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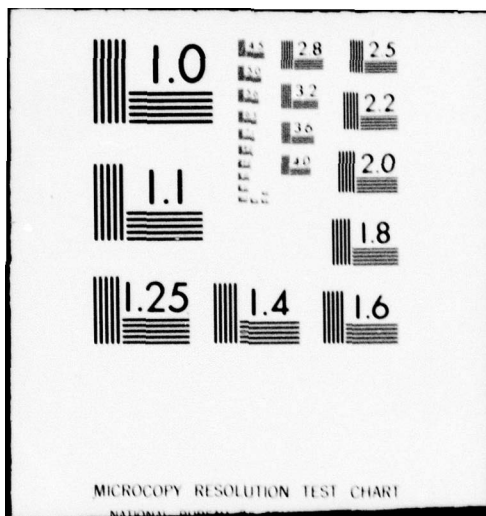
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**FUTURE UNDERWATER ACTIVITIES AND THEIR
IMPLICATIONS FOR THE COAST GUARD**

CIRCA 1978-2000

VOLUME I

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**AUGUST 1978
EXECUTIVE SUMMARY**

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Prepared for

**U.S. DEPARTMENT OF TRANSPORTATION
United States Coast Guard
Office of Research and Development
Washington, D.C. 20590**

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1. Report No. 19 18 USCG D-65-78-VOL-1	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle 6 Future Underwater Activities and Their Implications for the Coast Guard Circa 1978-2000, Volume I,		5. Report Date 11 August 1978	6. Performing Organization Code <i>per cover</i> 12-28p.
7. Author(s) 10 Charles W. Williams, Ronald Shalita, Peter de Arcangelis, Kendall Simmons, Wayne R. Logie, John Pierre-Benoit, Command Andrews		8. Performing Organization Report No.	
9. Performing Organization Name and Address Charles W. Williams, Inc. 801 N. Pitt Street Alexandria, Virginia 22314		10. Work Unit No. (TRAVIS)	11. Contract or Grant No. 15 DOT-CG-73571-A ✓
12. Sponsoring Agency Name and Address Department of Transportation U.S. Coast Guard Office of Research and Development Washington, D.C. 20590		13. Type of Report and Period Covered 9 Executive Summary Sep 1977-Aug 1978,	
14. Sponsoring Agency Code G-DSA-3			
15. Supplementary Notes			
16. Abstract <p>The objectives of this study is to develop forecasts of underwater activities circa 1978-2000 and to assess the implications of these forecasts for the U.S. Coast Guard.</p> <p>A macro environmental framework, a marine environmental framework, and an underwater activities systems model were structured to form a baseline for a forecast of underwater activities. Data with which to load the models and frameworks was developed through literature reviews, interviews, and written correspondence. The data was organized for each of the underwater activities under the following headings: Operational Systems, Environmental Requirements, Locations, U.S. National Interests, Implications, and Forecasts. Each activity development was then individually analyzed for future evolution, driving forces, barriers, and obviating factors. Each of the fifteen underwater activity categories within the model was translated into "Tailored Vignettes" for the Coast Guard. A final integrative inventory of forecasted operational systems was developed.</p> <p>Implications of the underwater activities forecasts were provided and analyzed for the current Coast Guard program structure. Conclusions and recommendations were presented as reasonable and important steps to be taken in order to prepare for the anticipated developments and implications.</p> <p>This is a three volume report. Volume I is the Executive Summary, Volume II is the Final Report and Analysis of Coast Guard Implications, and Volume III is the Detailed Forecasts of Underwater Activity.</p>			
17. Key Words Underwater Activity Future U.S. Coast Guard Marine Environment Forecasting		18. Distribution Statement Document is available to the U.S. public through the National Information Service, Springfield, Virginia, 22161	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 28	22. Price

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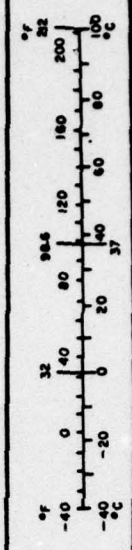
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures		Approximate Conversions from Measures	
Symbol	When You Know	Multiply by	To Find
LENGTH			
in	inches	2.5	centimeters
ft	feet	30	centimeters
yd	yards	0.9	meters
mi	miles	1.6	kilometers
AREA			
sq in	square inches	6.5	square centimeters
sq ft	square feet	0.09	square meters
sq yd	square yards	0.8	square meters
sq mi	square miles	2.6	square kilometers
acres	acres	0.4	hectares
MASS (weight)			
oz	ounces	28	grams
lb	pounds	0.45	kilograms
	short tons (2000 lb)	0.9	tonnes
VOLUME			
cup	cup	5	milliliters
fl oz	fluid ounces	30	milliliters
c	cup	0.24	liters
pt	pint	0.47	liters
qt	quart	0.95	liters
gal	gallon	3.8	liters
ft ³	cubic feet	0.03	cubic meters
yd ³	cubic yards	0.76	cubic meters
TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature

*1 in = 2.54 (exact). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Length and Measure, Price \$2.25, SO Catalog No. C13.10-286.

Symbol	When You Know	Multiply by	To Find
LENGTH			
mm	millimeters	0.04	inches
cm	centimeters	0.4	inches
m	meters	3.3	feet
km	kilometers	1.1	yards
mi	miles	0.6	miles
AREA			
sq cm	square centimeters	0.16	square inches
sq m	square meters	1.2	square yards
sq km	square kilometers	0.4	square miles
ha	hectares (10,000 m ²)	2.5	acres
MASS (weight)			
g	grams	0.035	ounces
kg	kilograms	2.2	pounds
t	tonnes (1000 kg)	1.1	short tons
VOLUME			
ml	milliliters	0.03	fluid ounces
l	liters	2.1	pints
m ³	cubic meters	1.06	quarts
m ³	cubic meters	0.26	gallons
m ³	cubic meters	35	cubic feet
m ³	cubic meters	1.3	cubic yards
TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature

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PREFACE

This is Volume One of a three volume report dealing with forecasted underwater activities circa 1978-2000 and their implications for the U.S. Coast Guard.

The three volumes comprising the total report are:

- Volume 1: Executive Summary: a summation of the other two volumes of the report developed with the objective of providing a complete overview of the project.
- Volume 2: Basic Report and Analysis of Coast Guard Implications of Future Underwater Activities: a summary of the research process and the analysis of the Coast Guard implications derived from the forecasts presented in detail in Volume 3.
- Volume 3: Detailed Forecasts of Underwater Activities: the detailed forecasts for overall underwater activities.

The forecasts are not meant to be exhaustive scenarios containing all aspects of future underwater activities, or all possible "alternative futures." Rather, they are tailored to concentrate upon illuminating those aspects of future underwater activities that will help to define the relationships to Coast Guard missions and operational responsibilities. These are termed "Tailored Vignettes." The concept of "tailored" means that a specialized interpretative dimension to the forecasts is being derived. The concept of "vignette" means that a middle ground is being adopted between comprehensive scenarios of all future possibilities and the event-oriented forecast. The former suffers from a level of generality which makes specific operational implications difficult to define. The latter, the event-oriented forecast, suffers from a specificity which inhibits the needed integrative insights. The "vignette" concept provides a useful "middle ground."

We have presented our conclusions in the form of forecasts and probability estimates within three basic time phases--1981-85, 1986-92, and 1993-2000.

The reader should approach these and all long range forecasts with an acute awareness that:

- The most difficult problem in comprehending probable future developments is overcoming the tendency to perceive the future only as a mirror image of our current operational day-to-day experiences.
- There is no single "right" or "wrong" view, for there cannot be that desired degree of scientific prediction. One is dealing with an art form replete with qualitative as well as quantitative information and judgments, interlaced with societal values, and the complex interactions of scientific, technological, economic, political, and social developments.
- We have sought to provide the reader with sufficient rationale and analysis to understand how we have derived our views, and if he so wishes, to have a baseline from which to develop alternate views if he deems our views to be invalid.

TABLE OF CONTENTS

PREFACE

CONTENTS

CONCLUSIONS

RECOMMENDATIONS

RESEARCH PROCESS

SUMMATION OF THE UNDERWATER ACTIVITIES FORECAST

SUMMATION OF THE IMPLICATIONS FOR THE COAST GUARD

GENERAL

PROGRAM

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EXECUTIVE SUMMARY

This executive summary outlines the results of a project to forecast the future underwater activities to the turn of the century, and to evaluate their implications for the Coast Guard.

CONCLUSIONS

1. Most of the future activities which will become a part of the Coast Guard's operational concerns by the turn of the century are already emerging or presently are in conceptual form. Despite this current situation, the future developments will create a wide variety of basic discontinuities. That is, the future of the underwater environment will not be one which can be envisioned by an extrapolation or projection of historic trends. For example, the extraction of oil from the ocean bottom which has been projected to increase steadily, could be disrupted by unanticipated terrorist activities. Some projections will provide reasonable insights into selected aspects of this future underwater environment. But the perceptions with respect to that future must be derived from a more complex form of analysis than that of trend projection alone.

2. These discontinuities will stimulate dynamic changes in the manner in which the federal government is organized to execute its roles with respect to the marine environment in general and the underwater environment specifically. As various agencies vie and jockey for management control of the marine environment, the Coast Guard roles and responsibilities will be highly sought after and coveted. There will be an effort to "invade" the integrity of the Coast Guard as an organizational entity. Concurrently, the Coast Guard may initiate a counter drive for adding significantly to its roles and missions. In the final resolution, it is likely that the Coast Guard will lose some of its current responsibilities and assume new ones. It will likely be relocated within a new organizational structure, devoted to Marine affairs, but it should remain sufficiently intact to have the legitimate terms of "an agency" applied to it. The themes and roles which will most likely be retained within the Coast Guard are those related to safety, law enforcement, and military capability.

3. There will be a number of major and dramatic events which will stimulate a series of investigative hearings, commissions and other special evaluative and investigative processes within the executive and legislative branches. Unless

the CG has practiced an extraordinarily skillful process of "anticipatory management," it is most likely that major embarrassments will accrue to the CG, tarnishing a rich tradition and heritage. Actions, in order to preclude being made the "scapegoat" or shown to be negligent in matters of profound national interest, must start presently if they are to be effective. These efforts must be sustained, and they must be directed with great wisdom, imagination, insight and creative leadership. The tools with which to do this are varied, but many are available. Application of these principles and practices within the underwater environment will be an important component of the overall CG management problem. (Note: We are aware that the CG is taking a number of imaginative steps to develop and sustain effective anticipatory management. Indeed, this project is an example in its own right.)

4. The future underwater activities entail profound and significant implications for virtually every program within the current structure. There are some implications which represent, for all practical purposes, new requirements that do not conform with any of the current programs.

5. The implications are so broad, diversified and complex that special mechanisms for aggressive leadership, development and coordination, are needed if the CG is to be prepared to meet future requirements in an effective, and exemplary manner.

6. It will become necessary that the CG have a diversified and effective underwater operational capability.

7. There will emerge a new role in military capability, which is qualitatively different and significantly more important than today's current concepts of military preparedness.

8. New law enforcement concepts will be invented which entail philosophies related to positive resource development and exploitation. These will complement the restraint/allocation concept which now dominates the law enforcement function. (For example positive management of injection vs. prohibition of pollution.)

9. Many new concepts and practices are required for adequate protection/safety systems, especially protection and safety systems related to antisocial technologies, increasing activity density, and multiplicity of use in common

water areas. These concepts will concentrate more on preventive methods, but reactive techniques will also be warranted in many new areas.

10. Some organized and formal process for integrated sea use planning/zoning will be mandated.

11. Development and operation of an effective unified surveillance, navigation and communication system will be ultimately achieved.

12. The requirement for an analytical service capability will evolve in order to develop objective analyses and integrative assessments of resource development plans and institutional activity plans. Safety will be the organizing focus around which this will be built. The Coast Guard is a logical candidate for the assignment.

13. CG will persistently need to monitor emerging technologies that specifically relate to underwater operational systems in order to assure that evolving technologies, regulations and standards match.

14. The changing character of offshore ports and vessels will require the implementation of a number of environmental effect and safety studies.

RECOMMENDATIONS

1. A special agency-wide coordinated multiprogram underwater capabilities plan should be developed. This plan should be the sum of:

- Individual program plans specifically addressing the underwater capabilities and development needs for each of the current programs
- Additional "nonassigned" requirements not currently related to a specific program manager.

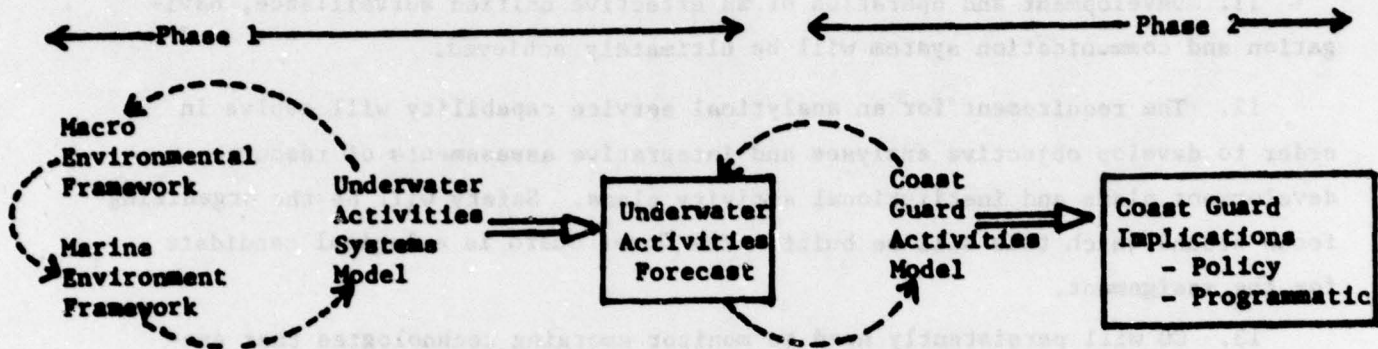
2. The above plan should be developed under the cognizance of an Underwater Activities Steering Group, appointed by the Coast Guard Commandant and reporting directly to him. Representation on the group should be as is necessary to assure adequate development of the plan, and monitoring of actual development and execution.

3. A special program of underwater R&D should be established, in order to integrate a systematic and sustained R&D program appropriate to the development of an effective underwater operations posture and capability within the CG.

THE RESEARCH PROCESS

The foregoing conclusions and recommendations were derived from a complex research/forecasting/analysis process. An overview of the process is shown in Figure 1.

FIGURE 1: OVERVIEW OF THE RESEARCH PROCESS



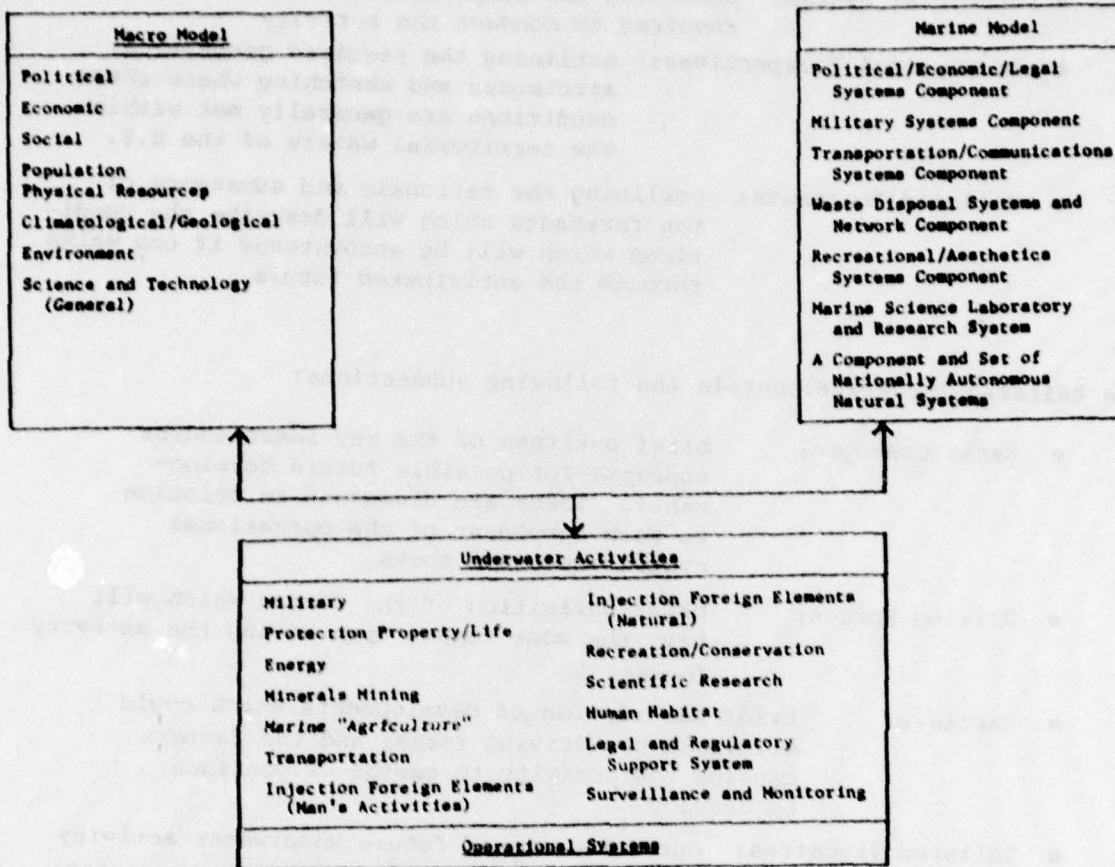
As Figure 1 shows, there were two phases: development of the underwater activities forecast, and development of the Coast Guard implications.

Both the underwater activities forecasts and the CG implications are presented in the form of "Tailored Vignettes"(see Explanation in Preface). The underwater activities vignettes were developed from an integrative analysis, which blended together three basic frameworks:

- The Macro Environmental Framework: Selected aspects of a structure which contains the basic trends and developments which affect all institutions within our society
- Marine Environment Framework: A structure which contains the trends and anticipated developments within the overall marine environment
- The Underwater Activities System Model: A structure which contains a more detailed analysis of trends and expected developments within the underwater environments, i.e., the specific domain with which we are concerned

An outline of the basic categories used to classify and organize data within each of the frameworks and the model is shown in Figure 2.

FIGURE 2: STRUCTURE OF THE THREE INITIAL FRAMEWORKS/MODELS



In addition to the 13 basic categories shown here, the Underwater Activities System Model contains 106 discreet underwater activities for which individual forecasts were developed. These activity forecasts were analyzed for cross relationships, and integrated into a set of tailored forecasts for each of the 3 basic categories.

Each category forecast is presented in a separate chapter within Volume III as follows:

- **Definition:** specific coverage of the activity
- **Background:** giving a few salient points which place the activity into historic perspective and give an overview or backdrop for the major future developments

- **Functional System:** Outlining the components which is required to conduct the activity
- **Geophysical Perspectives:** outlining the required geophysical attributes and sketching where these conditions are generally met within the territorial waters of the U.S.
- **Tailored Forecasts:** outlining the rationale and substance of the forecasts which will describe the conditions which will be encountered if one walks through the anticipated future

The tailored forecasts contain the following subsections:

- **Basic Concepts:** brief outlines of the key ideas and/or concepts for possible future developments. These are discussed in relation to each component of the operational system discussed above
- **Driving Forces:** brief definition of the forces which will have the most impact upon moving the activity forward
- **Barriers:** brief description of developments which could eliminate the driving forces and the factors causing the activity to emerge or continue to develop
- **Tailored Vignettes:** our forecasts of future underwater activity discussed in terms of substantive characteristics that will likely be found in existence. These are assigned probability estimates of high, good, low and minimal within three time frames: 1981-85, 1986-92, 1993-2000

Since the particular forms of hardware and operational systems are of such importance to understanding the nature of CG implications, an integrated outline/inventory of the operational systems forecasted for the underwater environment was also added to the Underwater Activities System Model as a separate classification. Nine major systems were identified and are shown in detail in Chapter 16 of Volume III.

The CG implications analysis began with a summation of the present roles and organizational structure of the federal government vis-a-vis the marine environment. Forecasts of organizational dynamics for marine affairs within the federal government were developed, and used as a foundation from

which to analyze longer range CG implications.

The Coast Guard implications are analyzed and presented at two levels:

- Overall implications for the Coast Guard as a whole
- Specific implications for each of the current CG programs.

The implications are expressed essentially as requirements related to future underwater activities which will impact upon the Coast Guard.

SUMMATION OF THE UNDERWATER ACTIVITIES FORECAST

Selected Features of the Macro/Marine Environments

- Nation states will remain as the dominant feature of international structures including government of the marine environment.
- It will be increasingly difficult either to negotiate or impose world order
- The "nuclear monopoly" will be eroded in two senses-- the proliferation of nuclear power to new nations and the emergence of a variety of other forms of anti social technology. Antisocial technology will give more nations the equivalent destructive effectiveness of nuclear power. This situation may be termed the emergence of "non-nuclear stratgetic parity."
- There will not be a successful achievement of world disarmament or even of overall arms limitations. The overall range of potential weaponry and military capability will increase. The arms race will enter into its next plateau, and the overall military capability of the world in general and the U.S. in particular will continue to expand. However, the composition of the weaponry and of the antisocial technologies which undergird such weaponry will undergo significant change.
- The U.S. will continue to see itself as needing to fulfill a role as a leading world power. The U.S. also will believe it necessary to retain an effective military capability as a deterrent to all forms of aggression.
- Although there will be significant structural changes within it, the U.S. economy will continue to be one of technological intensity. Technological leadership will be an important national value and goal.
- Problems associated with the increasing resource dependency of the U.S. economy will become more acute. These problems will lead to a retreat from the current support which tends to reinforce the concept of a "one world economy." There will be a continuing stream of national priorities for relative national independence in an increasing number of key resources. This will lead to changing priorities, policies, incentives, and related economic relationships with respect to the development of offshore resources.

- Advances in the state-of-art of antisocial technologies will continue across the entire spectrum of possibilities. At the same time, the essential monopolistic position over development, production and application of antisocial technologies, which generally has been held by organizations and agencies of national governments, will be eroded. Such capabilities will be operated by smaller organizations at decreasing costs and with more flexible forms of delivery.
- Protection systems against nonmilitary aggression utilizing antisocial technologies will lag seriously behind the emergence of potential destructive capabilities. A number of dramatic instances involving damages from nonmilitary aggression will occur somewhere and probably within U.S. territorial waters or within waters where U.S. interests are involved.
- Capabilities to predict the occurrence of natural disasters will grow significantly, creating a demand for more effective advance measures to reduce loss of property and life.
- The range and potential for accidents will expand in all categories of activities.
- Systematic discovery and inventory of the earth's total nonrenewable resources and renewable resource production potential within the marine environment will evolve at a rapid pace. Toward the end of the century, there will be a greatly increased capability to model the location and amount of reserves, the rates of their depletion, and the ecological consequences of various means of extraction.
- The territorial limits of interest to the U.S. and other nations will continue to expand. The current 200-mile limit will not remain stable.
- There will be a growing number of bilateral and multilateral treaties and international agreements which will tend to affect the marine environment. The monitorship of compliance by U.S. and other parties will become more complicated and more important in the overall management of national and international policy.
- Scientific interest and exploration of the marine environment will increase rapidly.

Selected Features of the Underwater Environment

Military Activities. The role and nature of marine military activities will undergo a major change. Naval strategy and tactics will shift from primary reliance upon surface based military capabilities to primary reliance upon underwater military capabilities.

The problem of determining whether a threat is present, and whether the threat has resulted from a foreign military or nonmilitary source will become an increasing intractable problem. In a growing number of areas there ultimately will be a merger of operational responsibility for protection and surveillance from a source which combines functions characteristically defined as both military and civilian.

Protection from Nonmilitary Applications of Antisocial Technologies. The forms of devices and techniques available for application will expand and include all of the following categories: mass explosive devices with nuclear destruction capabilities; exotic radiation instruments; sophisticated delivery and guidance systems including, for example, the use of ocean currents, self propelled mines, or trained mammals; disruptive chemical/biological agents; geophysical manipulation/modification techniques; selective breeding for the disruption of traditional marine life systems; economic models for targeted impacts; and various extensions of current conventional devices.

Many of these techniques replicate nature in ways which are largely non-discernible from actual natural events. Thus, even determining that an application of an antisocial technology has occurred will be a major problem. Subsequent determination of responsibility likewise will be extremely difficult to discern.

Protection from Damage by Natural Disasters. The ability to prevent natural disasters will remain very limited. However, the ability to forecast their occurrence will increase significantly. This capability will lead to the creation of an adequate warning system for operators in the underwater environment, along with appropriate means of evacuation and rescue.

Accidents. The range, scale, and frequency of damages from underwater accidents will grow significantly. Demands for improved means of preventive measures including traffic control, equipment design, and inspection will increase.

Underwater search and rescue capabilities will be required, as will the capability of underwater salvage.

Offshore Energy Industry. The offshore energy industry will continue to evolve beyond the conventional offshore drilling for oil and gas, and will include at least experimentation with many other energy systems. An offshore electrical generating industry will emerge, including floating power plants of various types.

Offshore Mineral Mining. Offshore mineral mining will continue to develop with increasing diversity and scope. Rapid advancements will occur in mining technology. Operations will include surface based and submerged platforms, as well as a few ocean bottom facilities. Extraction of critical minerals will have a favorable impact on the national economy.

Offshore "Agricultural Production." Fish cultivation and management will become a major activity. This will include monitoring the inventory of various fish populations, developing aquacultural and ocean farming techniques, and developing other means for increasing yield and productivity of a variety of marine species.

Recreational fishing will expand, and may ultimately lead to zonal controls, or allocations to protect game fish from commercial exploitation.

Cultivation and management of fish productivity will become intertwined with waste disposal and injections management systems. Some wastes which can serve as nutrients to increase fish productivity will be sought selectively.

Various marine plants will be cultivated and their value as a food supplement will increase. Some experimentation will be occurring in ocean development of kelp to be used as biomass energy fuel.

Transportation. Marine transportation will increase dramatically in volume, in diversity of vessels, and importance to the national economy. Submersibles in operation will be primarily for military or commercial purposes. Few, if any, large scale submarines will be in operation for anything other than military purposes. Commercially operated recreational submersibles offering group tours and individual rentals will gradually come into use.

The use of underwater pipelines, carrying a variety of materials, will be greatly expanded, as will cables for the transmission of electricity. The use of communication cables will not expand significantly.

Offshore ports will be developed that utilize floating support structures to facilitate the loading and unloading of different materials. Slurry pipelines for carrying ores and crushed raw materials will be in operation.

Injections Into the Underwater Environment. Continued growth is expected in the restrictions placed upon contaminants. Requirements for the capability to clean up or neutralize various forms of accidental "spills," especially of dangerous cargoes, will be a special and acute problem.

Concepts of positive waste management will be developed in which the marine environment is seen as a natural waste disposal system, and/or in which some wastes are pretreated to make them into desirable "nutrients" in order to increase the productivity of the marine resources.

Recreation/Conservation Preserves. There will be significant expansion of the concepts of underwater parks and the equivalent of "underwater wilderness preserves."

In addition, various underwater sites of unique historic interest will be designated as preservation areas.

Human Habitats. Large scale underwater communities or cities will not evolve within this time period. There will be, however, a number of underwater habitats in operation for military and commercial purposes.

Several underwater recreational habitats, such as restaurants or "hotels" will be in operation and others will be in the process of licensing and construction.

Regulations, Standards and Enforcement. Regulatory responsibilities and related activities will be involved in virtually every underwater activity area. There will continue to be a division of responsibility in many regulatory areas as exemplified by the case in environmental standards. Hence, the Coast Guard will have responsibility for the enforcement of many standards which are set by other agencies.

Equipment standards will become a more important part of the overall concepts of safety and protection. These standards primarily will be a Coast Guard responsibility. Suitable standards will include questions of vulnerability to sabotage, and factors related to the safety and health of operating personnel.

Inspection. Inspection requirements will greatly increase and will be regulated for virtually all of the underwater activities. Inspections of equipment, as well as surprise visits to determine the appropriateness of operating procedures, will be initiated. Personnel qualification exams and tests also will be administered.

Surveillance and Monitoring. The demands for surveillance and monitoring of underwater activities and facilities will be substantial.

Ultimately, there will be the need to integrate marine surveillance, underwater navigational, surface navigational, and underwater/surface communication systems into a united system.

Instrumentation systems for monitoring natural forces and for developing a prediction capability will be realized. Other areas of scientific and resource management interests will also expand rapidly.

SUMMATION OF THE IMPLICATIONS FOR THE COAST GUARD

GENERAL

The overall implications for the Coast Guard are presented in detail in Chapter 3, Vol. II. The discussion that follows highlights that material and it is grouped in the same major topical areas.

Territory

The exploitation of marine resources in waters beyond those now termed territorial will initiate an extension of our marine boundaries in a non-uniform manner. Hence, the CG will have expanded responsibilities in waters presently labeled international, to confront challenges to freedom of the seas and to protect U.S. national interests. In some circumstances, to avoid an "international incident" the Coast Guard's responsibilities will encompass the role traditionally executed by the Navy.

International Activities

International treaties on marine resource exploitation and the prohibition of or protection from antisocial technologies will commit the U.S. in general and the Coast Guard specifically to increasing enforcement tasks. To meet the stipulations of these agreements, the CG will have to develop subsurface operational capabilities and surveillance procedures which can readily be deployed in international waters. In some cases, the CG will be asked to assist other nations in their development of underwater capabilities.

Military Capabilities

As the Navy undergoes the transition from surface to subsurface, the problems of increasing efficiency of investments will escalate significantly. This trend will couple with the growing problem of distinguishing between military and nonmilitary applications of antisocial technologies to provide pressure for more effective methods of integration of military and nonmilitary marine operations.

The CG will be asked to assume greater military responsibilities and will be calculated as a component of our national strategic force. A clear delineation of operational missions under normal situations or times of crises will be articulated. As these developments emerge, the CG will be required to expand its undersea capabilities. This mandate will provide the CG an opportunity to assume some of the lead research and development programs that normally would be assigned

to the Navy. This new equipment should be designed to be utilized in both military and nonmilitary operations.

Protection Against Antisocial Technologies

The CG mandate to protect offshore national interests will be compounded by new responsibilities in preempting the applications of antisocial technologies. There will be an increasing responsibility to develop, in the nonmilitary context, an attractive "antisocial technology protection system." A key component of this system would be a threat identification program. The primary objection of the program will be to:

- Evaluate all possible delivery systems and deployment vehicles of antisocial technology
- Expand the intelligence process of the CG
- Create procedures to prevent, deter or respond to the application of nonmilitary initiated threats of aggression

Protection Against Natural Disasters

As methods improve to predict and in some cases prevent natural disasters, the CG will have expanded responsibilities for evacuation and property protection in the underwater during these periods of emergency. Instruments needed to execute these responsibilities effectively will include:

- Specifications/standards for all equipment operating within the underwater environment to withstand damages
- An inventory of all offshore facilities and activities to be warned
- Zonal controls of activity to reduce vulnerability
- Evacuation of personnel, including the possibility of evacuating into submersibles or submerged shelters which will provide safety from some natural disasters
- A communication system to provide warning and instructions
- A recovery system to move in fast for rescue, restoration and possible salvage operations

Protection Against Accidents Related to Human Activities

The probability of offshore and underwater accidents occurring will increase as the overall expansion of underwater activities escalate. Furthermore, the conflicting demands made by different activities on the same water space, the injection of foreign elements in the ocean environment, and the potentially dangerous cargos being transported will compound and accentuate the possibility of serious accidents. The CG's current accident prevention programs will need expansion

and new directions will have to be articulated for underwater activities. Among the principal concerns and potential new areas of development are:

- Effective means of traffic control in selected areas
- Effective equipment specifications and standards
- Effective training programs and mechanisms to assure that operational personnel within the underwater environment can properly execute their jobs
- Effective surveillance and communication systems to determine that an accident has occurred
- Effective response mechanisms for search, rescue and restoration

Underwater Surveillance, Navigation and Communication

The individual and diverse efforts of commercial, recreational and industrial participants in the underwater will ultimately require a united system of surveillance, navigation and communication. It is highly probable that the Coast Guard will be designated as the lead agency to coordinate and operate this integrated system.

The basic requirements which this system will fulfill include:

- The capability to determine who is operating where for what purpose
- The capability to direct and control activities as required for assurance of safety and compliance with required equipment and procedural standards
- The ability for everyone operating within the marine environment to know where they are, what other activities are going on within their proximity, and what they can and should do in the way of movement and activity
- The ability to determine that a threat or an emergency condition exists, to determine where it exists (including tracking of any movements associated therewith) and to direct appropriate responses and response teams to the scene and through their operations
- The capability to determine injections which occur illegally or accidentally, and to direct the appropriate responses thereto.

Coast Guard Underwater Capability

The diverse types of underwater activities which the CG may have to protect or monitor, the increasing military preparedness aspect of the CG role, and the new threats posed by antisocial technologies, will demand that the CG rapidly expand and maintain its underwater capability. Specific requirements

will include the ability to conduct:

- Underwater patrols and seize or arrest any vessels or any other threat as appropriate
- Underwater navigational and communications linkages
- Underwater inspection

Policy Analysis

The unanticipated consequences that result from interaction of multiple activities requires careful long range analytical planning to prevent the undesired from developing. This situation will be true in the expansion of underwater activities. The CG should seize the opportunity to coordinate these strategic assessments, for not to do so would potentially impair the CG's effectiveness to carry out its other operational missions and responsibilities.

Problems Between Standard Setting, Inspection and Enforcement

The present diversification of responsibility for various forms of developmental policies and environmental standards is expected to continue. Thus, the CG will remain in the situation where they enforce standards which they did not determine. Improved means of integrating the CG perspectives on standards, inspection and enforcement procedures with those agencies who determine them should be pursued.

Sea Zones

Many of the requirements and forecasted developments of the underwater underscore the need for some form of sea zoning plan and process. The CG is already developing some analytical evaluations of this concept and such efforts should be sustained.

PROGRAMS

Short Range Aids to Navigation

As underwater activities rapidly develop an effective underwater navigational system will become essential to insure the safety of trafficking vessels, offshore and underwater facilities, and the lives of those individuals who work in the marine environment.

The objectives of this underwater system will be to integrate its detection capabilities with the capabilities of surface navigational systems.

Radio Navigation Aides

An operational underwater navigational system will extensively utilize the radio. It is likely that development at some fixed and mobile underwater stations will be needed. Primary objectives of radio navigation will include:

- Determination of the specific location of a person, vessel or facility of integrating a complex of transmitting stations. Signals will emanate from a subsurface, surface, airborne or satellite stations
- Identification of authorized presence for efficient patrol and protection systems
- Identification and tracking ocean properties or marine species which are of operational or scientific significance

Enforcement of Laws and Treaties

As the type of underwater activities increase, there will be an increase in the number and the complexity of laws and treaties with which the CG will be required to participate. Some of the CG responsibilities to uphold the law and treaties will be in the following areas:

- Securing rights of passage
- Protecting resource exploitation both agricultural and mineral from foreign intrusion and that trade agreements are adhered to by entering vessels
- Protecting against the deployment of antisocial technologies
- Containing and preventing foreign elements from being injected into the ocean

Marine Environment Protection

The expanding uses of the ocean both on the surface and below will increase the number of undesired elements which are injected into the underwater. This will increase the CG's requirements for environmental monitoring, surveillance and protection as it relates to the ocean in general but more significantly to the underwater. The most direct impact upon this program will be the need for underwater operational capabilities.

The evolution of concepts of positive waste management and utilization of the offshore as a natural waste disposal system will demand new and different dimensions to the type of monitoring that will be needed. The initial transition will start with clean-up techniques which shift from removal to neutralization.

A detailed and specialized manual will be created that identifies all potential forms of injection/pollutant degradation techniques.

Commercial Vessel Safety

The establishment of an underwater commercial vessel safety system will be required. New technical standards and manuals will be instituted for underwater operational vessels. In certain circumstances, there will be a need for visitation and observation of underwater operations.

Deepwater Ports

The concept of deepwater ports will change; new material will be pumped through pipelines, floating platforms will become operational; some support facilities will be located in the subsurface. These changes will require the CG to develop an underwater operational capability to insure compliance with specific standards.

Port Safety and Security

This program will be impacted upon significantly as more underwater vessels become subcomponents to commercial, industrial, military or recreational activities. An effective surveillance system for the entry and exit of vessels both above and below the surface will be required. This system will also provide for protection against antisocial technologies and the accidental injection of foreign materials in the underwater environment.

Search and Rescue

Underwater operations will require a specialized search and rescue system which will have the ability to locate and gain access to underwater vessels and facilities. Substantial research will ascertain the full parameters of the program. "Rescue" operations may include responsibilities beyond underwater evacuation; preemptive capabilities to deter accidents and to neutralize potential catastrophic events will be required.

Marine Science Activities

Scientific monitoring of the underwater will eventually be assigned to an agency other than the CG. However, the CG will have a close interface with this other group and protective oversight of certain marine activities such as agricultural production seems likely. The degree to which the CG becomes involved will be heavily affected by the level of leadership and the type of initiatives that are pursued in offering its services.

Recreational Boating Safety

There will emerge an underwater counterpart to recreational boating which will include recreational diving in submersibles, and advanced scuba equipment. Parks, some underwater restaurants and observations points are a component of this underwater recreational activity.

The Recreational Boating Safety program will be expanded and it will have new responsibilities for marine recreational activity, particularly in the underwater. To insure the safety of underwater operations and operators, new equipment specifications will be developed, zonal controls will be employed, and procedural training and licensing will be institutionalized.

Bridge Administration

There seems to be little direct impact upon this program resulting from the forecast of underwater activities, although surface transport may be impacted significantly.

Military Preparedness

The Coast Guard military capability will become a more integral part of the overall U.S. military capability. To meet this requirement the following developments will be administered:

- New equipment concepts to assure military usages
- Joint operations of effective surveillance systems
- Effective underwater operational capability

The Military Preparedness Program will be broadened to become the critical coordinating point for the entire reorganization of the military role of the Coast Guard.

Reserve Training

Underwater activities will create a major new area of personnel specialties. Reservists will be instructed in various procedures for protection, emergency services, inspection and perhaps even operational takeover of underwater facilities. Significant upgrading of the reservist training to promote an understanding of the operational equipment of the underwater may be warranted.

Communications

An effective underwater communication system will be of paramount importance. The primary objective of this system will be to keep communication linkage between

operators and operations, within the underwater. Capabilities to demand recognition and to achieve a quick and accurate response will be important. The current program will be redesignated from a support program to a primary mission program.

Public and International Affairs

The growing interest in and exploitation of offshore resources will make new demands on public affairs of the Coast Guard. Some of these responsibilities will include:

- Provide information of the underwater activities to public interest groups
- Serve international organizations or fulfill treaty obligations by extending required information to key participants
- Enhance CG public image in congressional hearings and investigations

Research and Development

The advent and rapid development of underwater activities will make new demands on the CG. Maintenance of effective scientific and technological forecasting systems will be especially important. As alluded to previously and stated throughout, some other specific program concerns and general areas of priority will include:

- Developing effective protection systems in all categories
- Developing an effective surveillance system
- Developing an entire new network of equipment specifications related to standards for regulation and enforcement of safety for all underwater operations as well as for Coast Guard operations
- Determining the nature of the Coast Guard's required underwater operational capability and moving ahead to begin developing that capability
- Defining the risks, threats and countermeasures for all potential applications of antisocial technology
- Developing the needed navigational aides for underwater operation
- Developing effective mechanisms and procedures for execution of the underwater missions
- Enforcing positive waste management concepts

Personnel

New skill categories and training programs, and constant refinement of personnel recruitment and motivation procedures will enhance the Coast Guard capabilities for dealing with the future underwater operational world.

Civil Rights

There are no particular implications for civil rights programs which are unique to the underwater activities.

Legal

Coast Guard legal staff will participate in the formulation of new legislation for underwater activities. New procedures for determining negligence and assignment of fault in accidents in the underwater are representative of the types of laws that will be created.

Engineering

The emergence of underwater activities will impact directly on equipment design both in terms of the CG requirements and in terms of setting standards for equipment to be used by others. Also of significance to engineering support is the area of equipment and procurement design related to the new dimensions of military capability.

Medical

Medical research derived as an outgrowth from underwater activities will focus upon the psychological and physiological effects of working, living and participating in the subsurface. Effective methods of determining the degree to which underwater activities has contributed to personnel disability will be a growing need, and probably a specialized area of medicine.

Intelligence and Security

The problems of effective prevention and protection systems against potential threats from nonmilitary applications of antisocial technology will ultimately require more sophisticated and refined intelligence systems. These requirements will best be fulfilled by cooperating with established national and international intelligence networks.

Safety and Occupational Health

Specialized safety requirements will be determined for equipment standards to assure the safety of persons working in underwater habitats and vessels. Basic medical research in the areas of human physiology and psychology will serve as the foundations upon which standards that relate to human activity in the underwater are determined.

Financial Management

There will be a variety of pressures to bring the service functions of CG administration in the underwater environment into the general philosophy of user charges. The CG financial management personnel will be called upon to evaluate new and alternative ways in which the financial aspect of the underwater environment can be handled.