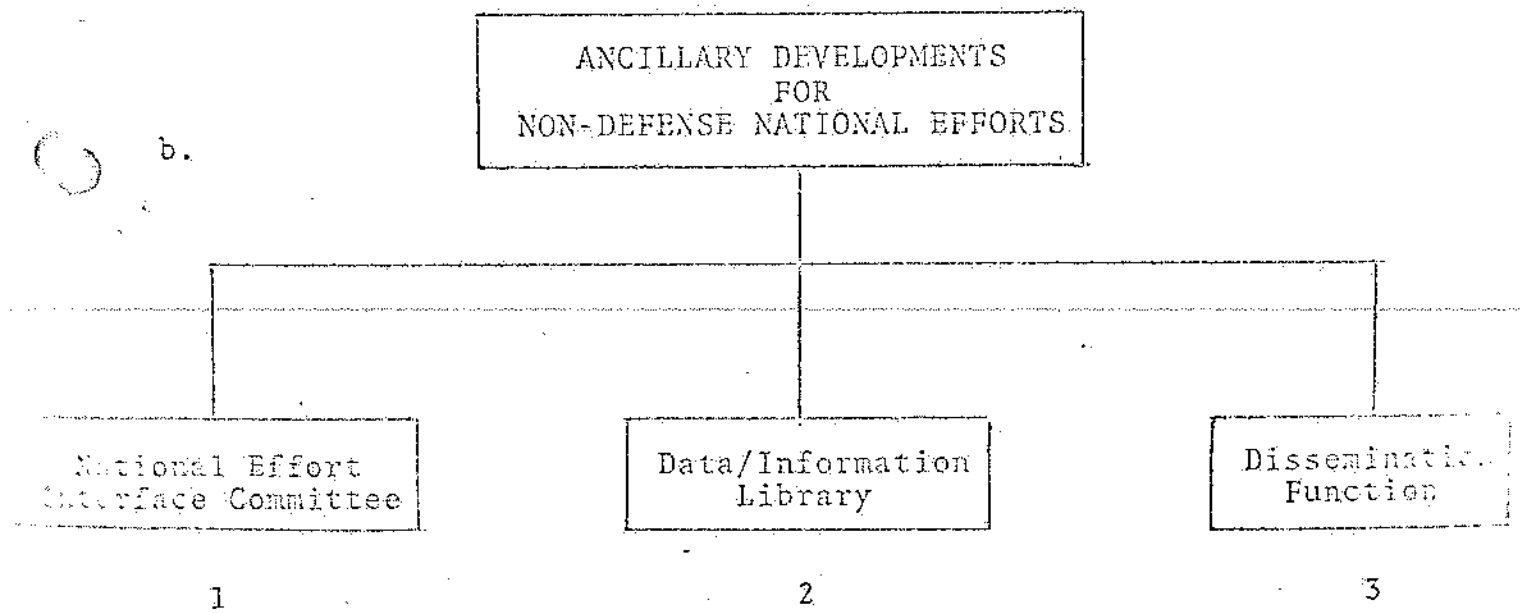

c. Identification of SEABEE Functions and Tasks

1. Assist as directed

2. Provide input

3. Provide training of selected submersible operations and divers

d. Identification of other NAVFAC responsibilities.

1. Assist as directed.

2. Provide input

3. Provide undersea civil engineering information

SEE DESIGN CONCEPTS

FOR

SEABASED STRATEGIC DETERRENT SYSTEMS

APPENDIX B

PRESENTATION BRIEFS

BLUE WATERS REPORT

BY

CAPTAIN L. E. ZENI, OPNAV

In Phase I a Navy position was formulated for those aspects of oceanography where Navy's interests in the ocean bottom conflict with those of industry and government. Phase II concerns the legal and jurisdictional problems. A principal finding of Phase I is that "Naval missions over the foreseeable future require that the Navy foster research engineering and development in the ocean..... The Navy cannot depend on other oceanographic contributions to operational capability unless its relevance and responsiveness to the Navy mission can be demonstrated." The Navy planning documents only lately have started to state "the Navy wants to be able to operate at any depth at any time anywhere in the world." Absence of more concrete objective statements shows that CNO is not convinced of the need yet.

Interference to Navy can be expected to grow as commercial submersibles, offshore and other uses of the sea increase. The Navy must anticipate and plan for the "real estate" needs of ocean ranges -- perhaps NAVFAC has a role here. By 1975-1980 projections show as many as 350 commercial submersibles in existence. The rescue and safety missions of the Navy will have to expand to augment the Coast Guard's role. For the time being the Navy has a complementary role to other government agency programs.

The CNO has taken a firm position in using his requirement documents to set the pace of effort; others should act accordingly.

Phase II findings are that the Navy should push towards maintaining national jurisdiction of the continental shelf as close to the shore -- about 200 meter depth -- as possible. Extension of the continental shelf beyond the 600 meter depth would be detrimental to Navy interests. The geophysical limit of continental shelf is about 2500 meter depth -- and that's where industry would like to see national jurisdiction extended.

The ensuing discussion indicated further the complexity and conflicts of interests involved.

THE NAVY DEEP SUBMERGENCE OCEAN ENGINEERING PLANNING GROUP REPORT AND RELATED REMARKS

BY

CAPTAIN C. M. ESLER, OPNAV

The Navy Deep Submergence Ocean Engineering Planning Group was formed on 14 August 1967 in order to determine the Navy goals, assess current programs, determine projects to fill gaps and form a base line program. The following projects were examined: Exploratory Development by CND, Bio-Medical Research, Deep Ocean Technology, the Submarine Bio-Medical Development Project and the Extended Depth Man-In-The-Sea (MITS) and the Extended Depth Salvage Projects; in addition, ALVIN, AUTEC and DOLPHIN vehicle projects. Recommendations were: (a) increase ocean engineering and development effort from $16 to $50M per year, (b) cancellation of the Extended Man-In-The-Sea and Extended Salvage Projects. Two manned bottom habitats are proposed, an increase of the San Clemente Range facilities, and an increase in pressure test facilities. The thousand foot depth is the target depth for most initial capability to be developed. This is about the limit of the continental shelf. The basic philosophy is to proceed slowly both in depth, internal life support, and freedom from surface support capability.

NAVFAC can contribute most in the Manned Underwater Laboratory (MUL) and the possible management of the new MITS program.

The Group doesn't see a requirement for a military mission performance involving Man-In-The-Sea at significant depth -- activity of depths up to 1000 ft. in the 1970-80 period is envisioned. The most significant finding of the DSOEPPG for Man-In-The-Sea appears to be a "glimmer" requirement for underwater construction. No hard Navy military construction task was found to exist for today's military requirement. However, for the period 1978 plus ocean bottom facilities such as silos, command ports, etc. become more probable.

Navy capability can help national effort; Navy would like an open bottom (i.e. no industrial exploitation) beyond the 600 ft. depth. Ocean bottom construction capability could be of value in giving U. S. a stronger negotiating position for international law provisions as to sovereignty over bottom area. Reference to the "Blue Waters" Study was made.

DSSP'S PROGRAMS AND GENERAL REMARKS

BY

CAPTAIN W. M. NICHOLSON, DSSP

DSSP is constrained by fund limitation thus pursuing the first three of the following five programs which constitute the scope of its mission:

a. NR-1
b. Rescue System
c. Man-In-The-Sea
d. Submarine Escape System
e. Working Techniques for Ocean Bottom

Since firm and sufficient funding for the Navy's program won't materialize until about 1971, the problem is how to stretch the available funds and keep the technology alive until the program opens up.

There is ambiguity in drawing the line between a habitat and a submarine.

The Navy cannot move ahead in the program, except for technology development with available funding, until the CNO and SECNAV make certain decisions; in the interim it behooves the ocean engineering community to present to the CNO facts until he decides.

There are no existing construction missions in the Navy today. Technology must be developed by "doing", therefore, focal projects are devised. However, funding of focal projects hinges on the existence of missions, and missions hinge, in part, on the availability of the very technology to be developed by the focal project. Thus goes the cycle.

The Navy appears reluctant to charge in and join the efforts by the President's Commission.

SEALAB is intended to develop technology and tools not to build anything specific. NAVFAC has not been used by DSSP in planning SEALAB or its site selection because the expertise resided in DSSP, NUWC and NAVFAC 2 years ago was not heavily involved in underwater work -- or at least there was no visibility in NAVFAC. Reliance for SEALAB support has been placed in NAVSHIPS because of established expertise with diving systems and life support.

Habitat is essentially a submersible and it uses technology that essentially resides in NAVSHIPS. However as regards bottom stability, foundations and construction, the field is clearly in the hands of NAVFAC and NCEL.

If NAVFAC can see where and when the Navy can use undersea construction, it should take the initiative to develop and sell the concept to the CNO operators whose prime concern is not to develop technology but rather to operate the fleet with existing technology.

NCEL should develop its capability by doing basic technology development then they stand in good shape to get to do the development for DSSP systems.

NAVFAC should support the planning documents being currently generated such as the PCR and the NDS OEPPG Report and make sure the programming system produces sufficient funds 3-5 years hence.

Little interest exists among the submarine force "elite" in burdening the submarines with extensive and expensive submarine escape systems, at the expense of other utilization of their critical space.

ASW SURVEILLANCE

BY

CAPTAIN V. F. ANDERSON, PM-4

A description of the mission and organization evolution and program structure of ASW-205 was given. Although not specifically identifying proposed or contemplated ASW projects involving fixed ocean bottom facilities, there are existing needs for better engineering and construction in ocean bottom structures supporting ongoing systems. (Detailed write up of presentation is available in FAC 03 upon request and after approval from ASW-205.)

SOUND SURVEILLANCE SYSTEMS

BY

LCDR R. E. JACOBS, OPNAV

A summary of the existing operational and research surveillance system was discussed. This presentation identified a number of ocean construction projects that are currently underway or planned in the ASW field. It also identified RDT&E areas in ocean bottom constructions. (Detailed write-up of presentation is available in FAC 03 upon request and after approval from OP-32.)

DIVERS IN UNDERWATER CONSTRUCTION

BY

CAPTAIN W. F. SEARLE, NAVSHIPS

SEABEE divers (in Captain Searle's experience) have performed very competently whenever they were furnished proper equipment. Diving equipment assigned to SEABEES tends to be poor and poorly maintained because of the infrequent usage and other battalion workloads. Specific effort must be exerted to keep SEABEE divers and their equipment in high degree of training and readiness in the future.

SUPSAL is very satisfied with NCEL as a practical laboratory to do the kind of development work that salvage requires, i.e. pumps, pontoons, hoses, cement, magnets, bottom stabilization. NCEL should not get in those aspects of equipment development requiring extensive physiological considerations -- stick to tools and work equipment.

A rule of thumb for the wise: design all underwater hardware so that a diver is not needed other than to observe. He will be needed anyway because things never work as planned. Don't handicap the operation by involving him in the planning stage.

For some years to come divers will be restricted to less than 1000 ft. Routine diving at more than 1000 ft. won't materialize for at least 10 years. Extreme depths will not be reached on a routine but rather special job basis. For working at depths greater than 1000 ft. specially designed submersibles will be required -- probably submarines without weaponry and propulsion elements.

CERTIFICATION OF SUBMARINE AND PRESSURE HULLS

BY

CAPTAIN R. J. DZIKOWSKI, NAVSHIPS

Certification of the SEALAB has been limited to those items for which there exists data. There is much about the performance of equipment in exotic atmosphere which is not known but can be learned if funds were available.

NAVSHIPS has capability to certify deep ocean vessels using existing talent.

Consideration has been given from time to time to build a large pressure facility to check out a whole submarine in a pressure environment before going to sea. Most failure problems show up after several cycles i.e. after the ship has been in use for sometime. This coupled with the expense of building a large pressure facility tends to create little active interest in the concept.

Any kind of a movable habitat that can perform a surveillance mission with suitable life supporting capability and personnel safety will end up costing nearly as much as a regular submarine minus weapons and propulsion system.

Submarine hull certification methods could be used to test and certify pressure tanks ashore.

MARINE CORPS 1985 AND OTHER REMARKS

BY

MAJOR C. D. BLACKWELL AND MAJOR G. H. DOUSE

MARCORPS 85 describes the USMC role in 1985. It is a sea based concept envisioning the use of the LHA from which VTOL aircraft and SES can assault a beach -- 50 mile standoff and 500 mile radius of operation. Envisioned are the following:

a. A towable submersible capable device that can store fuel for refueling the VTOL.

b. A submersible container for the bulk storage of general purpose supplies -- such as rations, ammo, etc.

c. A submersible platform or staging area to support troops who can propel themselves through the water and land on a beach up to battalion size operations.

d. Low cost or retrievable support facilities of all kinds on the beach, on the water surface, on the ocean floor.

e. Underwater habitat for clandestine reconnaissance and other military missions.

There are no firm requirement documents. MARCORPS 85 is being revised. Stanford Research Institute is now working on a Seaboard Mobile Logistics System that may show a greater role for submersibles and underwater systems than now envisioned in the MARCORPS 85 which is mainly a surface concept, i.e. LHA, VTOL, and SES.

SEABEES will be required if crisis control functions of the MARCORPS in the 1985 time frame are protracted over several months durations.

NAVORD'S ROLE AND ACTIVITIES IN OCEAN ENGINEERING

BY

CAPTAIN E. C. WHITE, NAVORD

After a description of the NAVORD organization and way of doing business it was stated that project management (PM) is used on large multi-million dollar projects like the MK 48 torpedo. PM is a very expensive way for doing business. SP has taken over strategic deterrence problems so effectively NAVORD is out. CURV is the major effort of NAVORD in deep ocean technology area. NAVORD has contracted with the University of Rhode Island to undertake a study that relates environmental problems to engineering problems anticipated for the future. It is an oceanographic study basically. They'll be looking, in FY 70, at weapons systems and the deep ocean -- this will be an engineering study. The purpose of the present study with the University of Rhode Island is to determine comprehensively what is known and what is being done to learn about the ocean environment. It will help NAVORD allocate their R&D dollar. Study will be ready toward the end of 1969.

Recent revisions to GOR 15 indicate the need to look into the ocean bottom environment for future systems. When ocean bottom systems get really big, they'll probably be done by contract rather than SEABEES. Since the systems are now speculative it would be even more speculative to answer who will build them. The Captor System -- which is having funding difficulties -- is a mine warfare system and does include ocean engineering.

NAVOCEANO ACTIVITIES BEARING ON THE SUBJECT

BY

DR. C. C. BATES, NAVOCEANO

Oceanographic instruments in measuring bottom and water column characteristics and a survey ship were used to locate the Robert Louis Stevenson ship which loaded with explosives, intended for a controlled explosion experiment, vanished. Various slides were shown of seismometers, containers, seabottom cameras, submersibles, magnetometers, etc. A few remarks were made regarding the H-Bomb recovery off Spain. An Ad Hoc equipment capability is being assembled now by NAVOCEANO for standby capability for future searches. A description was given of how one would go about to survey for a Manned Bottom Installation pointing out that with present sonar capability detail smaller than 100 ft. won't show at depths of 6000 feet -- thus it is imperative to develop a submersible platform for bottom surveys.

THE FUTURE FOR WATERFRONT CONSTRUCTION AND OTHER REMARKS

BY

MR. W. J. BOBISCH, NAVFAC

Army Corps of Engineers is looking into ocean engineering capability requirements for Army's construction problems and missions. An AE is to render a report to the Army suggesting a role.

Future waterfront requirements call for materials, methods and systems to reduce maintenance, prolong life, and render waterfront facilities responsive to the operational environment, and the "fleet" systems. Dry docking, fender, POL and AMMO off-loading facilities, floating structures, piling, container facilities, breakwaters, dredging and excavation (nuclear) requirements of the future, call for new materials, methods, systems, etc.

NAVFAC is doing considerable waterfront and future work - especially in RVN. SEABEES and contractors and A&E share in the execution of the work. Port building experience in RVN is not being recorded and documented, as far as the speaker knows, besides the Raymond Report. The crying need in RVN is for a temporary, quick way to install harbors for 3-5 year use.

Present NAVFACHQ engineering capability is as follows: ocean structure and waterfront consultant for looking ahead, and waterfront structures group for day to day problems; in fairly good shape is soil mechanics; on the thin side in electrical design; not staffed for materials other than the specification people; SOEASTDIV is very strong in waterfront structures.

APPENDIX C

EXISTING CAPABILITY SURVEY

Appendix C - EXISTING CAPABILITY SURVEY

1. Personnel Assets.

Trained and experienced personnel constitute the major NAVFAC resource in ocean engineering. These are listed in Exhibit C.1 according to their NAVFAC or field office code, rank or grade, specialty, approximate yearly work effort available, and the most appropriate capability category. They are summarized in Section II, Table II.B.1. In producing the summary it was estimated that these personnel are only 0.8 effective in ocean engineering. Accordingly Table II.B.1 is the summation of this Appendix times eight tenths.

EXHIBIT C.1

NAVFAC CODE OR ACTIVITY	GRADE	SPECIALTY	MAN/YR AVAIL	PRIME CAPABILITY CATEGORY
NAVFAC 041G	1-GS15	Deep Water Structures	1.0	Underwater Structures (total scope)
NAVFAC 041H	1-GS15	Waterfront Structures	1.0	Waterfront Structures (total scope)
NAVFAC 04126	1-GS14	Waterfront Structures	.6	Waterfront Structures
NAVFAC 04125	1-GS13	Dredging	.3	Site preparation; trenching, earth moving
NAVFAC 04126A	1-GS13	Supervisor, Floating Structures	1.0	Site preparation and materials; stabilization in surf
NAVFAC 04126B	1-GS13	Waterfront Facilities	1.0	Site Engineering and materials; foundations, moorings, anchors
NAVFAC 04126C	1-GS13	Marine Railways and Drydocks	1.0	Site Assembly; Weight Handling and transport
NAVFAC 04126D	1-GS13	Special Weight Handling equipment	1.0	Site Assembly; Weight handling and transport
NAVFAC 04126	1-GS12	Waterfront Structures	1.0	Site Engineering and materials
NAVFAC 0421	1-GS15	Nuclear Engineer	.3	Power, Nuclear
NAVFAC 04	CDR-CEC	Civil and Nuclear Engineer	.1	Power, radioisotopes
NAVFAC 04211	1-GS14	Nuclear Engineer	.5	Power, radioisotopes devices
NAVFAC 04212	1-GS13	Nuclear Engineer	.1	Power, Nuclear power plants

NAVFAC CODE ACTIVITY	GRADE	SPECIALTY	MAN/YR AVAIL	PRIME CAPABILITY CATEGORY
NAVFAC 04211A	1-GS9	Nuclear Engineer	.9	Power, radioisotope devices
NAVFAC 0422	1-GS15	Nuclear Engineer	.2	Power, Nuclear Systems Engineering
NAVFAC 042R	2-GS14	Radiological Safety Engineer	.2	Power, Nuclear Safety
NAVFAC 042R	2-GS13	Radiological Safety Engineer	.1	Power, Nuclear Safety
NAVFAC 0321	1-GS14	Research Engineer	.5	Ocean and Waterfront Amphibious Engineering, Manager
NAVFAC 0321C	1-GS13	Research Engineer	1.0	Ocean and Waterfront Engineering
NAVFAC 0321C	1-GS13	Research Engineer	.4	Amphibious and Sanitary Ports and Amphibious Engineering
Ft Belvoir, Va.	103 persons	Nuclear Power Unit	103	Power Nuclear Systems and Isotope devices
NCEL L56	1-GS14	Head, OceanEngineering Division	1.0	Total scope
NCEL L56	1-GS14	Research Civil Engineer	1.0	Materials
NCEL L56	1-GS14	Research Structure Engineer	1.0	Materials
NCEL L56	1-GS13	Mechanical Engineer	1.0	Site Assembly; diver equipment; life support
NCEL L56	1-GS12	General Engineer	1.0	Site Preparation; anchors and moorings
NCEL L56	2-GS12	Civil Engineer	1.0	Site Survey; soils
NCEL L56	1-GS11	Oceanographer	1.0	Site Survey; oceangraphic
NCEL L56	1-GS11	Mechanical Engineer	1.0	Site Assembly; diver tools and techniques
NCEL L56	1-GS11	Engineer Technician	1.0	(Varies)
NCEL L56	1-GS7	Engineer Technician	1.0	(Varies)
NCEL L56	1-GS11	Civil Engineer	1.0	Materials
NCEL L56	1-GS9	Mechanical Engineer	1.0	Site Assembly; diver tools and equipment

NAVFAC CODE ACTIVITY	GRADE	SPECIALTY	MAN/YR AVAIL	PRIME CAPABILITY CATEGORY
NCEL L56	1-GS11	Mechanical Engineer	1.0	Site Engineering and Materials; structural
NCEL L52	1-GS14	Research Physist	1.0	Materials, metallurgists
NCEL L56	1-GS9	Engineer Technician	1.0	(Varies)
NCEL L56	1-GS12	Biologist	1.0	Life support; environmental
NCEL L55	1-GS14	Head, Amphibious and Harbor Division	1.0	Amphibious and Shallow Water Construction (total scope)
NCEL L55	1-GS14	Research Hydraulic Engineer	1.0	Site Assembly/Construction; utilities
NCEL L55	1-GS13	Civil Engineer	1.0	Site Engineering and Materials; amphibious equipment
NCEL L55	1-GS12	Research Hydraulic Engineer	1.0	Site Assembly/Construction; utilities
NCEL L55	1-GS12	General Engineer	1.0	Site Engineering and Materials; amphibious equipment
NCEL L55	1-GS11	Civil Engineer	1.0	Site Engineering and Materials
NCEL L55	1-GS11	Engineer Technician	1.0	(Varies)
NCEL L51	1-GS13	Research Structure Engineer	.5	Site Engineering and Materials
NCEL L64	1-GS13	Research Mechanical	1.0	Site Construction; life support
NCEL L65	1-GS13	Research Electrical Engineer	1.0	Power, surface umbilical, cables, etc.
NCEL L64	1-GS13	Mechanical Engineer	1.0	Site Assembly/Construction
MEDIV 045	1-GS13	Waterfront Structures	.3	Waterfront Structures
MEDIV 045	1-GS12	Waterfront Structures	.2	Waterfront Structures
MEDIV 045	1-GS11	Waterfront Structures	.2	Waterfront Structures
EAST DIV 045	1-GS13	Waterfront Structures	.2	Waterfront Structures
EAST DIV 045	3-GS12	Waterfront Structures	1.0	Waterfront Structures

TAC CODE ACTIVITY	GRADE	SPECIALTY	MAN/YR AVAIL	PRIME CAPABILITY CATEGORY
ESTCNTRLDIV 045	1-GS13	Waterfront Structures	.3	Waterfront Structures
LANT DIV 042	1-GS13	Waterfront Structures	.4	Waterfront Structures
SEDIV 04D	1-GS13	Waterfront Structures	.3	Waterfront Structures
MIDWEST DIV 049	1-GS13	Weight Handling	1.0	Site Assembly/Construction; weight handling and transport
MIDWEST DIV 049	3-GS12	Weight Handling	3.0	Site Assembly/Construction; weight handling and transport
MIDWESTDIV 049	1-GS11	Weight Handling	1.0	Site Assembly/Construction; weight handling and transport
CARIB 045	1-GS12	Waterfront Structures	.3	Waterfront Structures
SW DIV 042	1-GS13	Waterfront Structures	.3	Waterfront Structures
SW DIV 042	1-GS13	Coastal Engineering	.2	Site Survey; Oceanographic, topo soils
[illegible] DIV 042	2-GS12	Waterfront Structures	.5	Waterfront Structures
NW DIV 042	1-GS13	Waterfront Structures	.4	Waterfront Structures
NW DIV 042	1-GS12	Waterfront Structures	.3	Waterfront Structures
MIDPACDIV 045/5	2-GS13	Waterfront Structures	.9	Waterfront Structures
MIDPACDIV 045	1-GS12	Shore Protection	.2	Site Survey; Soils and Slope Stabilization
PACDIV 042	1-GS13	Waterfront Structures	.3	Waterfront Structures
SW PAC 040	1-GS13	Waterfront Structures	.3	Waterfront Structures
THAILAND	1-GS13	Waterfront Structures	.3	Waterfront Structures
MARIANAS 042	1-GS13	Waterfront Structures	.4	Waterfront Structures

In addition to the above personnel assets which can be closely tied to the technical capability categories, there are various billets which though they cannot be directly related to a capability category are of sufficient importance to mention briefly below. They help in creating the nucleus for ocean engineering operational systems capability.

a. Approximately two (2) man-years of technical effort average grade GS-12 are currently expended in matters pertaining to ocean engineering in the following functional areas:

(1) Military Personnel Division (Code 061)--Management of personnel programs; plans and formulates training programs; justifies requirements; procures, and makes utilization recommendations on CEC officer and Group VIII enlisted personnel.

(2) System Plans and Policy Division (Code 062)-- Develops techniques, concepts and requirements for, and assist CNO staff members in Naval Construction Forces programs.

(3) Systems Operations Division (Code 063)-- Establishes policy for and coordinates the operations of the Naval Construction Forces; provides staff assistance in SEABEE technical and financial support matters; manages field support activities. Operational coordination includes special projects such as SEABEE support of TEKTITE I.

(4) Logistics Division (Code 064)-- Performs all materiel management functions.

(5) Functional Component Division (Code 065)-- Translates conceptual requirements, objectives, technological developments and guidance into hardware for support of the Naval Advanced Base Functional Component System. Examples of functional components include the B5C (Lighterage), AMMI Pontoon series and P21 (Harbor Clearance Component).

b. The SEABEE Systems Engineering Office (SSEO) CBC, Port Hueneme, California supports the management of the Naval Construction Forces. Included in the SSEO is the STINGER System Analysis Group expert in operational research techniques and staffed with 6 analysts. About 0.5 man years are currently expended in ocean capability aspects of the Naval Construction Forces. Available is an IBM 360 computer.

c. The engineering and design functions for all Advanced Base Functional Components for which NAVFAC has System Engineer responsibility is a part of the SSEO CBC, Port Hueneme, California. This includes field coordination of RDT&E efforts for functional components and SEABEE equipment. Approximately two (2) man-years of technical effort is expended on ocean oriented components such as pontoons, etc.

d. Other elements of the SSEO are (a) a Logistic Support Planning Division which integrates matters of supply, maintenance, technical data, and personnel and training requirements, and (b) a Division providing specialized contract and procurement capability.

2. Equipment, Facility and Data Assets

a. Information and computer systems are available and used in ocean engineering as follows:

(1) Computers: Available in NAVFAC:

(a) Time sharing B5500

(b) Ollivetti Underwood Programa 101

(2) Computers: Available to NAVFAC:

(a) UNIVAC 1108 (National Bureau of Standards

(b) U. S. Air Force IBM 7094

(c) Technical libraries:

1. Complete library Waterfront facilities, oceanography and ocean engineering.

2. Technical information on nuclear power systems, energy conversion systems, radiosotopes, transportation and storage of radioactive and fissile materials, health physics and radiation monitoring and control.

(3) U. S. Naval Nuclear Power Unit at Ft. Belvoir, Virginia. Resources: The Unit has engineering support facilities for design drafting, engineering drawings and manuals, analog simulator facilities and technical labrary. The Unit also has training facilities for operations and maintenance and has mechanical and electrical specialties shops.

(4) U. S. Naval Civil Engineering Lab at Port Hueneme, California is equipped as follows:

(a) Computers: IBM 1620 Data Processing System with IBM 1622 Card input/output device. IBM 026 Cardpunch and IBM 407 Accounting machine.

(b) Technical Library: Complete technical library having most of the technical books in the areas of oceanography, ocean engineering and waterfront engineering.

(c) Testing Facilities:

1. Ocean Simulation Laboratory - Facility consists of six 9-inch ID pressure vessels and one 18-inch ID pressure vessel all permanently mounted; and three portable 9-inch

vessels. All vessels have a 20,000 psi safe working capacity and use seawater as the pressurizing medium. One 72-inch ID, 120-inch inside length 5,500 psi pressure vessel.

2. Soil Laboratory - Facilities for performing routine soil analyses and tests, such as triaxial test, vane shear tests, compaction tests, etc.

3. Amphibious and Waterfront Facilities - Amphibious and waterfront research is supported by two warping tugs; wave basin; pontoon barges and tanks; test equipment for handling anchors up to 30,000 pounds; instrument car to simulate movement of a ship dragging anchor; facilities for development of ship to shore fuel delivery systems and floating booster stations; facilities for making pontoon causeway assemblies; etc.

(d) Special Ocean Engineering Facilities -

1. Deep Ocean Test Instrument Placement and Observation System. This is a platform having a 6000 foot depth capability. This platform has a TV camera, a photographic camera, a data and command telemetry package and lights. To this platform, such accessories as in-situ vane shear and penetrometer devices can be added.

2. Several oceanographic and load handling winches.

3. Level of Effort to Date

The only funds specifically justified on the basis of ocean engineering needs are $1,200,000 in Exploratory Development and $765,000 of Advanced Development R&D funds in FY 1969. Approximately 11,000,000 has been spent over the past ten years in a program which has made basic contributions to sea floor engineering and underwater construction.

4. Project Management in Ocean Engineering

a. NAVFAC provides construction program project management throughout the entire Atlantic Undersea Test and Evaluation Center (AUTEC). This included the development, planning, and implementation of the requirements for the Undersea Test and Evaluation Center.

b. AUTEC involved many aspects of ocean engineering in facilities both fixed and non-fixed. The NAVFAC personnel participated in investigations of: sea moorings, flooding and submerging of facilities, insulation and laying of cable on the ocean bottom and escarpment; raising and lowering various facility hardware. NAVFACENGCOM constructed the associated harbor development and off-shore shallow water platforms, used as cable terminals.

5. Summary of SEABEE Capabilities and Deficiencies.

a. SEABEE capability in deep diving is currently restricted. Six Group VIII personnel are qualified as saturation divers. Two CEC officers are qualified as helium-oxygen diving officers. One is qualified as a saturation diver. Requests for a suitable number of SEABEE divers to support research diving at NCEL have been made over the past two years. None have been successful to date. Currently, Group VIII personnel are not authorized to attend First Class Diving School.

b. Only the BU (Builder) and SW (Steelworker) Ratings can attend Second Class Diving School, although exceptions are granted on an individual basis. The overloaded condition of the Deep-Sea Diving School will further delay the development of significant SEABEE diving capability unless aggressive action is taken.

c. The BU and SW Ratings which are authorized to attend Second Class Diver School require qualification skills which could readily be extended to include the capability categories included under site assembly/construction in Appendix C. Good potential exists among the other ratings for similar extensions to improve Navy capabilities. However, there is very little demonstrated experience to date.

d. CEC/Group VIII authorized allowance billets which require or involve special training, excluding MCBs and ACBs, are:

2 - CEC at postgraduate school in Ocean Engineering.

2 - Group VIII NEC 5342 1st Class Divers at Tech. Off. San Diego, California.

3 - Group VIII NEC 5343 2nd Class Divers at NCEL.

e. There are 63 authorized NEC 5342 2nd Class Diver billets in 21 MCBs (3 each). However, current on-board count indicates that not all billets are filled and there is limited diver special equipment on board and servicable. No Group VIII diver billets are currently authorized in the two ACBs and no special underwater equipment is available. UDT personnel and gear are utilized for ACB tasks which involve diver operations.

f. Experience Data. The most recent recorded experience in SEABEE underwater operations includes the following:

(1) NMCB 5 - Exploration/inspection/reconnaissance of a river bottom in preparation for driving bridge piling; working depth 1-4 meters; dive time, 1 hr.; scuba gear utilized.

(2) NMCB 40 - Miscellaneous projects since 1 March 1968, 166 hours total using scuba gear and related equipment down to 71 feet. Cleared wreckage of Bailey Bridge from river, salvaged pontoon and crane, inspected 8" POL line, cleared fish nets from boats and landing craft, tightened bolts in 10,000 bbl. steel tank; cleared away old bridge piers using explosives; reconnaissance and survey of river bottom for new bridge.

(3) NMCB 3 - Bottom laid pipeline, 2 men, 80 man-hours; scuba gear utilized. 1 - 2nd Class Diver (on board), BUR3; 2 - 2nd Class Divers (at school), 1- BU1, 1 - BUR3.

(4) NMCB 62 - Inspection of bridge piling; 3 diving man hours utilizing open scuba in 30 feet. 5 - 2nd Class divers on board 8 July 1968.

(5) NMCB 58 - (a) Set pilings for Ammi-Pontoon Bridge; open scuba at 35 feet.

(b) Search and recovery of sunk VC Sampan; open scuba at 50 feet; 3 - 2nd Class Divers; 1 - EM1, 1 - EO1, 1 - CE2

(6) NMCB 53 - (assisted with NMCB 58 Project (a) above)

(7) NMCB 71 - (a) Inspection, repair and maintenance of bottom laid off shore POL lines at 50 feet depth.

(b) Place explosive charges to clear way for pile driving operations at 20 feet depth.

(c) Reconnaissance for aircraft, mines and other ordnance at 25 feet depth.

(d) Clearing and repair of damaged screws and rudders at depth to 25 feet.

(e) 3 - 2nd Class Divers on board; 1 - BU2, 1 - SFP2, 1 - CN.

(8) NMCB 1 - Reconnaissance of destroyed bridge foundations; 3 sites; one diver at 15 feet, fins mask, snorkle; 2 divers aboard.

(9) CBU 201 - Photographed and inspected Elliot Quay, McMurdo Station.

g. Other tasks typical of SEABEE experiences in SEA operations include: installation of Ammi Piers; construction/ maintenance of anchors, moorings navigational aids, buoys, and floating platforms; installation of Ammi-PBR bases, bridges; recovery and/or clearance of dropped objects such as towers, bridge spans, bulldozers.

h. Special Amphibious Construction Battalion Capabilities. Amphibious Construction Battalions are closely associated with the ocean-air interface because of their prime mission of providing ship-to-shore cargo off-loading facilities. Their major equipment includes pontoon causeways, barges, warping tugs, M-boats, air compressors, cutting and welding machines, and large cranes. The unit is self sufficient and hence can operate and maintain all equipment on and in the water. The ACB could be a major SEABEE surface support unit for underwater operations.

i. TEKTITE I. Recently it was determined that SEABEEs will be used in Project TEKTITE I. This test sponsored by Navy, NASA, General Electric and the Department of Interior consists of a lab/habitat placed at 50 foot depth near the Virgin Islands. It will be manned for 60 days by a 4-man Department of Interior crew. It will be constructed by SEABEES. SEABEE divers will emplace, maintain and remove the station. It will be necessary to draw upon both CBLANT and CBPAC Group VIII diver personnel and equipment.