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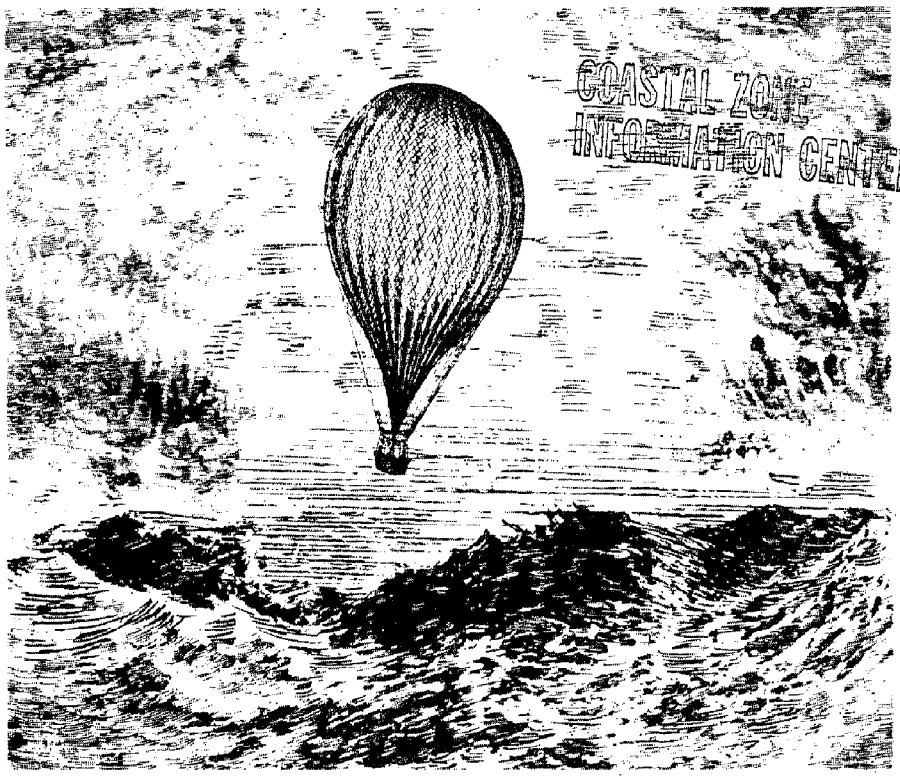
A Report to:

The President and The Congress

Coastal Zone Information Center



COASTAL ZONE INFORMATION CENTER

Fifth Annual Report June 30, 1976

5 National Advisory Committee on Oceans and Atmosphere

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A Report to:

The President and The Congress

by the

National Advisory Committee on Oceans and Atmosphere

U.S. DEPARTMENT OF COMMERCE NOA
COASTAL SERVICES CENTER
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Fifth Annual Report

June 30, 1976
Washington, D.C.

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NATIONAL ADVISORY COMMITTEE
ON
OCEANS AND ATMOSPHERE
Washington, D.C. 20230

To the President and the Congress:

Sirs:

I have the honor to submit to you the Fifth Annual Report of the National Advisory Committee on Oceans and Atmosphere.

The Committee was established by P.L. 92-125, approved on August 16, 1971, and was directed to submit a comprehensive annual report to the President and to the Congress setting forth an overall assessment of the status of the Nation's marine and atmospheric activities.

We are pleased to be able to comment this year on atmospheric matters such as weather and air safety, air pollution research and development, climate change, and weather modification. In marine affairs we have given attention to national planning and policy, to the important Sea Grant effort, to energy from the sea, and to a number of other significant oceanic programs. As in past years, NACOA has selected those topics it felt were ripe for action.

This report is sent via the Secretary of Commerce as provided for by the statute.

Respectfully,

William J. Hargis, Jr.
Chairman

June 30, 1976

FOREWORD

This Report is intended as the beginning of an action process. The legislation establishing NACOA requires the Secretary of Commerce to prepare a response on behalf of the Federal agencies to accompany the Report as it is forwarded to the President and the Congress. NACOA is fortunate in having comment on its Annual Reports mandated. The arrangement stimulates an exchange on findings and recommendations and provides a perspective for action which neither document alone could do.

Some topics appear in a NACOA Report for the first time (Energy Research, Development, and Demonstration; Air Pollution Research and Development; Weather and Air Safety; Diving Safety). Some have been touched on in previous Annual Reports (Policy and Planning for Marine Affairs; Energy from Offshore Sources; Defense Oceanography; Climate Change; Weather Modification). The Chapter on Sea Grant is a brief account of a special report to be published later this year.

The Committee has come to be called on more frequently than before for testimony and for advice and finds more occasion to offer advice on its own volition. NACOA normally meets once a month during the year to be briefed on a host of subjects bearing on marine and atmospheric affairs and to prepare for this Annual Report. In addition, it forms ad hoc panels, which develop specific subjects in greater depth than can be done in plenary sessions, for subsequent discussion

and action by the parent Committee. This work, where appropriate, forms the basis for chapters in these reports.

During this past year, several important marine issues arose which required NACOA to comment prior to this Annual Report. One such problem is the tragic possibility that the GLOMAR EXPLORER, a unique ocean engineering instrument, may be scrapped. A second was the relation of the developing National Fisheries Plan to the significant fisheries legislation extending jurisdiction in U.S. coastal waters out to 200 miles. NACOA will be following with great interest and full attention the ways in which the 200-mile extended fisheries jurisdiction legislation is put into practice and how it influences the well-being of the United States coastal fisheries. We will report briefly on the NACOA actions undertaken on these two items, among others, at the end of this Report.

SUMMARY OF RECOMMENDATIONS

NACOA, FINDING that events affecting our prospective uses of the sea are developing more rapidly than the policy, plans, and organization to cope with them, and FINDING ambiguity in scope among existing approaches to formulating national marine policy and supporting plans, RECOMMENDS that:

> **An ad hoc task force be established by legislation to formulate a comprehensive marine affairs policy, plan, and an adequate coordination mechanism;**
>
> **The scope of the policy and plan should cover: (1) use of ocean space; (2) development and conservation of marine and coastal resources; (3) protection of the marine and coastal environments; (4) support and conduct of marine-related environmental research, ocean engineering development, surveys, and technical services; (5) training of personnel; and (6) support for national defense ocean technology.**

NACOA, FINDING that we are moving as through an obstacle course in developing our domestic oil and gas resources, especially offshore, and that technological safeguards for drilling procedures and submerged completions exist (and can be enforced) which permit the environmentally safe development of these fields, and URGING an increased effort to diminish the adversary interactions between industry, governments, and those most actively interested in environmental protection where it serves only the negative function of delay, RECOMMENDS that:

> **As a nation we recognize the need to explore and develop offshore oil and gas resources consistent with enforceable, environmentally safe procedures and the need for maintaining strategic reserves, and that we reconcile the process with an economic atmosphere suitable for development.**

NACOA, FINDING that the Sea Grant Program's unique contribution to a balanced national effort in marine resource development and use and marine environmental protection is of increasing importance, but that after 10 years its goals, priorities, guidelines, management, and relationship to other Federal programs need some modification, RECOMMENDS that:

> **Funds be increased over the next 3 to 5 years from the present $23 million per year to a minimum of about $40 million, in order to enable Sea Grant to maintain a strong local and regional orientation for its educational activities, applied research, and advisory services as an integral part of an effort directed toward national needs;**
>
> **The Sea Grant Act be amended to permit responsiveness to Federal-level requirements through provision of additional earmarked funds free of the matching funds requirement;**
>
> **Special attention be paid by the Administrator of NOAA to improving the operation of the program, clarifying its goals, and setting its priorities within the national context; and**
>
> **Steps be taken by the Office of Sea Grant to improve its proposal review process, and to clarify the function, composition, and tenure of the Sea Grant Advisory Panel.**

NACOA, FINDING undue emphasis on haste in establishing R&D programs in energy resource development whose payoff is a long way off, and that the outpouring of legislation and funds for research, development, and demonstration creates pressures on ERDA not easily solved by the advocacy approach to R&D, which can be wasteful of funds and of time, RECOMMENDS that:

> **There be established in ERDA a Directorate for Oversight of Energy Research whose function it would be to act (in a manner analogous to the Director of Defense Research and Engineering of the Defense Department), as R&D advisor to the Administrator and as a group with no stake in any particular R&D approach, so that it can balance the many simultaneous avenues now being explored, and assist in shifting the priorities and keeping them current as information develops.**

NACOA, FINDING that the accomplishment of longer term basic research by EPA is inadequate, due in part to the intense short-time pressures on EPA because of the urgent need for scientific data to support immediate regulatory decisions, RECOMMENDS that:

> **EPA continue to maintain a strong R&D capability in direct support of its near-term regulatory functions; and that EPA conduct longer term basic research, to the extent that resources permit;**

Lead agency designation be accorded in each of three major environmental areas, and that the following agencies accept the prime responsibility for leadership in assuring that there are no major gaps in the overall Federal program of longer term environmental research directly involving:

human health and disease—National Institute of Environmental Health Sciences

the atmosphere and the oceans—National Oceanic and Atmospheric Administration

plant and animal life on land and inland waters—Department of the Interior.

CEQ lead a high level interagency coordinating committee to assure appropriate policy guidance, establishment of priorities, and coordination of the several long-range research programs and of these programs with the EPA.

NACOA, NOTING that weather-related aircraft accidents continue as a significant proportion of the total (especially with general aviation) and FINDING that division of responsibility for the provision of aviation weather service between the National Weather Service and the Federal Aviation Administration has taken too much weather out of the air traffic control and too much aviation out of weather forecasting, RECOMMENDS that:

The Federal Aviation Administration put greater emphasis on the early recognition of deteriorating weather situations in civilian pilot training and on the requirement for weather knowledge in pilot certification;

The National Weather Service improve the quality of air weather information by computer checks on observations, by post-mortems on forecasts, and by training in format and enunciation for voice communicators;

Aviation weather expertise be put back into the traffic control environment and, especially, that the Kansas City Test (integrating controllers and professional weather personnel) be extended and developed throughout the Nation (for controlled flights) and the Enroute Flight Advisory Service (largely for general aviation) also be extended throughout the Nation;

The agreements between, and the directives to, the National Weather Service and the Federal Aviation Administration, splitting the responsibility for aviation weather service, be reviewed and updated and the requirements for aviation weather service be reviewed in the light of technological advance on a broad front.

NACOA, FINDING that there are serious deficiencies in research related to diver physiology, and in the development of safe proven decompression tables, RECOMMENDS that:

Research be directed toward the development of tables and procedures to allow more rapid decompression of divers, based on safe physiological considerations, and toward significantly increasing our understanding of both the long- and short-term physiologic effects due to work under hyperbaric conditions. An additional $3.5 million should be directed towards these research efforts annually.

NACOA, FINDING indications of increasing Defense Department reliance on non-DOD sponsored ocean research in areas of technical importance to defense, and cautioning that excessive dependence on the efforts of civilian agencies could seriously weaken Navy technical strengths, erode its capabilities, and make it vulnerable to technological surprise, RECOMMENDS that:

DOD ensure that increasing reliance on non-DOD sponsored research does not have a deleterious effect on Navy technical posture.

NACOA, FINDING that there is a marked lack of involvement of younger academic faculty in DOD research and development and that DDR&E has recognized this problem and has a small corrective program underway in the Army and Air Force, RECOMMENDS that:

The Navy initiate efforts to increase the direct involvement with its laboratories and operational facilities of younger faculty members in areas of oceanography and atmospheric R&D.

NACOA, FINDING that our capability for incorporating climatic assessments into planning related to food, energy, and water is not being exploited as effectively as it might be because no single Federal agency has the clear responsibility for doing so, and FINDING that research directed toward developing a capability for prediction of climatic fluctuations is not being vigorously pursued, again because no agency has the clear responsibility, RECOMMENDS that:

The Congress enact legislation such as H.R. 10013, the "National Climate Program Act of 1976," to: provide for a program of climate watch, development of improved climate forecasting, and conduct of climatic research; and to authorize the Secretary of Commerce to coordinate the efforts in the field of the various concerned Federal agencies.

NACOA, FINDING that the fragmented Federal effort in weather modification places too much emphasis on operations, with insufficient attention to the basic research which is needed before weather modification can become a reliable operational tool, and FINDING that

enough studies have been conducted to permit a decision to be made as to how to proceed, RECOMMENDS that:

> **Action be taken now, by the Executive Branch or by the Congress, to give NOAA the responsibility for coordinating and managing a coherent Federal program of weather modification research and experimentation.**

TABLE OF CONTENTS

Letter of Transmittal iii

Foreword v

Summary of Recommendations vii

I. Policy and Planning for Marine Affairs 1
A Federal Responsibility—Ocean Policy—Scope—Organization—Summary

II. Energy from Offshore Sources 5
Moving at a Snail's Pace—Environment, Economics, Technology, and Red Tape—Basis for Progress

III. The Sea Grant Influence 11
Background—Sea Grant Mission—Meeting Broader National Needs—Sea Grant and Participating Institutions—Sea Grant Funding—Management of Sea Grant—Summary

IV. Energy Research, Development and Demonstration 19
Energy from the Ocean—Rushing Ahead—The Need for Oversight

V. Air Pollution R&D 27
EPA R&D in Air Pollution Control—Evaluation of EPA Programs—Pressures—Mission Support Research—Other Agencies in Air Quality Impacts Research—Coordination—Closing Comment

VI. Weather and Air Safety 37
Aviation Weather Service—Weather Information—Education—Summary

VII. Some Marine Matters 45
Diving—Navy Environmental Research: Technical Facilities—Navy-Academic Exchange

VIII. Some Atmospheric Matters 49
Climate—Weather Modification

IX. Shorter Comments 55
GLOMAR EXPLORER—Framework for Marine Resources Planning—Offshore Assets—Coastal Zone Management

Appendix 1: NACOA Enabling Legislation 61

I. Policy and Planning for Marine Affairs

Despite increased activity toward development of national ocean policy, and concern for coordination and management of ocean affairs, it has not been possible to formalize a focus for marine affairs on a national basis. The number, diversity, and ambiguity of national goals in the oceans is a prime reason. NACOA proposes reducing the uncertainty about goals and approaches by developing a comprehensive national marine plan during the next year, and suggests that this could be best carried out by an ad hoc task force under joint Legislative-Executive guidance.

A Federal Responsibility

NACOA once again calls attention to the significance of the international context for United States ocean development. This more than anything else requires the Federal Government to take an active, anticipatory, and managerial role that goes beyond mere adjustment to technical and political forces.

Furthermore the Federal Government, as a party to virtually all U.S. marine activities, is uniquely situated to note their complex interaction, assess and reconcile regional differences, and relate their collective impact to the public good. This is unlike the situation on land where the jurisdiction of States and localities and long-standing practices and customs combine to create a system requiring Federal intervention only under unusual circumstances.

At the same time, industry is and should continue to be the major operating agent for execution of commercial activities in the ocean.

Ocean Policy

We believe that most of the elements of a national ocean policy are already in being. What is needed is to rationalize and organize them

in a form useful as guidance for further action and decision. This form should both express national intent and guide our ocean-related contacts with other nations.

With regard to interactions among U.S. marine activities and programs, we believe that the Federal Government should explicitly fulfill its responsibility for developing and coordinating a comprehensive and long-range national program in marine and coastal zone affairs and in marine-related environmental science and services. The broad goals of this program should be to benefit this Nation, taking into account our responsibilities to all mankind, by:

- contributing to the protection of health, property, and the environment;
- providing for the balanced utilization, conservation, and management of marine resources;
- enhancing our commerce, transportation, and national security; and
- resolving conflicts between State and Federal Government responsibilities and authority in marine affairs.

Achievement of our national goals will in many instances require negotiation of new international agreements to minimize conflicts and assure global cooperation over the long term. Pending achievement of such international agreements, the United States also has the clear responsibility to take action to prevent the destruction or wasteful use of resources, the pollution of the environment, and the misuse of important ocean areas, and to provide encouragement to U.S. technology and enterprises. The drafting and passage of the Fishery Conservation and Management Act of 1976 is a clear example of how such responsibility is being met.

Scope for Marine Affairs Planning

Sporadic efforts to block out the elements of a national plan for marine affairs have all failed to meet the need, although a number have improved our understanding of the problems and opportunities. One handicap has been that the scope limited planning to marine science and engineering development, even when the word "resources" was introduced. This is obviously too narrow a field of view. Although national defense ocean technology would appear to be a special situation, basic support for that effort must also be considered. Therefore, we now propose that the national planning effort be organized around the uses of the sea, not merely ocean technology itself.

In our view, these would include:

- the use of ocean and coastal zone space for commerce, special facility siting, recreation, and national security;
- the development and conservation of marine and coastal resources;
- the protection of the marine and coastal environment;
- the support and conduct of marine-related environmental research, ocean engineering development, surveys, and technical services;
- the training and education of personnel in marine matters; and
- support for national defense ocean technology.

Organization for Marine Affairs Planning

The Congress has been very active in promoting the development of new ocean policies and means to carry them out. However action, or talk of action, is also in evidence elsewhere. Proposals such as that for reestablishing a Marine Council chaired by the Vice President or, alternatively, chaired by a "lead" cabinet officer, for assigning responsibility for national marine planning to a lead agency or to a new White House "advisor" and staff, and the like are being discussed and considered.

In previous reports, NACOA has made detailed recommendations for organizing the conduct of marine and atmospheric affairs, including the establishment of a cabinet- or White House-level body for interagency coordination and planning. Although our recommendations for reorganization are still valid, it appears unlikely that they will be adopted in the immediate future. However, the need for improved national marine affairs planning is urgent and need not wait for a full-scale reorganization. Accordingly, we hereby propose an ad hoc task force to prepare an initial long-range plan that provides for interim implementation pending the establishment of a high-level planning activity on a permanent basis.

Actions to mobilize the full range of U.S. capabilities will require close cooperation of both the Congress and the Executive Branch and the understanding and support of the private sector if they are to reflect the national commitment needed for success. Accordingly, we do not hesitate to recommend the formation of a joint Executive-Legislative steering group to oversee this planning effort. We further suggest that NACOA monitor and review the planning effort, providing advice as appropriate to the President and the Congress.

The daily work towards such a plan must be carried out by people with a full-time assignment to such a job, even if such assignment were temporary. We think the core of such a staff ought to be civil service.

backed up by consultants and contract assistance. Housekeeping and administrative support requirements reinforce this suggestion. NACOA experience suggests that a staff of 10–15 professionals with a similar number of support staff backup would be required to include and make effective use of the expertise needed.

There are many advantages in assigning the responsibility for providing basic staffing and administrative backup for this planning effort to a lead agency with strong capability and experience in the fields involved. NOAA would seem to be one suitable candidate. However, White House staff management might also be appropriate, considering the diversity of interests that must be reconciled. To be effective, the assignment of responsibility should be accompanied by the provision of the required authority and resources to do the job and we would suggest a legislative basis for this mandate.

Summary

To sum up, we foresee a dramatic change in the demands on our national capacity to manage our marine affairs and develop a dynamic national ocean policy whether or not there is international agreement on new rules and procedures for the conduct of ocean activities at the United Nations Conference on Law of the Sea. These demands imply a more explicit statement of national policy, a more comprehensive and unified national plan, and a more coherent and coordinated program in marine affairs than now exists.

We propose a special ad hoc task force, guided by a joint Executive-Legislative Branch steering group, to carry out such a planning effort during the coming year. We further recommend that this task force be established by legislative action.

We also propose the formation of a high-level continuing Marine Affairs Council to implement the plan in a coordinated coherent fashion and to see to its continuing review and update. Such a forum is required to represent the marine needs of the Nation in a balanced framework.

II. Energy from Offshore Sources

It has proven so easy to delay the development of needed domestic offshore oil and gas resources that an essential fact is being lost sight of: enforceable, environmentally safe procedures can be reconciled with an economic atmosphere suitable for development and, in the national interest, they must be.

Moving at a Snail's Pace

The paradox of our current national approach to solving energy problems is that we rush ahead with activities which may bear fruit in a few decades, and go at a snail's pace with what we can do today.

The fuel readiest to hand, most convenient to use, with a tailored market and a complete distribution system, comes from oil and gas fields. When it comes to lessening United States dependence on foreign sources of oil and gas by accelerating the exploration of offshore domestic sources, however, we have controversy whose main result is delay.

In just a few years, we have seen disappear the paradise of cheap energy from a global pool, and we have lost the comfortable illusion of an atmosphere with the limitless ability to absorb or disperse unpleasant byproducts and an ocean which could accommodate spills without damage. Our own land-based oil fields are being depleted; our proven reserves are lessening. Foreign producers of oil have come to see production control as a way to maximize their benefits and economic well-being—not ours. All the while we import more each year. Whatever decision is made to use or conserve our own offshore resources, the long lead-times necessary to bring them to the point of production means we have to act now.

No longer will increased prices alone produce the capital and the incentive to explore for new domestic sources, develop the more difficult fields, and improve the efficiency of recovery. It may be necessary but not sufficient. A number of very important new elements, extraneous to economics and simple market forces, have entered the picture.

Environment, Economics, Technology, and Red Tape

These new elements have to do with environmental impact and with the changing roles of multinational corporations. The environmental impacts are of two major kinds: (1) the effects of producing, transporting, refining, distributing, and marketing offshore oil and gas, and (2) the effects of using petroleum products, particularly in internal combustion engines. The change in the role of multinational corporations is a direct reflection of the explicit hardening of the differences in interest between the developed and the developing nations, and between the producers and the users of raw materials.

The environmental issue is: do we know enough to minimize adverse effects on the environment if we go ahead and open up our continental shelf to increased offshore drilling and production? The multinational issue is: can we be confident that all our national interests will be served by corporations with large responsibilities to and dependence on foreign sources when their foreign policy, if they serve their stockholders, may not always parallel that of the United States?

Different interests look at these issues from different points of view. As participation of local governments increases and an active element of the public intervenes, the result is not resolution but irresolution. The general situation is for advocates of one approach or another to oversimplify their own position and that of their adversaries, and charge ahead. The major result, of course, has been delay.

The delay, unfortunately, is being built in, and what concerns NACOA is that it may become harder and harder to remove or tolerate. Industry is faced with changing rules of the game and unresolved regulatory, legislative, and environmental uncertainties. Assurance can be offered that the technical ability exists to safeguard the marine environment in drilling. (It must, of course, be enforced.) Can assurance also be offered that the economic safeguards exist which are needed by industry if it is to make the huge investments required without running into boobytraps caused only by bureaucratic procedures and tactics of pure delay rather than by reasons of environmental safety or other paramount causes?

Along with air, food, and water, hydrocarbons may be, today, the most essential substance to U.S. national welfare. NACOA's purpose in this brief statement is to emphasize how complex the situation is, and to appeal for a process of cooperation based on an understanding of its complexity. Mutual trust does not, in fact, exist. Therefore, arrangements for mutual watchfulness must be made for the common purpose of making energy available. Holding up the development of domestic

resources is the equivalent of sawing off the limb we are standing on. We have to get going by establishing a mode of watchful movement rather than one of cautious delay.

A Basis for Progress

NACOA has for some years urged that we develop our offshore oil and gas resources with due regard for impact on the marine and coastal zone environment. In 1973, the Committee wrote that the oceans must play an increasing role during the transition from national reliance on domestic terrestrial fuel to substantial use of energy from offshore and foreign oil and gas sources and from nonconventional sources.* NACOA then recommended establishing single-point moorings in preference to deepwater ports for oil transshipment.

In 1975, in its Fourth Annual Report, the Committee went into some detail in relating coastal zone management and offshore oil and gas development. The Committee recommended that:

> "The Outer Continental Shelf Lands Act of 1953, or the Coastal Zone Management Act of 1972, be amended:
>
> > "To assure reasonable State input to Outer Continental Shelf development plans and production, to expedite State management planning related to the consequence of offshore oil and gas development, to assure that proposed Outer Continental Shelf exploration and development programs are fully consistent with State plans, and to provide adequate information and technological data to assist in coastal zone planning and decision making.
> >
> > "To give negatively impacted States compensation for the effects imposed upon those States.
>
> "Private industry continue its role in oil and gas exploration and development on the Outer Continental Shelf under explicit Federal permit and leasehold guidelines to assure a balance between development, conservation, and environmental protection.
>
> "Environmental impact assessments of Outer Continental Shelf exploration and development plans in frontier areas where there has been no previous production be made in stages commensurate with the differences in hazard between resource exploration and resource development.

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* Report to the President and the Congress by the National Advisory Committee on Oceans and Atmosphere, Second Annual Report, June 29, 1973, p. vii.

"Less detailed environmental impact statements should be accepted for exploration plans, but the review process leading to approval of production plans should be accompanied by thoroughly detailed environmental impact statements."*

Legislation in this regard is still evolving in both the House and the Senate.

Let us restate the essential facts:

- We need to make it possible to use, if we wish, our offshore oil and gas for the near-term relief of the Nation's energy needs.
- The environment is not necessarily protected for long doing nothing, for if doing nothing goes on long enough, it could bring on a panic of correction and overreaction without regard for environmental consequences.
- Technologically safe procedures for drilling and submerged completion of offshore wells exist today. These permit the production of oil from the Continental Shelf with due regard for protecting the environment. It is possible to construct and operate environmentally safe pipelines and pipeline landfalls. These safeguards are available but must be enforced.
- Investment and production programs to develop offshore oil and gas resources will be slow to start if delays are expected to occur from capricious court battles.
- No one, neither industry, nor government, nor the environmentally active public, is ready to depend on its own interests being safeguarded by the others.
- Environmental protection and impact assessment depend to some extent on facts which are not available and which may take a long time to gather.
- It is not necessary to marshal every fact about all the impact possibilities of exploration and production before getting started, but it is necessary to have consistent procedures followed in good faith.

Conflicting interests would be easier to sort out and perhaps resolve if there were less confusion about the meaning of what is safe. It is in the national interest to remove the delay to exploration and to exploit carefully but no one wants to agree until he is assured that the other parties will, or can be made to, stick to their part of the bargain. The

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* Report to the President and the Congress by the National Advisory Committee on Oceans and Atmosphere, Fourth Annual Report, June 30, 1975, p. vii, viii.

environmentalist wants to be certain resource exploitation will not harm the environment. Industry wants to be certain it doesn't start up a large effort only to get tied down with its money stuck and the production phase delayed or made impossible. Government must be certain that the public interest in the value of the resources being withdrawn is properly recompensed. Pending legislation has features bearing on all these aspects. No one seems disposed to trust the other fellow very much, but it becomes increasingly clear that some middle course will have to be found that assures safeguarding of the environment, and that makes economic sense. The alternative is a continuing decrease in the availability of natural crude oil and gas and increasing dependence on foreign sources of supply.

This proper course, NACOA suggests, is to establish firm and predictable schedules for factfinding, assessment, and go-no-go decisions. This would allow financial, exploratory, and production planning to proceed and priority for environmental factfinding to be established so that activity can begin as early as possible. The distinction between an initial phase of pure exploration and a succeeding phase of combined exploration and production, which NACOA has suggested (as have others), would allow matching the impact statement requirements to operational realities. Even though exploration continues throughout the entire production of a field, production itself does not begin until an economically viable project has been established through discovery of hydrocarbons. Exploration should not be held up by the need for the fully detailed impact statements that are really only required and can only be detailed when production plans are established. A delay can be tolerated and planned only if it is limited and anticipated.

A second major source of industry uncertainty is the suggestion that government do the exploration and industry the production on the ground that lease-offering would be less of a gamble than is now the case. NACOA has opposed this for a number of reasons—not because the government shouldn't have better knowledge of the value of what it offers for lease, but because this method would probably result in a poorer estimate than is now offered by the combination of government surveys and industry bidding procedures and would of certainty greatly delay development. Exploration by government would introduce an element of economic conservatism into exploration, a high-risk, high-payoff field of endeavor, which is geared for the entrepreneurial rather than the bureaucratic approach. Production is the prize industry takes risks for in its exploration. If you remove the chance for the prize, a great deal of incentive has been chopped out of the

process. There are better ways of assuring fair return to the country for the mineral resources taken out of the Continental Shelf.

NACOA's message once again is that it is extremely important that we make it possible for industry to explore and to produce where oil is found and can be got out in an environmentally acceptable fashion. We urge and encourage safe but rapid development of our offshore oil and gas resources, and believe industry can minimize adverse impact on the marine and coastal zone environments as is necessary, provided it has the incentives to do so. If we change too many of the rules in oil and gas field development and production in which United States industry leads the world, it is hard to see how we could do the American people a worse service.

III. The Sea Grant Influence

NACOA has reviewed the Sea Grant program and here summarizes its findings and recommendations. It found a program which, while relatively small in size and budget, exerts a large influence on the Nation's marine resource development effort, and it found several ways in which its functioning might be improved.

Background

The Sea Grant program was created in 1966 by the National Sea Grant College and Program Act (P.L. 89–688) which authorized the establishment and operation of Sea Grant colleges and programs of education, training, research, and advisory services related to the development of marine resources. The program was assigned by the Act to the National Science Foundation, and the first grants were made in FY 1968. Sea Grant was transferred to NOAA when that agency was created by Presidential reorganization in 1970.

Sea Grant is now nearly 10 years old. During its early years, the program grew steadily, both in budget and in number of participating institutions. In FY 1968, grants totalling $2.5 million in Federal funds were made to six institutions* for multiproject Sea Grant programs; by FY 1973, the number of such institutions had grown to 25 and the Federal funding level had grown to $19.5 million. Since that time the number of institutions with multiproject programs has remained constant, and the funding level very nearly so, growing only to $23.1 million in FY 1976, despite continued inflation which far exceeded the increase in financial support. Sea Grant presently supports some type of activity in 26 states, the District of Columbia, the Trust Territories,

* We refer here to institutions participating with multiproject programs. In addition, Sea Grant has, since its inception, supported individual projects at a level of $2 to $3 million per year.

American Samoa, and Guam, involving more than 3500 participants. Sixteen institutions or combinations of institutions are full participants, in the sense of carrying out the entire scope of activities intended by the Act. Nine other institutions have smaller multiproject programs, and a great many more participate in a subsidiary manner such as involvement in a single project.

The faltering budget support in recent years, and dissatisfaction with the program heard from several sources, led NACOA to undertake a comprehensive review of Sea Grant. This study was carried out by a 10-member panel of NACOA, and a separate detailed report is now in preparation and will be issued shortly.

NACOA did not, in its review, attempt to judge in detail the scientific quality of Sea Grant's projects and programs. Rather, we concentrated on the statutory responsibilities of Sea Grant, its role in national and regional marine activities, and its impact on marine-oriented education, research, and private industry.

The Sea Grant Mission

With the growth of a nationwide effort in coastal zone management, and with the assertion of jurisdiction over the resources within a 200-mile economic resources zone off our shores, the United States has assumed new responsibility for management of extensive fishery and mineral resources. To carry out this obligation, we will need to increase our knowledge of these resources, and to exert greater effort directed toward their assessment, management, utilization, and protection. New techniques and new skilled personnel will be required.

Sea Grant, while modest in scope, plays an essential role and can have a major impact on this effort. The majority of Federal agencies and programs have missions directed towards specific resources or single purposes such as fisheries, offshore oil and gas, or coastal zone management. In contrast, Sea Grant is set up to call upon experts in many fields in universities and research institutions, and to some extent in industry, and to apply this multidisciplinary expertise to a variety of problems which may not be receiving adequate attention, in a way not generally possible for the traditional Federal agencies involved in resource development and management.

Research projects of low cost, aimed at prompt and practical results, are another characteristic feature of Sea Grant. Working with local (and usually small) businesses, and State and local regulatory agencies, Sea Grant can help expedite the transformation of research and engineering results to practical and economic use. Short term, early, and practical payoff responsive to such needs is a unique contribution of

Sea Grant to the overall national marine research and development program.

Sea Grant advisory services, like agricultural extension services, have come to play an important and expanding role in translating marine research and technology into language understandable to the public and the business community.

Expanded national responsibility in the coastal and economic resources zones will almost certainly lead to an increased need for trained workers in marine industries, skilled managers and regulators at local, regional, and national levels, and marine educators. Again, Sea Grant is in a unique position to identify, encourage, and support the development of programs of education and training to meet these needs.

Sea Grant is not simply another research program. In intertwining education, research, and advisory services, it is in effect a service program, identifying needs, selecting appropriate modes of response, conducting research and training, and drawing on its own results and those of other programs to provide users with the knowledge and the skilled personnel they need. It is not simply a science program; it encompasses the disciplines of business, law, economics, government, and management, and draws on experts in all these fields to meet the needs of marine agencies.

Sea Grant is a matching fund program. The States and other sponsors who contribute at least one-third (and in some cases more than one-half) of the funds are important participants, and have an influence on the nature of the programs undertaken at the participating institutions. This serves to ensure that institutional programs are responsive to clearly identified problems of direct interest to an industrial, commercial or governmental entity which is willing to share in the costs and effort needed to arrive at a practicable solution. Sea Grant thus encourages local initiative in addressing problems which, while their specific manifestations may be local or regional in character, are collectively of importance to the Nation as a whole.

Meeting Broader National Needs

Our Nation needs to develop its marine resources, but the approach required differs from region to region. This, together with the fact that much private marine industry is in the form of small businesses such as seafood processors, shipyards, marinas and so forth, makes it natural for much of the effort in fostering new investment, more efficient operations, market development, etc., to be carried on at the regional and local level. Nevertheless, there are broader national and even international needs which could profit from the expertise which

Sea Grant is able to mobilize, and it would be beneficial to develop a means by which the Sea Grant resource could be drawn upon by other Federal agencies for purposes deemed of high priority at the Federal level.

We do not believe it would be practical or appropriate to ask a matching fund program to address needs more general than those identified as important by those who provide the match. Additionally, we would not like to see Sea Grant's responsiveness to local and regional needs diminished by diverting existing funds to such Federally identified purposes. We therefore suggest, where national and international programs are to be undertaken in response to Federal initiatives, that specially earmarked funds be provided free of the matching requirement. This could be in the form of a separate authorization for this purpose, or in the form of a provision permitting other Federal agencies to transfer funds to Sea Grant for activities to meet their needs, free of matching. Whichever way it is accomplished, such unmatched funds should not be allowed to dominate the basic nature of Sea Grant. We therefore suggest that additional appropriations for these purposes be limited to a small fraction of the total Sea Grant budget,* and that acceptance of funds transferred from other Federal agencies be subject to the discretion of the Secretary of Commerce.

Sea Grant and the Participating Institutions

In addition to providing the Federal Government with a means of drawing on universities and other nonfederal institutions, Sea Grant has served as a vehicle by which such institutions can effectively provide public service functions which are within their capabilities but for which the usual organization of a university is poorly suited. Many university administrators have recognized this, and have welcomed the opportunity to participate in Sea Grant, even though the administrative burden of doing so is sometimes great.

Two conditions must be met for the Sea Grant program at a particular institution to be effective. The program must be of sufficient size, and have sufficient financial support, to attract the attention of faculty members as participants and to persuade university administrators of

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* H.R. 13035 and S. 3165, Sea Grant amendment bills recently passed by both Houses of Congress, authorize $8 million and $18 million respectively for such Federally identified purposes, in addition to the basic Sea Grant authorization of $50 million. These relative amounts are generally consistent with our recommendation.

the importance of Sea Grant to their institution, and it must be of sufficient quality to command the respect of the academic community. The first of these depends upon adequate funding of the program as a whole; the second depends upon program management which gives high priority to quality.

Sea Grant Funding

Sea Grant is not presently receiving sufficient funds to permit it to fulfill its mission adequately. We estimate that to remedy this will require the Federal funding base to grow from the current $23 million to about $40 million as a minimum over the next few years, apart from increases needed to keep pace with inflation.

We have looked into the extent to which Sea Grant funding policy reflects what is sometimes called the "seed money" approach, in which local clients in industry and State government assume responsibility for activities started by Sea Grant and demonstrated to be of value. Such an approach, it is supposed, would permit the Federal investment in Sea Grant to be gradually phased out or at least scaled down over the years, having done its job of catalyzing industry and local and regional governments to do what they should have been doing all along.

We are pleased to note that such a policy is in fact being pursued now—not with the intention of phasing out Federal support for Sea Grant as a whole, but for the purpose of restricting Federal funds to those stages of problem resolution which are not yet ready to be turned over to local government or industry for implementation. When a Sea Grant institution takes on a problem, it does what research is required, institutes those training programs which are called for, provides information and guidance to industry and State agencies—and then moves on to new problems, having made the necessary start on the old one so that further development can be left to industry and to State and local government. Given the current state of marine resource development, it is unrealistic to suppose that the time will come very soon when new problems, requiring the sort of attention Sea Grant is suited to provide, will not continue to arise. This is a state of affairs which must be reexamined from time to time. For the present, the approach Sea Grant is taking provides continuity to institutional programs while ensuring that resources do not remain committed to specific projects any longer than is necessary.

Management of Sea Grant

In the course of our review, we encountered concern about the guidance given to participating institutions by the Office of Sea Grant

to assist them in establishing priorities, and in determining what is and what is not suitable for Sea Grant support. While from time to time differing viewpoints between the Office of Sea Grant and the institutions may have led to some confusion about priorities and purpose, we believe there is a deeper underlying problem caused by different opinions at the Federal level of what the Sea Grant goals and role should be. We recommend that NOAA undertake the resolution of this matter and in particular clarify its own view of the program's place within the broader context of the Nation's and NOAA's overall effort related to marine resources.

We estimate the overall Federal effort in marine resource development to run more than $300 million per year.* Of this, NOAA's total effort runs on the order of $100 million, of which Sea Grant represents less than 25 percent. Priorities and emphasis in the overall national effort will change with time, and so will the areas in which Sea Grant is needed.

The Sea Grant Advisory Panel, a group of experts which offers guidance to the Office of Sea Grant concerning the programs at participating institutions, is in a good position to help assess the extent to which Sea Grant's individual undertakings combine in the aggregate to have impact on a national scale, and should devote a portion of its effort to reviewing the program's effectiveness for this purpose. However, the primary function of the Panel should be to advise the Administrator of NOAA and the Office of Sea Grant on broad policy issues. Other duties, such as assisting in program reviews, should be ancillary. We recommend revising the makeup of the Panel to include more experts in such fields as advisory services, communication and publications, and education at all levels, and more representatives of potential users, and we recommend more systematic and frequent turnover of the Panel membership.

A second area of concern has to do with coordination with other related Federal programs. While cooperation exists at the working

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* The Interagency Committee on Marine Science and Engineering, in its budget summary for the Federal Ocean Program, reports that in FY 1976, $128 million was budgeted for programs relating to living resources (the bulk of which went to fishery resource assessment, development and management, and to enforcement of fisheries treaties), $119 million was budgeted for nonliving resources (the bulk of which went to OCS assessment, leasing, and management), and $126 million was budgeted for development and conservation of the coastal zone. In addition, smaller amounts went to engineering, transportation, oceanographic research, and international cooperation, part of which is marine-resource related.

level between Sea Grant and other Federal programs, it appears to be unsystematic and erratic on occasion. Identification of areas in which formal coordination between elements of NOAA is needed and establishment of the necessary mechanisms have progressed too slowly. We recommend that the Administrator of NOAA take steps to see that appropriate procedures for coordination between Sea Grant and other elements of NOAA are implemented.

A third area of concern is the Sea Grant proposal review procedure. The process is time consuming and places a heavy administrative burden on the participating institutions. This may be a consequence of the nature of Sea Grant. A Sea Grant institution's proposal is a collection of individual projects, encompassing in the aggregate not only a wide range of academic disciplines, scientific and nonscientific, but also the nonresearch areas represented by education, training, and advisory service activities. Because of the difficulty of judging complex interdisciplinary projects, the various stages of review which now take place are essential if the program is to maintain its high quality. The existing provision for local and State advisory bodies to have their input in the early planning stages, before the proposal is passed on to the Federal Office, is particularly appropriate since these groups represent those who are contributing matching funds.

Nevertheless, there are a number of ways in which it may be possible to ease the administrative burden and the time required for the process. One way is to operate in a 2-year cycle. This can be done in several ways, e.g., by subjecting an institutional program to complete review once every 2 years, and looking only at proposals for new projects in the intervening year, or by reviewing half the proposal one year and half the next.

We feel, however, that it is important to subject proposed projects to close scrutiny, both for quality and for readiness for phasing out after having served a "seed money" purpose. If a heavy administrative burden and a lengthy proposal review process are part of the price that must be paid, we feel that it is worth it. However, it is important that the time consuming review process not hamper the institution's ability to respond quickly to newly identified needs. We favor maintaining the present flexibility provided to the institution's Sea Grant Director in the form of a discretionary fund to permit undertaking short term problems and developing new projects, subject to guidelines and review by the Office of Sea Grant.

Summary

Sea Grant occupies a unique and valuable place in the Federal structure directed toward marine resource development, characterized by

its ability to draw on the talent and expertise in a wide variety of fields found primarily in the Nation's universities and research institutions, and to direct this talent toward the solution of practical problems faced by industry and government in their effort to develop and regulate the use of marine resources. Other programs address problems recognized at the Federal level; Sea Grant addresss primarily problems identified at the local and regional level which, although they may be small individually, determine in the aggregate the extent to which the Nation benefits economically from its marine resources.

NACOA believes that Sea Grant's ability to contribute to the overall national interest would be enhanced by provision of additional funds directed toward problems identified at the Federal level, for which the matching requirement would be waived; by clarification of Sea Grant's goals and role in the broad context of the overall national effort; and by improvements in the proposal review process, the role of the Advisory Panel, and the extent of formal coordination with other programs. We believe such improvements would increase Sea Grant's effectiveness and its ability to mesh appropriately with other Federal activities.

We recommend that the funds provided annually to the program be increased from the present $23 million to a minimum of about $40 million over the next 3 to 5 years (in addition to increases needed to undertake projects initiated at the Federal level and to keep pace with inflation), in order to allow those institutions already participating to build their programs to a point which reflects their capabilities to meet demonstrated local needs. We believe that the present mode of funding, which includes a mix of short term project support and long term program support, is well suited to the purpose to be served.

IV. Energy Research, Development, and Demonstration

In placing ocean energy resources in the context of the broad national effort in energy research, development, and demonstration, NACOA finds need for a better balancing of research with development, and each with demonstration, than is now happening with nonfossil-fuel sources. It is unlikely that this need will be met by the normal procedure in which the line elements responsible for particular approaches compete with one another for funds and attention, program priorities are established by persuasion, and systems aspects treated sporadically. NACOA proposes a Directorate for the Oversight of Energy Research to act as technical staff and advisor to the Administrator of the Energy Research and Development Administration—in a manner analogous to the DDR&E for the Secretary of Defense.

The oceans absorb most of the sun's energy which reaches the earth. The role of the oceans must therefore be taken seriously in the intensifying national inquiry into a means for using solar energy.

NACOA found, however, that not all the various sources of ocean energy were being fully considered, and that those which were being considered were being examined in the isolation of separate technological arenas. They were not being compared as systems in which the energy resource, first tapped and then converted to a useful form, must also be introduced into a competitive market.

The Committee therefore charged a panel with looking into the ocean-related aspects of energy against a broad context of resource availability, technical feasibility, and the infrastructure of distribution and, where necessary, against land-based solar energy alternatives.

The panel viewed various proposals for extracting energy from the oceans in this broad context. It did not, for various reasons, examine each in a comprehensive fashion. It could not. It found in fact, that nowhere, nationally, is this being done in a systematic fashion. It was this realization which led to NACOA's recommendation for a Direc-

torate for the Oversight of Energy Research to report to the Administrator of ERDA.

Nonfossil-fuel Energy from the Ocean

There is a lot of energy in the oceans. They are so huge, whatever they have is in large quantity. But the energy is also so diffuse that getting it out is not easy nor are the best ways of doing it obvious at this time.

Most forms of available energy derive ultimately from the sun. Winds arise from the effect of the sun's heating on the atmosphere, and waves arise from wind. The potential for a heat engine, running on the difference in temperature between the ocean surface and the deep, arises from the sun's heating of the surface waters in the tropics. The chemical energy of the ocean's living resources arises from photosynthesis, the capture of sun's energy by plants. The physiochemical energy inherent in the difference in salt content between the ocean and the rivers of freshwater that run into it, arises from the evaporation cycle. Even tide comes in part from the sun's as well as the moon's gravitational pull, and ocean currents from a combination of these factors including the rotation of the earth. For completeness we remind the reader that coal and oil energy also was prepared by the sun. The usual definition of solar energy separates this by time-in-storage before utilization.

The great difference between solar power programs on land and those in which the ocean is a mediator is that in the former the fundamental problems are the collectors, the concentrators, and the energy storage whereas in the latter they have to do with the relatively small differences of temperature, velocity, and chemical composition. There are also myriad unevaluated considerations having to do with oceanic response such as the effect of biological activity and fouling on mechanical parts, possible interruption by natural events such as storms, thermal scars on the water surface, and so on. We will review the major suggestions briefly.

Ocean Thermal Energy Conversion (OTEC): This is a program to build engines which would exploit the 20°C difference in temperature between the ocean surface and depths in the tropics. Such engines have been successful on a small scale and several competitive engineering concepts have been proposed which would do this on a scale large enough to be useful. The very size of some of the components offers difficulties. Although the entire device is sensitive to rather small differences in surface temperature, the cooling effects from the passage of tropical storms are not known. Because it draws on so vast an energy

store, OTEC is an attractive approach should it prove technically and economically feasible.

Marine Biomass: Alcohol is a fuel rich in energy and for years has been made from agricultural and forest materials. To avoid competing for land acreage with food, the farming of fast-growing California kelp has been proposed and has received support. The concept is not yet well enough defined to merit comment except to note that agricultural and forest waste and residues already exist to supply with known technology the existing market and to urge strongly that the concept be tested on a small scale before embarking on large demonstration projects.

Wave Energy: Pumps and other devices have been built which convert the up and down motion of the ocean surface to more available mechanical energy (and thence to some other form if more desirable). The attractive possibility here is that there are a lot of waves, and that the wind, which spends only a fraction of its force in generating waves as it blows over the sea, could build them up again if one cropped the waves by extracting their energy. But no engineering studies (of the type done for OTEC) have yet been undertaken and they must be to determine actual capabilities.

Tidal Energy is, of course, being used in France (the Rance Estuary) and has been talked about for the Passamaquoddy and the Bay of Fundy for the Northeast United States for a long time. There are interesting possibilities in using the Bay of Fundy for generating usable power from the tides without affecting its actual rise and fall because the Bay is close to being resonant with the tidal frequency, and the effect of extracting energy will be distributed more widely than over the Bay alone. The practical usefulness of using tidal energy is site-specific however, and has all the engineering problems associated with a low hydraulic head, as well as other engineering and cost aspects which are not trivial.

Salinity Power is solar in nature because the difference between salt ocean water and river freshwater is maintained by evaporating the ocean and by feeding the rivers with rain. Its potential is theoretically enormous. The theoretical energy available from the difference in salinity between 1 pound of ocean water and one of fresh water is the equivalent of the mechanical energy you could get by letting that pound of water fall 600 feet. The only trouble is that there is as yet no readily practical way of getting this energy out.

To Recap: The greatest virtue of the ocean for solar energy conversion—the ubiquity which allows it to collect and store so much of the sun's energy that falls upon it—proves also to be its greatest drawback for use. The effects one wishes to take advantage of are small, or quite

diffuse, and it is difficult to get the energy from where it is to where you want it. NACOA found no general panacea in ocean sources of energy. But while the flaws and difficulties are relatively unique in each of the approaches, some generalizations are possible. All are partial solutions, all are location-dependent, and some are very far down the road indeed. This is not to say that any one or all of the approaches suggested could not pay off. Each may contribute. But they seem rather far off and none can do the whole job of meeting total increased demand.

Rushing Ahead

Enthusiasm for solar energy, because it is endlessly renewable and because of its assumed environmental advantages, has generated an outpouring of interest, support, legislation, and funds for research, development, and demonstration. Not unexpectedly, there is a parallel rise in confusion. There is confusion of purpose, of approach, and confusion born of haste. In the process some things we should be doing today are lost sight of.

The oil embargo in 1973 especially stimulated a burst of legislation in the Congress. At least four major laws were enacted in 1974 which have direct bearing on solar energy.* The four Acts singled out are consistent with one another in the large. They focus on different aspects of solar energy R&D: near-term demonstration, organization for nuclear and nonnuclear energy research, a solar R&D program, and nonnuclear energy R&D in context. In detail, there is some overlap; they do emphasize haste and there is heavy dependence on parallel or multiple efforts, i.e., simultaneous efforts in research, development and demonstration, as an efficient way to speed things up.

It is perhaps unfair to characterize multiple development as a confusion of approach, but the heart of the problem here is whether programs receiving emphasis occurring early by chance rather than by merit, end up, having been started up first, by pulling so much money and effort that they develop a momentum independent of changing needs and so become hard to contain. There are some of us who

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* P.L. 93-409, 9/3/74, The Solar Heating and Cooling Demonstration Act of 1974; P.L. 93-438, 10/11/74, The Energy Reorganization Act of 1974; P.L. 93-473, 10/26/74, The Solar Energy Research, Development, and Demonstration Act of 1974; and P.L. 93-577, 12/31/74, The Federal Non-nuclear Energy Research and Development Act. Others having to do with energy R&D are P.L. 93-410, The Geothermal Energy Research, Development, and Demonstration Act of 1974; P.L. 93-275, The Federal Energy Administration Act of 1974; and P.L. 93-319, The Energy Supply and Environmental Coordination Act of 1974.

would characterize the nuclear approach (especially vs. the solar approach) in just this way.

These are all expected side effects of a fast start on a large national effort and given time and a little assistance (the nature of which we will propose below), will be worked out as we go along. It is clear that as a Nation we want to do something about energy development which at the same time protects the environment, that we are willing to pay for the search, that we will listen to new ideas, and that the range of our vision goes into the world of our children's children. It is also true that we often find it more satisfying and comfortable to pursue what lies decades ahead than to face the hard problems of today. We gave evidence of this in our earlier chapter on extracting energy from offshore fossil sources. We find further evidence in our relative inattention to systems problems, especially of distribution and marketing of the nonconventional sources technically accessible today.

The nature of the U.S. program in energy is such that it is geared to R&D, not to adaptation. To the extent that problems concern production, marketing, and economics, diffidence is noticeable. Recently some bills have been introduced in the Congress which would support a demonstration program. But technical feasibility may not be the issue involved.

In a study of problems associated with introducing methanol usage to the United States for example,* the conclusion was reached that methanol can be used as a distillate fuel oil for public utility combustion turbines and provide an immediate opportunity to extend the United States supplies of petroleum. Yet there has been little significant action and little significant support for an examination of the practical problems involved in using available forest or agricultural waste material for the production and utilization of methanol as a fuel. Part of the problem is the "all or nothing" syndrome. Methanol can be used to drive internal combustion engines and gas turbines. It can be used as a gasoline extender although there are mechanical, production, and marketing problems. European car manufacturers are already undertaking serious testing and demonstration programs in an effort to free themselves from total dependence on oil. But there are no reasons why methanol fuel needs to be used in all of these ways at once. Planned introduction should be considered. But, ironically, not being R&D, sup-

* "The Introduction of Methanol as a New Fuel into the United States Economy," W.T. Barr and F.A. Parker, American Research Co., McLean, Va., for the Foundation for Ocean Research, La Jolla, Calif., March 1976.

port by government is difficult to come by; not being a simple extension of an existing market, support by industry is also slow.

We have great admiration for the speed and energy with which the legislative requirements for organization, for planning, and for management are being attacked. We are, however, concerned that in the less proven areas the pressure to move from research to development and demonstration, with the consequent expenditure of large sums of money, may prove too strong to resist. This is not criticism of a particular program but is calling attention to a danger—a danger that calls for careful technical oversight of these programs.

The Need for Oversight

We need someone to ride herd on the now and the later and to look into aspects of use as well as of development. It is clear that very heavy conceptual and financial commitments are being made without taking full advantage of what is known—somewhere by someone. ERDA is under great pressure to make decisions which not only involve great expenditures of money but commitments which might be hard to reverse in a few years if the decisions made in haste prove to have been shortsighted.

It is a severe practical problem to dig into dusty corners and get a number of major programs going at the same time. When one superimposes pressure for results on an environment created by the inheritance of programs started under other agencies with other missions, it is not surprising to find underexamination of some alternatives in the solar energy field, for example, if only because the role of the oceans in a broad sense had not previously been spoken to.

More serious, there appears to be no mechanism with a technical base for evaluating what needs to be done to introduce a different energy source into the economy. The tacit assumption that there will be time to take care of the problems of introduction if it should turn out to be a good idea almost forces emphasis on the longer range and hazier paths. So, for example, when the Governor of Maine came to Washington to seek major financial support for an experimental program to harvest waste or diseased wood and convert it to methanol, he found no organization with the mission or responsibility to respond with funds.

The Solar Energy Research Institute which is mandated by law did not appear to the NACOA Panel to be the organization to act as an overseer and firefighter to plug the gap between concept and reality for the overall energy problem although it provides for such considerations within its solar area. What is needed is an oversight orientation which is not confined to solar research, one that can provide the techni-

cal backup for cross-division comparisons, and one that would have the responsibility for providing technical, systems, and other advice when it came to mediating between different approaches, time scales, and divisions in ERDA.

There comes to mind an office which was given this mission within another great government agency when it was formed from existing, separate government departments—the Department of Defense. When the DOD was formed, its management had the problem of aligning and adjusting the research programs of formerly autonomous services. The DDR&E, Director of Defense Research and Engineering, had just that job of seeing to it that the long-range research programs of the Army, Navy, and the Air Force would complement each other and serve the same Nation instead of three different versions of the same Nation. It could also look into matters common to all three (materials, for example). The office made sense technically, it made budget sense. It introduced a broad-based nonparochial R&D adviser to the Secretary of Defense.

NACOA believes that a similar such directorate would have a place in ERDA to assist the Administrator in balancing and harmonizing the broad approaches, the time horizons, the emphases and priorities of his various divisions, in plugging gaps where they appeared, and in providing quick response where it seemed required.

There may be some overlap with the proposed Solar Energy Research Institute, and this must be taken into account, but the major responsibilities of the Directorate would be to provide the Administrator of ERDA with the staff and technical advice to help him allocate resources between nuclear and solar energy, between distillate and electric power, between research, development, demonstration, and conservation, and to assist where necessary in the adaptation of a new energy source to market. These questions are too important to be settled by competition between division advocates for a summary judgment.

V. Air Pollution R&D

The United States continues to confront a wide range of urgent environmental problems for which the scientific data base is incomplete (or not yet in existence) and on which analysis is not easily done. Nowhere is this more evident than with air quality maintenance. Lax standards affect the health of us all; rigorous standards based on inadequate evidence impose an economic burden which may be unnecessary. On the ground of urgency and complexity there has been a tendency to put R&D on a firefighting basis in direct support of regulatory decisions. In this Chapter, NACOA discusses the need for protecting a significant portion of this mission-oriented research from the intense demands to support immediate management decisions, and for defining a forward-looking, integrated research program which would identify possible pollutants, the processes of formation and transport, and their effects on health, the ecosystems and the environment, and for assigning the responsibilities to an appropriate Federal agency.

The control strategies and regulations promulgated by the Environmental Protection Agency (EPA) in response to legislation passed to clean up and protect our environment have stirred up controversy. Much of the difficulty centers on the adequacy of the scientific information used as the basis for regulatory and pollution control decisions. Industries which have been required to invest large sums to clean up their operations have challenged the regulations and the control strategies in the courts. Conservation groups and other public interest groups have also gone to the courts, alleging that the regulations and terms for compliance are not as stringent as required by the law.

Although many factors are involved, the uncertainties in the scientific knowledge base for estimating the effects of pollution are pervasive and fundamental. Accordingly, NACOA formed a task group to review EPA's research and development program and its plans for improving this knowledge base. In order to keep our effort manageable, we focused our attention this year on R&D for air pollution effects and control methods.

The NACOA task group reviewed the records of the many Congressional hearings on the EPA R&D program as well as reviewing studies undertaken by the National Academy of Sciences (NAS), by the General Accounting Office (GAO), and by the EPA itself. The full Committee was briefed by representatives of the EPA and the National Academy of Sciences.

EPA Research and Development Program in Air Pollution Control

The Clean Air Act, as amended,* directs EPA to conduct research on the causes, effects, extent, and methods of controlling air pollution. This program is to furnish EPA with the knowledge needed to establish prudent controls based on known or potentially adverse health and ecological effects, to define and develop control systems, and to evolve strategies for minimizing emissions.

The EPA R&D strategy in air pollution research is built around four objectives: to quantify the effects of pollutants on people, animals, plants, and the general environment; to develop and verify predictive models relating sources, transport, and sinks of the major pollutants; to develop techniques for monitoring these constituents; and to develop new technology for prevention and control and demonstrate its cost and effectiveness.

The research program in health effects includes epidemiological, clinical, and toxicological studies of the impact of air pollutants on human health. Ecological processes and effects research deals with the effects of air pollutants on plants and animals. Transport and fate research encompasses three major categories: (1) meteorological research to determine pollutant transport mechanisms; (2) investigations of chemical and physical pollutant processes; and (3) determination of the environmental impact of automobile fuel, fuel additives, and catalytic reactor emission-control devices.

Research on industrial processes concentrates on point sources of air pollution arising from the industrial sector of the economy and is focused on those mining, manufacturing, service and trade industries which are involved in the extraction, production and processing of materials into consumer products. This research activity is directed toward the development and demonstration of new or improved cost-effective technology for such industrial processes.

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* P.L. 91-604, December 31, 1970.

The air monitoring and technical support program has two components: (1) the research, development and standardization of methods, equipment and techniques to quantify and characterize air pollutants in ambient air and emissions from mobile and stationary sources; and (2) the provision of technical support through which the results of these research and development programs are made available to other parts of EPA, to industry, and to other concerned agencies.

Evaluations of EPA Programs

EPA R&D programs have been subject to critical review and assessment during the past few years.

In August 1973, the Senate Committee on Public Works contracted with the National Academy of Sciences to obtain an independent evaluation of the costs and benefits of achieving the auto emission standards specified by the 1970 Clean Air Act Amendments, and of the relative costs and benefits of various options for meeting air quality requirements of varying degrees of stringency. This contract was to parallel a more comprehensive effort requested of the Academy by the same Committee 2 months earlier to undertake a thorough review of the health effects of those air pollutants for which national ambient air quality standards have been published.

These studies were completed in September 1974. The study panels found that the data base currently available for setting standards was inadequate but found "no substantial basis for changing them."* The panels called for additional research to identify the chemical composition and particle size distribution of pollutants causing the health effects in man. The panels emphasized the need for further epidemiological research to improve the estimates of the health effects of specific individual air pollutants and of those combinations that actually occur in the atmosphere.

The completion of the NAS study on auto emission problems stimulated the Senate Committee on Public Works to request a similar review of sulfur-related pollutants from stationary sources and the resulting report was published in March 1975. Again, a key finding of the study was: "Information concerning neither the magnitude of the deleterious effects of sulfur oxide emissions, nor the atmospheric chem-

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* "Air Quality and Automobile Emission Control," Report by the Coordinating Committee on Air Quality Studies, National Academy of Sciences, National Academy of Engineering. Prepared for the Committee on Public Works, U.S. Senate, Vol. 1, September 1974.

istry of sulfur oxides, nor the control of emissions, has been found to be sufficiently reliable and extensive to permit resolution of the attendant controversies with a high degree of confidence."* The report emphasized the need for an *integrated* study of air pollutants, their sources, and their effects, pointing out that looking at only a part of the larger problem may lead to partial, perhaps even incorrect solutions.

A GAO Report of December 1975 concluded that overall "EPA does not have adequate resources—manpower, funds, or facilities—to conduct the research needed to develop a sound information base for air quality standards established to protect public health and the environment."**

But NACOA was not satisfied that EPA's need for concentrating primarily on problems of the day would even permit adequate resources to be applied to long-term research. Many pressing current problems can be answered satisfactorily only after longer range research is undertaken. Even then there will be uncertainties. How good is good enough? What resources must be directed toward today's problems and what must be directed toward tomorrow's?

Pressures

There was evidence that some important questions (such as: are we controlling the right pollutants?) have not been adequately addressed under the pressure of time and circumstances imposed by the legislative mandate. The significant feature of the Clean Air Act Amendments of 1970 is that they specify priorities and deadlines, and name the pollutants for control. They name objectives and raise the pressure for definite answers without recognition of the unavailability, or the imprecision, of the facts required to form the answers.

While strengthening EPA's hand in moving against pollution sources, this approach has also produced irresistible pressures on EPA's research community for hurry-up studies and crisis-fighting to meet the legislated deadline. It has thus been difficult for EPA to set up a long-range program and to disentangle it from quick-reaction firefighting where completion of a task often simply replaces one set of technical

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* "Air Quality and Stationary Source Emission Control," Report by the Commission on Natural Resources, National Academy of Sciences, March 1975, p. xvii.

** "Federal Programs for Research on the Effects of Air Pollutants," Report to the Chairman, Subcommittee on the Environment, Committee on Commerce, United States Senate, by the Comptroller General of the United States, December 11, 1975 (RED-76-46).

controversies with another. If we are to assure the availability of well-founded regulatory procedures, both in the short and longer term, there has to be some sorting out of research programs in terms of current or future usefulness.

Mission Support Research

NACOA's review of the numerous and varied evaluations of the EPA program, and the experience over the years of some of us with R&D programs in various aspects of environmental pollution* have led us to underscore one familiar reason for this difficulty. It is the inherent conflict between the need to *understand* the physical, chemical, and physiological phenomena on the one hand, and the need of the regulatory officials to pull together whatever knowledge might be available now for regulatory decision making. EPA emphasizes research programs which are in direct support of its regulatory missions. To quote:

> "EPA's overall research program must support the mission of a regulatory agency. Specific research objectives and priorities derive from objectives and priorities that EPA establishes in fulfilling its total legislative mandate. Accordingly, the research program is mission-oriented with emphasis on production of timely and quality outputs; i.e., research results that are directly useful to environmental decision makers, regulatory officials and polluters." **

The trouble is, such emphasis stresses the needs of the decision makers perceived at a given time. This inevitably proves inadequate to meet agency needs for very long.

This issue was explored in some detail during hearings in February 1976 before the Subcommittee on the Environment and the Atmosphere of the House Committee on Science and Technology on EPA's R&D authorization bill for FY 1977. EPA witnesses testified that they recognized the importance of the problem and reported that they were attempting "to shift the base research program to focus on some of the longer term problems." A specific plan for doing this, however, was

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* For example, see "Restoring the Quality of the Environment," Report of the Environmental Pollution Panel, President's Science Advisory Committee, November 1965 and "Chemicals and Health," Report of the Panel on Chemicals and Health of the President's Science Advisory Committee, September 1973, Science and Technology Office, National Science Foundation, September 1973, p. 10.

** "U.S. Environmental Protection Agency Environmental Research Outlook," Report to Congress, Office of Research and Development, U.S. Environmental Protection Agency, FY 1976-80. EPA-600/9-76-003, February 1976.

missing from the EPA 5-year plan for R&D* which was under discussion at that point in the hearings. In particular, the basic need for organizational as well as policy measures exempting long-range research activities from the pressures of regulation, which was raised by the Chairman of the Subcommittee, was not explicitly acknowledged by the Agency.

Other Agencies in Air Quality Impacts Research

Even with a management and organizational policy protecting at least part of the research staff from diversionary fire alarms, it is clear that EPA should not be expected to meet longer term environmental research needs exclusively through its own programs, in-house or sponsored. The field is too wide and many other agencies are conducting important work in these areas and should continue to do so.

To give an idea of the extent of work going on in this field, the Special Analyses of the Budget** states that in FY 1977, 21 Federal agencies and departments expect to have outlays of $8.7 billion in three broad environmental program categories: pollution control and abatement; understanding, describing, and predicting the environment; and environmental protection and enhancement activities.

Approximately $1.5 billion of this amount supports environmental research activities. It is not clear from the Special Analyses just what fraction of the R&D programs summarized might be classified as long-range or basic research. But many of the older agencies in the Federal establishment have evolved policies and structures that support a significant portion of their long-range research effort in one or another aspect of environmental research and which have the potential, in our opinion, to see to it that gaps are covered for fundamental research of potential value not only to themselves, but to other agencies in other departments and, therefore, to EPA. We cannot identify a *single* existing agency that could assume lead responsibility for *all* long-range environmental research. As noted, the research areas are much too broad. We do believe however that if we divide much of the long-range environmental research into three major areas, there is for each a particular agency which might be able to accept the responsibility for general Federal coordination. These areas are:

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* *Ibid.* (See footnote "**" on p. 31.)

** "Special Analyses, Budget of the United States Government, FY 1977," USGPO, p. 296.

- environmental research directly involving human health and human disease;
- environmental research concerning the atmosphere and the oceans, including life in the oceans; and
- environmental research concerning life other than human on land and in inland waters.

NACOA recommends that the lead responsibility for long-range environmental research concerned with human health and human disease be accepted by the National Institute for Environmental Health Sciences (NIEHS). This should embrace the responsibility to see that environmentally-related health programs are reviewed against the broad background of national needs and the total national programs of research on environment and human health.

NACOA recommends that responsibility for long-range research in environmental matters in the atmosphere and the oceans be with the National Oceanic and Atmospheric Administration (NOAA), which already contains a very large share of Federal competence in these areas.

Recommending the assignment of lead-agency responsibility for long-range research in environmental matters concerning life other than human on land and inland waters is difficult due to the fact that there is no single agency that seems to have all the diverse competence that would be required. The Department of Agriculture has a broad responsibility for research on land and inland-water life systems with specialized competence in problems of pollution effects on agricultural plants, crops, and farm animals. NSF, NASA, ERDA, and the EPA itself have significant programs related to the area, as well. On balance, however, we suggest the Department of the Interior as the lead-agency in view of its long involvement with basic research related to its responsibilities in protecting and improving land and water environments and in resource management.

We emphasize that the lead-agency responsibility that we recommend does not imply either the transfer of funds from, or control of expenditures by, other agencies. For example, the large programs of the National Cancer Institute in carcinogenesis should remain in that Institute and under that Institute's control. The National Institute for Environmental Health Sciences would have the responsibility and authority to see that those programs were reviewed and discussed against the broader background of the total national program of research on environmental impacts on human health. As the lead agency in this case, the NIEHS would be responsible for taking the long look, familiar-

izing itself with all the current hints of what basic research questions are likely to become important in years to come.

In each of the three areas, lead-agency responsibility could well be coupled with responsibility for an annual report to Congress, one that would both sketch current programs and indicate new areas of possible concern.

We note that the Congress has increased its capability for overall review and oversight for environmental research. We expect that this will exert a coordinating influence for environmental research programs.

There are other major environmental research areas, not included in the three that we have identified, for which longer term programs must be supported. These include research on pollutant control technology; pollutant monitoring systems and instrumentation; socio-economic aspects of pollution abatement; pollution problems associated with energy generation, transmission and use and other industrial processes. EPA possessess special competence in some of these areas and should maintain its lead role.

An alternative approach to the designation of lead agencies would be the establishment of an Environmental Institute and, in fact, such a concept was proposed in the President's Message on the Environment on February 8, 1971. As a practical matter, however, it may be some time before such a *new* entity is likely to be created.

Coordination

As lead-agency responsibility is assigned and implemented, there will be a need for further sorts of mechanisms to provide:

- continuing advice from scientific sources outside of government; and
- necessary coordination among research in the three broad areas.

Just how this can best be accomplished will require working out. However, we question the feasibility of EPA's functioning as the coordinating body for all these long-range programs (even though directed to do so by their current statutes). Having EPA "coordinate" all of these programs would couple much too wide a range of environmental research to the mission needs of the EPA as regulators. There are similar drawbacks for each of the other "lead" agencies.

We recommend, as a better alternative, a high level Interagency Committee chaired and staffed by the Council on Environmental Quality. The Council on Environmental Quality, in the Executive Office of the President, has statutory responsibility to prepare recommendations to the President on national policies for improving environmental qual-

ity and for coordinating Federal programs relating to environmental quality and is well situated to lead the coordination effort. The lead agencies can be expected to utilize their existing scientific advisory committees or to form new ones in order to assure continuing advice from scientific sources outside of government.

Closing Comment

With regard to meeting EPA's own need for acquiring research information wherever it may be found, we note with a feeling of encouragement a number of developments arising out of the ferment of its experience in the last few years. First, EPA is aware of the importance of having an in-house program and expertise in basic research aspects related to its mission and of improving the organizational conditions under which it works. It is also aware of the need to improve the management of its research and applications activities by a better and more systematic intelligence effort regarding sources of information from other agencies and programs. It has had, since 1974, a Science Advisory Board whose function is to assist this process and has, since the reorganization of its R&D Office a year ago, increased the activities and effectiveness of this body. We applaud this effort and look for its continuance.

VI. Weather and Air Safety*

Weather is a particularly important factor in aircraft accidents. It can be a severe hazard, particularly for the small aircraft which dominate general aviation, for a whole number of reasons from pilot training, to less accessible service, to the altitudes at which smaller planes fly, to the lack of experience of the pilots when in a weather jam. Providing aviation weather service to pilots is a joint responsibility of the National Weather Service and the Federal Aviation Administration, an arrangement formalized by administrative agreements over a decade ago. In this Chapter NACOA examines the situation today to see what time has done to these arrangements and to see whether the budget and the application of current technology has kept pace with the need in a situation of split function.

Weather continues to be a primary factor in air safety despite the increased refinement of aircraft, tighter control of air space, and more numerous (if less personal) services available to pilots.

Statistics over some years show that 35 percent of all civil aviation accidents are weather-related and that weather is the *prime* cause in 18 percent. General aviation suffers about 15 times as many fatal accidents as does air-carrier aviation when normalized to hours flown. It is not clear what proportion of these general aviation accidents is caused directly by the weather (low ceiling, icing, turbulence, fog, etc.), and what proportion is caused by the inexperience of the pilot in reacting to worsening conditions. But the grim accident statistics in general aviation led NACOA, which includes members with aviation and weather experience, to ask: Are weather services to aviation adequate? Is weather information adequately distributed and interpreted? Are pilots prepared to assimilate weather information and react appropriately?

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* This discussion concerns itself with highlights of the problems having to do with weather and civil aviation safety. It does not consider air traffic control in general, nor weather and military aviation.

If the answer to any of these questions is "No," does that "No" stem from failure to take advantage of technical progress, from lack of budget, or is it because "institutional" factors intervened?

The latter is not a superficial possibility. One reaction to the explosive increase in air traffic of recent years, largely in the area of general aviation, has been to specialize the contributions of the National Weather Service (NWS) and the Federal Aviation Administration (FAA), the Federal agencies most directly involved. The specialization makes the NWS a "wholesaler" of weather information (which decouples it from the growth of aviation) and the FAA the "retailer" of weather information (and in a position to adjust to consumer growth).

The NWS has the unified responsibility to furnish public weather services. This entails basic weather observations, analysis, and forecasts of weather conditions, including those for aviation. The responsibility of FAA includes collecting some of the aviation-related weather information, disseminating weather information to all types of pilots, and responding to inquiries from pilots through direct briefings and telecommunications. In addition, FAA is responsible for certification of pilots and their proficiency in all aviation-related skills and knowledge, including weather.

The producer of aviation weather information has become largely separated from the consumer of it. In end use, aviation weather information and pilot education about weather suffers a lessened emphasis because FAA's primary mission is avoidance of mid-air collision between aircraft, not separation of aircraft from weather. Success of the arrangements and directives which established the respective responsibilities and budgetary procedures of the two agencies* is possibly fading because secondary interests usually suffer in times of financial stress. When austerity rules, each agency protects its core program and saves on secondary services. Thus gradually (and insidiously) deficiencies can develop.

To ascertain the extent to which this has happened—if it has—NACOA established a panel which looked into the adequacy of aviation weather service, information, and education.

Aviation Weather Service

The NWS and the FAA both collect weather observations which are the basis for the aviation weather forecasts the NWS prepares. There

* Primarily the BOB Circular A-62 of 1963 and the Memorandum of Agreement between FAA and the NWS arrived at in 1965, which details agency responsibilities.

are many forecasts—terminal forecasts for airports, route forecasts for major routes, synopses for pilot briefings, area forecasts for flight planning, for special or hazardous circumstances, and winds and temperature aloft forecasts for flight planning.

The FAA, responsible for making this information available, operates the communications network, handles pilot briefings, broadcasts weather information and provides inflight assistance and control.

While general and air-carrier aviation are not handled separately as such—and they do use the same air space and often the same terminals —their control is largely differentiated. Air-carrier flights are almost entirely under positive control of the FAA controllers in the Air Route Traffic Control Centers (ARTCC's) and Terminal Control Centers. They largely fly above the weather except, of course, upon takeoff or landing. (At altitude they can run into clear air turbulence and thunderstorm tops, in which real-time pilot reporting is important.) The pilots are highly trained and some airlines have their own meteorological service—mostly for flight planning, though it can act as a ground link to get weather information from pilot to pilot.

General aviation on the other hand is largely *not* under positive control and flies low where many weather hazards exist. Rather than actively guiding general aviation (unless on instruments), the FAA responds only when queried. The general aviation pilot taps into the Flight Service Stations (FSS) for everything from a forecast to assistance when lost in the air, and for myriads of navigational aids and routine broadcasts—all at the pilot's discretion. The air-carrier system control is largely active; general aviation control is largely passive.

It is the FSS which deals mostly with the general aviation pilot and, as the number of airplanes grows, so have the calls for service. There is insufficient time and manpower to serve aviation personally in every instance. Though automatic procedures can take over for routine service, time and the manpower to handle the special cases have decreased and the impetus to keep up technologically has diminished. For example, FSS personnel do not have access to high resolution satellite data which are now available every 20 minutes to those with facilities to receive them. Likewise, a real-time radar presentation is usually lacking. Instead, low resolution and delayed data are presented on the facsimile which is a basis for the aviation weather briefer.

In recent years, there has been little quality control of airway observations (split between NWS, FAA, and contract observers) and of aviation forecasts. Monitoring the quality of observations has essentially disappeared from the NWS program and budget proposals and has appeared nowhere else. Controllable elements, in addition to the

quality of observations, are the quality of forecasts and their timeliness and their applicability. With an interagency gap, complaints about forecasts are attenuated by the distance between the pilot-consumer and the aviation weather service. The aviation weather specialists are a dying breed in the NWS; the on-call weather backup for the FSS has shrunk.

This slow decay has been caused by the fact that funding and the assignment of the essential manpower, because of the organizational split, are not coupled. The National Weather Service, not being responsible for retailing aviation weather service, can't budget for it. The Federal Aviation Administration, which does do the retailing, is not in the best position to know what should be done. Also weather information is only one of many responsibilities.

The system of resource allocation which separates dollars, manpower, and responsibility has led to a deterioration of service, but weather hazards have not become less. Communication facilities to Weather Service Offices are overloaded in times of bad weather and many of these offices lack aviation weather specialists. This affects general aviation particularly adversely when calls are attempted from isolated airfields. The inadequacies of funding of quality control and of the application of current technology (a subject not covered here in the detail it deserves) are not the result of neglect but come about by the split in responsibility between the NWS and the FAA for aviation weather service with the consequence as we noted above that funding and manpower do not go hand-in-hand.

Weather Information

Many factors go into the distribution of weather information: preparation and coding; transmission and reception; delivery to the parties most concerned; and their training to enable them to use and understand it.

There is an enormous amount of routine information which must be gathered, digested, and distributed. Thus great difficulties in selecting out important elements exist. They are met in part by SIGMETS and AIRMETS.* Even these have had to be made routine and, for example, if a weather hazard which had not been forecast is reported

* SIGMETS (Significant Meteorological Information) are inflight advisory forecasts of hazardous weather for aircraft; AIRMETS indicate such conditions for light aircraft or inexperienced pilots.

(or is forecast on a short time scale out of sequence) it has to be coded, wait its turn on the hour wheel to get on the weather circuit, be teletyped all over the country, picked off, brought to the controllers, and then sent out to the pilots—by which time it may obviously be too late to be of help.

What has happened in separating weather and control at the organizational level is that it has become hard to merge them at the operational level. In setting up radar control of air traffic, every technical effort was made to get the weather out of the radar return so as not to obscure the position of the plane itself. It thus now depends on a communicator system to get the weather information from weather radars back to the controller looking at a weather-clear scope. This is easier said than done, considering that the communication networks of the NWS and the FAA are geared for different purposes and loaded for different users. What is perhaps more important is that the professional competence and concentration of the controller in his very taxing work doesn't give him the time to sort and interpret fresh weather information not acquired in set ways.

In other words, there is a great deal of weather information in the ARTCC derived from the radars, the communication network, and from pilot reports, but it is not readily accessible to the system so that the controller can merge it with his controlling. It is worse when the weather is bad because everyone is busier.

An effort is being made in a test being conducted at the Kansas City Air Route Traffic Control Center to bring significant weather back to controller and pilot. NWS and AWS (the Air Force's Air Weather Service) forecasters monitor and interpret radar data and pilot weather reports. They provide controllers with information on areas suspected of hazardous weather. The controller relays it to the pilot. This integrates controllers and professional weather personnel, using weather information from FAA radars, refined by NWS radar information. These forecasters also interpret reports on weather conditions encountered in flight (pilot reports, or PIREPS) which are immediately incorporated into the system. Success of this test is leading to its extension at the Kansas City Center.

Expansion of the scheme to the whole country appears most desirable. Every bit of evidence points to the fact that economy-forced automation will not improve the situation, but that adequate professional manpower has to be brought back into the loop. Estimates of forecaster manpower needed to do so, were the service of the Kansas City Test to be introduced country-wide, indicate a need for about 200

forecasters. The annual cost of $6 million is minimal compared to what it might save.

The situation for most general aviation flights is quite different from that for air-carrier flights. The pilot is generally not under positive control. He is also, in addition to flying an airplane, turning to his instruments for various types of information, so that he usually gets weather information only by asking for it. What is needed is a way of getting to him with important weather information if he is tuned to a control station.

The general aviation analogy to the Air Route Traffic Control Center is the Enroute Flight Advisory Service (EFAS) which had a slow beginning on the west coast but is now to spread eastward. The EFAS air-ground-air communication permits pilot reports to be exchanged and the real-time weather situation on a route to be both reported and disseminated. NACOA favors its rapid extension. If EFAS, which offers a ground to air link for general aviation, were to be combined with an Air Route Traffic Control Center which contains a weather component, this would provide improved weather advice to all aviation.

Prompt availability of information on hazardous weather aloft and in approach zones is required and NACOA recommends taking advantage where possible of an override capability for such warnings from control centers on frequencies used by pilots.

It should also be noted that in practice voice communication of weather information by radio is in many cases abominable. No standards for enunciation by weathermen and communicators exist and speech training is minimal. In many cases the radio communication might just as well not take place.

Education

One of the "softest" spots in the weather accident problem is pilot education. This applies particularly to general aviation. The accident statistics clearly indicate that it is principally the inexperienced pilots who get into weather-related predicaments. Many of these situations occur when visual conditions unexpectedly change to a situation requiring instruments. Considering the fact that 180,000 pilots, of the 725,000 total certificated in 1975* are classified as students, and about half (150,000) of the private pilots have less than 200 hours of flying experience, their lack of weather judgment must be compensated for by rigorous standardized education.

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* Review of FAA Activities—FY 1975, DOT, FAA

Presently FAA sets no minimum requirement for demonstrating weather knowledge in FAA certification tests. There are unnecessary requirements for the pilot to decipher weather teletype messages—a skill he seldom uses. Factors such as this lead to examination priming and rote memorization because almost invariably the teletype information is directly interpreted to pilots by FAA personnel. Much of the present training literature on weather, although technically impeccable, is written with a scientific approach which is often irrelevant to the operational information needs of incipient pilots. Much training literature is academic and does not prepare the pilot for recognition of changing weather conditions. There is need for new texts and, for ground school teaching, these new texts should be supplemented by film material. Similarly, development of a weather simulator for trainers at ground schools should be undertaken.

Summary

We will summarize the essential findings which are the basis for our recommendations:

- *Aviation weather service* seems to be deteriorating. There is no quality control of observations, professional meteorological backup for the Flight Service Station (general aviation) has diminished, and new technology is incorporated into the system too slowly.
- *Weather information dissemination* tends to be largely routine. Real-time transmission of pilot reports tends to lose out, although the Kansas City Air Route Traffic Control Center Test and the Enroute Flight Advisory Service, for general aviation, already introduced on the west coast and being extended, are getting men back in the loop.
- *Pilot education* and certification for general aviation pilots, as related to weather, do not seem to be adapted to practical needs. The instructional material is theoretical and there is insufficient emphasis on early recognition of deteriorating weather situations and proper decision making. One should train pilots to be weather-proficient, not as aviation meteorologists. Evidence for the lack of direct application of weather information to pilot certification is the fact that no minimum of weather knowledge is required to pass the certification test if the student pilot does well in other categories.

NACOA therefore recommends:

With regard to training for the use of weather information

- Improve educational standards for weather instruction to pilots with an emphasis on the effects of developing weather situations on flight control and improve teaching aids for weather instructions. Certification should include minimum requirements for demonstrating an understanding of weather implications for flight practice.

With regard to the quality of weather information

- Institute a computer program which screens for consistently deviating data on airway weather observations.
- Institute a system of "post-mortems" on aviation forecasts.
- Institute quality control on voice communication of weather information to pilots with attention to format and enunciation.

With regard to service to pilots in flight, aviation weather expertise must be put back into the control environment

- Assure rapid weather hazard warnings to all pilots in the air in the vicinity of the hazard.
- For controlled flights, largely air-carrier, extend the Kansas City Test and develop plans to expand its procedures throughout the Nation.
- For uncontrolled flights, largely general aviation, extend the En-route Flight Advisory Service (EFAS) throughout the country; and make use of an override capability to communicate hazard warnings on the frequencies used by pilots.
- Combine the EFAS with the ARTCC's so as to make the most economical and efficient use of available weather experts.

With regard to the management of aviation weather services by the government agencies involved

- Review and renegotiate the agreements and directives embracing the FAA and the NWS which are now over a decade old.
- Review on a broad front the requirements and capabilities for aviation weather service in the light of technological advance.

VII. Some Marine Matters

In this Chapter NACOA takes up: (1) the immediate need for research relating to safe decompression procedures for diving and for research on its physiological effects; and (2) the importance to the Navy of maintaining strong Navy-directed research efforts and of a program to orient young oceanographers in the scientific aspects of national security problems in the oceans.

Diving

A significant growth has taken place over the last decade in diving activities for purposes as diverse as recreation and recovery of offshore oil and gas supplies. Diving's unique capabilities are being applied (with varying degrees of effectiveness and productivity) to areas such as oceanography, salvage, offshore resource development, archaeology, biology, geology, hydrography, coastal zone problems, recreation, and rescue operations. It has already proved possible for man to dive to depths of 1000 to 1800 feet and he should soon be able to reach 3000 feet or more. Furthermore, through the development of various diving techniques, work can be performed at these depths for extended periods of time. This capability has been developed over the years with the help of hyperbaric research undertaken by the government, universities, and private industry.

Safe proven diving decompression tables have been assembled at a number of specific depths, but the use of interpolation at the "fill in" depths rather than the conservative values applicable to the next lower depth is both untested and unreliable. Further research needs to be directed towards development of a comprehensive decompression theory, and towards the development and testing of tables and procedures allowing more rapid diver decompression based on safe, tested physiological principles. Programs should be focused, as well, on safe ways to increase the divers' on-the-job capabilities. Additionally, there is a lack of research on the long- and short-term physiological effects of hyperbaric work. Research of this type cannot be done on a crash basis, requiring hundreds of carefully planned exposures on humans.

There are three well equipped laboratories in the United States capable of carrying out advanced deep diving research in addition to a number of smaller laboratories with more limited capabilities. The major laboratories are at the University of Pennsylvania, Duke University and the U.S. Navy Laboratory at Panama City. The latter, however, is normally not available for outside research activities, being fully utilized in support of Navy projects.

NACOA regards the current U.S. effort in diving physiological research in civil applications as inadequate, and urgently recommends that increased funds on the order of $3.5 million be made available in this vital field annually.

Navy Environmental Research Technical Capabilities

The Navy, being a highly technical service, has long sought expertise wherever it resides. It has for years been foremost amongst the military services in the development and support of a cadre of civilian scientists –both academic and industrial–who were oriented and concerned with Navy problems and requirements.

NACOA's great concern with the decrease in the relative level of support by the Navy of the ocean and atmospheric sciences in the civilian community has been strongly stated in previous Annual Reports and will not be repeated here. The nub of the comment was that the Navy depends on a very broad source of scientific knowledge, that this will shrink without DOD support, and that it is not in the Navy's best interests to reduce this vital relationship with the academic community.

There is another side to this coin. It has to do with the maintenance of internal DOD technical capabilities. We concern ourselves here with the need for the Navy to maintain its in-house technological skills in areas where the Navy has both the foremost expertise and the requirements. One problem is that Navy and civilian technical interests which superficially may appear to have much in common, may actually be addressing quite different questions. Another is that the growth of Federal ocean research has suggested the possibility that an increasing number of DOD areas can be adequately covered by ongoing civilian research. However, NACOA strongly cautions against excessive technical dependence on "related" civilian research assumed to be applicable and available for use in areas of vital military importance. Such dependence on non-DOD sponsored research in areas of importance could, within a short period of time, erode capabilities, make DOD vulnerable to technological surprise, and result in a weakened Navy posture.

The total real dollar amount in DOD R&D is increasing. We are well aware that program balance within Defense R&D is a difficult act of juggling a host of pressing demands within a constrained budget. A long list of needs must be measured against current and anticipated operational requirements. It is tempting, with the increased civilian activity in the marine environment to assume there will be spinoff for the military as a quid-pro-quo for the civilian spinoff from military research. This is, however, a temptation which must be resisted.

The rapid (and sometimes diffuse) external growth of many areas of technology in the civilian sector—many evolved through DOD research—should not lead to the erosion, dismantling or weakening of what are, in many cases, excellent defense programs or facilities directed toward national needs. Any undue reliance on non-DOD directed research in areas of military importance may result in a weakened long term Navy capability which may not be quickly reversed. Dependence on catching spinoff from non-DOD controlled R&D as significant inputs to defense needs to be looked at very cautiously. It is no solution except under limited circumstances.

NACOA recommends that a continuing DOD review should be undertaken to ensure that national security needs will be met in those areas where reliance is or may be placed in non-DOD controlled research due to budgetary pressures. NACOA does not believe any excessive transfer-out of Navy responsibility has taken place as yet, but simply desires to inject a proper sense of caution. The development of any national ocean policy must, in its upcoming deliberations, likewise understand the *unique* factors necessary to the maintenance within DOD of a truly effective military oceanographic and atmospheric environmental capability.

Navy-Academic Exchange

NACOA finds that a need exists at the present to bring academic faculty members, particularly younger ones, into closer working associations with defense R&D within the DOD labs and operational facilities. A close technical involvement with DOD personnel and facilities can allow the development of a deeper and more intimate awareness and understanding of military research problems, capabilities and methods. This program of funding younger faculty members for work within DOD facilities should be thoughtfully structured to address both specific near-term problems, and to draw interests and talents towards the longer term problems of evolving an increasingly formidable defense capability for the coming decades.

NACOA considers that the initiation of small programs within the Army and Air Force that specifically bring younger faculty members directly into defense laboratories and operational facilities for a portion of their DOD-funded R&D is an excellent step. We believe the Navy should develop such a program in the fields of oceanography and the atmospheric sciences, and that an expansion of this concept of technical interaction with DOD facilities will prove to have significant long- and short-term benefits to all parties.

VIII. Some Atmospheric Matters

There has been more study of what to study about climatic change and weather modification than there has been government action to launch coherent programs. In this Chapter, NACOA discusses what has occurred since it last reported and suggests what should be done.

Climate

Anticipation of short-term fluctuations and long-term climatic changes, either natural or resulting from human activity, which can have serious impact on the world supply of food, water, and energy, would enable governments to respond more effectively when they do occur. But little progress in this direction has been made, and the situation in general concerning climate stays essentially as described in NACOA's Third and Fourth Annual Reports.

We have at present only a limited capability for prediction. It is primarily a capability for short-term statistical projections concerning the likelihood of a good crop year, severe winter, a regional drought, etc. This capability is not being exploited as effectively as it might, primarily because there is no Federal agency with a responsibility to take the lead in doing so. There exists also a long-range potential for climatic prediction, but considerable basic research is needed before that potential can be confidently assessed, let alone realized. This research is not being pursued as vigorously as it should again because no agency has the clear responsibility.

Some steps have been undertaken by the Federal Government within the past 3 years to remedy this situation. NOAA has established a Center for Climatic and Environmental Assessment. NSF has established a program in climate dynamics. The Department of Agriculture, NASA, and NOAA are cooperating in a Large Area Crop Inventory Experiment in seeking to determine whether global monitoring of crop growth by satellite is a feasible tool in agricultural planning. Welcome as these programs are, they remain isolated efforts. There is still no coherent national program.

At the same time there have been numerous studies, reviews, reports and recommendations on how to develop an effective climate prediction capability. These were considered by a subcommittee of the Domestic Council which, in December 1974, produced a report* calling for a national climate program which would:

- Establish a climatic impact warning system to provide both real-time warnings and assessments of the risks of future climatic impacts.
- Improve current monthly and seasonal climate predictions.
- Continue development of mathematical-computer systems for prediction of climate and for simulation of man's effects on climate.
- Develop a global climate monitoring system to support early warning and prediction efforts.

A response to these recommendations has not yet been made.

In October 1975, a bill was introduced in the House (H.R. 10013) by Congressman Philip H. Hayes, which proposes virtually the same program. It outlines all the essentials. These are: a sustained global climate watch, development of improved procedures for projecting climatic fluctuations, and research on the causes of climatic changes and fluctuations, man-made alternations of climate, and impacts of climate on human welfare. In addition, it provides for coordinating authority to be vested in the Secretary of Commerce to see to it that a coherent program is established within the Federal Government. Finally, it provides for grants to cooperating states and institutions and authorizes funds for that purpose.

Although we believe these steps could be taken by Executive action, without new legislation, we note the apparent reluctance of the Executive Branch to move. In view of this, we support H.R. 10013 and urge its passage with minor changes recognizing the international activities in this field. The need for these changes arises from the fact that climatic fluctuations are global in character and require international cooperation for effective study. It would, indeed, be particularly desirable if the legislative history of the bill were to include specific reference to Objective 2 of the Global Atmospheric Research Program (GARP). GARP, a long term international interdisciplinary program begun almost a decade ago, is aimed at testing advanced prediction

* "A United States Climate Program." A Report of the Subcommittee on Climate Change of the Environmental Resources Committee, Domestic Council, December 1974.

models by global observations in a series of carefully graduated field exercises. The potential for advancing our ability to predict climate change was given increased priority status by the 7th World Meteorological Congress in 1975,* and is reflected in a current planning study of the Joint Organizing Committee of GARP, operating under the auspices of the International Council of Scientific Unions and the World Meteorological Organization.

In our opinion strong U.S. initiative in pressing forward with a coherent climate program would be a timely and suitable adjunct to our emerging role as leading supplier of food exports in an overpopulated world.

Weather Modification

In recent years, there have been numerous studies, by NACOA and others, of the U.S. effort in weather modification. A number of carefully thought out recommendations have been made. These have been considered by the special Subcommittee on Climate Change of the Environmental Resources Committee of the Domestic Council, which reviewed the situation and presented its recommendations in a report completed in December 1975.** Among these recommendations, the subcommittee called upon the Federal Government to:

- foster a broad-based effort of research and experimentation in weather modification;
- decide upon an institutional mechanism for planning and coordinating the national weather modification research effort;
- provide increased funding for weather modification research;
- support a more vigorous program of fundamental research and experimentation in the physics and dynamics of cloud processes; and
- place greater emphasis on developing improved methodologies for evaluating the effects of weather modification.

The Subcommittee also suggested appropriate roles for the Federal Government, the States, and the private sector when and if appropriate weather modification techniques become feasible, and while finding

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* The World Meteorological Congress is the planning and policy organ of the World Meteorological Organization.

** "The Federal Role in Weather Modification," A Report of the Subcommittee on Climate Change of the Environmental Resources Committee, Domestic Council, December 1975.

that new Federal regulatory legislation is not now needed, recommended establishing a formal procedure for periodic reassessment of regulatory needs. The Subcommittee also noted the importance of assessing the potential international implications of weather modification activities.

We believe the Domestic Council Subcommittee report can serve as a basis for a decision by the Federal Government on how to proceed.

Such a decision is needed, we feel, because present budget policy has created a situation which greatly hampers further progress: (1) While some types of weather modification are operational, we have prematurely engaged in applied research directed toward other forms of weather modification without sufficient attention to badly needed basic studies. The result has been disappointment, disillusionment, and wasted funds. (2) The Federal research effort is an uncoordinated and fragmented one, carried out by a number of Federal agencies, in which certain important parts of the problem are not recognized as any one agency's responsibility. (3) Field experiments are conducted with inadequate funding and observational support, and conclusions must be drawn from incomplete information.

We understand that the position of the Office of Management and Budget is that weather modification represents one of many means by which a variety of Federal agencies may accomplish their missions, and that each agency should make its own decisions as to the kind of research it should support to develop the operational weather modification capability it needs. There is merit in this point of view, although we believe the case would be stronger were weather modification further along the road than it is today. What causes us concern is that under this policy no one agency assumes the responsibility to support those basic studies that are necessary for further progress along a broad front. We are also disturbed because in many areas essential coordination and cooperation between Federal agencies are missing.

The principal need at this time is for a stepped-up effort to understand the physical processes which operate in cloud formation, precipitation, and severe storms. This requires a stronger, larger scale effort in basic research, including theoretical, laboratory, and field studies, than is currently being undertaken.

We do not advocate centralization of all weather modification research within one Federal department. We do, however, urge most strongly that one agency be given the authority to examine the whole field and lay out a plan for action, to identify aspects of weather modification research in which the cooperative effort of specific agencies is required, and to identify and fund those studies which are required as a basis for further progress but which do not clearly fall within the

province of any one agency and would therefore otherwise remain undone. We believe that of the concerned agencies, NOAA has the broadest range of relevant capability and expertise in the physical processes involved in both weather prediction and weather modification, and we urge that NOAA be given this lead responsibility.

This is not intended to minimize the roles of other departments and agencies. In particular, the Department of Agriculture, which has little activity in this area at present, should assume lead responsibility for assessing the impact of weather modification on crop production, and should participate in the design and analysis of field experiments aimed at using weather modification to maximize the production of crops.

It has been suggested that the Interdepartmental Committee for Atmospheric Sciences (ICAS), which oversees the Federal effort in basic atmospheric research, might provide coordination for a Federal program of weather modification research. But an interagency coordinating committee, while it plays an important role in fostering communication between agencies, is by its nature and composition unsuited to providing coordinated management of a research program. An operating agency should be chosen to provide coordination and guidance for a coherent research effort in weather modification. There is no reason to expect matters to change under the new statutory Federal Coordinating Council for Science, Engineering and Technology. While the newly created Office of Science and Technology Policy can be expected to provide policy guidance to Federal agencies, neither it nor the Council is intended to fill the managerial function that is needed.

While we believe that the necessary steps to institute this program can be taken by Executive action, past reluctance to do this suggests that legislation may be called for. If no action is taken by the Executive Branch within a reasonable period of time, in response to the Domestic Council Subcommittee report, we urge the Congress to assign NOAA statutory responsibility for developing, in cooperation with other Federal agencies, a national program of weather modification research, and for funding basic studies which are needed for progress but which do not now clearly lie within the mission of any one agency.

An important element in the weather modification picture is its international aspect. The World Meteorological Organization is proceeding with its own plans for an international weather modification research program, and it is important that the United States be prepared to participate. There are also international aspects to the pursuit of our own program goals. NOAA's Stormfury project, which studies the effects of intervening in the dynamics of tropical convective storms and offers hope of a future ability to modify hurricanes, was to be moved from the Atlantic to the western Pacific for scientific

reasons. Objections on the part of some western Pacific nations prevented this move and it will instead be conducted in the eastern Pacific and western Atlantic. It is important to the ultimate success of this effort that we recognize that other nations which might be affected, or which believe they might be, have a legitimate interest in understanding its expected benefits, the risks involved, and the safeguards proposed.

We also recommend that greater attention be paid to the possible adverse environmental, economic, and social impacts of weather modification. The scientific and technical progress that is needed appears to be within our reach, once we organize properly to get it done. It is likely, however, that ecological, social, and legal limitations may significantly inhibit realization of the full potential of weather modification once it is available as an operational option, if we do not continue and expand our examination of these aspects, and pave the way for whatever legal and regulatory actions are required to fully exploit this potentially powerful tool. Even if we do not develop an operational weather modification capability because of socio-legal considerations, we need to pursue this research in order to understand the implications of weather modification that occurs inadvertently as a result of urbanization and industralization.

A number of weather modification bills have been introduced in both Houses of Congress during the past year, indicating that the Congress is aware that we have not achieved our potential in understanding and utilizing weather modification. Several of these bills are specifically directed toward drought prevention and alleviation operations. It is unfortunate that we as a Nation do not have the scientific basis for such measures, but the fact is we do not. It is for this reason that we reiterate our earlier recommendation to conduct the basic research needed to bring us to the point where we can undertake such prevention and alleviation efforts with reasonable hope for success.

Another of these bills, S. 3383, directs the Secretary of Commerce to conduct a study and, on the basis of this, to recommend to the President and the Congress, within 1 year, a national policy on weather modification and a national weather modification research and development program. Although such a study seems redundant at this point, if it will help the Executive Branch and the Congress to see the direction in which they should move, then NACOA supports such legislation. Should this bill be enacted, we hope the Secretary will lean heavily on the Domestic Council Subcommittee report, and will proceed as soon as possible with his recommendations for a national policy and a national research program.

IX. Shorter Comments

NACOA, during its monthly meetings, maintains a watch over most of the areas of major interest treated in its Annual Reports. It also takes up urgent specific matters which are brought to its attention by Members, and responds to requests from various sources. Brief accounts are given in what follows of some of the significant items that were handled in such a fashion within the past year.

GLOMAR EXPLORER

For almost a year efforts have been made to obtain conventional programming support for the GLOMAR EXPLORER now that the initial mission for which it was built has been terminated. But neither the President nor the Congress has promised to keep up the ship system beyond this fiscal year (and perhaps the transition quarter) should the attempt to meet its admittedly heavy operating costs in the open market not succeed. Both government and industry have been invited to put up the cash to use this ship with its extraordinary open-ocean station-keeping and heavy lift capability. No other option has received official approval.

A number of efforts have been made to buy time beyond the imminent deadline (first given as 30 June 1976) after which the ship would be declared surplus and perhaps scrapped. Mechanisms to keep the options open so that haste, at least, would be avoided, have been suggested and offers to help, or letters of concern and inquiry, have been made by Members of Congress. But the major outward effort to preserve the ship has consisted of a survey of government agencies as to their needs, and the issuance of a request-for-proposals in the hope that a consortium of interests would be found that would lease the ship and keep it going for a few years.

NACOA's interest is high because the ship has unique ocean capabilities and its members feel that the Nation will need these capabilities within a few years. What concerned the Committee was that current efforts to assure its preservation seemed doomed because too little time

had been allowed for the planners to catch up with the surprising physical capabilities of the ship, and that the cost analysis would be favorable only if it were extended over a sufficient term and not confined to the next 2 or 3 years.

At the direction of the Committee, Chairman Hargis wrote to the President on 22 April outlining the Committee reasoning and urging that the President "forestall hasty foreclosure before the detailed pros and cons of the situation can be examined." The Chairman noted:

- The GLOMAR EXPLORER is a ship with unique and remarkable capabilities for ocean research, exploration, and engineering.
- It is in danger of being wasted as a result of circumstances which withhold the clear responsibility for its preservation and maintenance from any one Federal agency.
- It has been hastily put up on the auctioneer's block before its potential usefulness to the Nation in a new and open role had been adequately examined.
- A significant national use for it can be demonstrated if sufficient time is provided to allow engineering plans to be developed.

After summarizing the physical capabilities of the ship, the Chairman pointed out that, for industry, its use could permit early proof testing of subsurface oil and gas well completions at great depths, assistance in building offshore structures, etc. The letter then went on to point out uses for the research community, both oceanographic and ocean engineering, and for work in connection with energy conversion. The Chairman concluded by expressing the hope that the President would designate an agent as its champion to find the funds to maintain the GLOMAR EXPLORER as an integral system for at least 1 year beyond its present expiration date to give government and industry the opportunity to take a hard look at what the ship can do for us today in open and useful work.

We have been assured, in a reply by Mr. Humphreys of the Domestic Council, that the White House has considered the matter carefully, and "Should neither lease nor sale effort result in acceptable offers, other options will be considered. In that connection, your constructive suggestion to create a special government entity will be given careful consideration."

Framework For Marine Resources Planning

NACOA stimulated a major effort by NOAA to construct a national fisheries plan in which the imperatives of proper biological and economic management of the Nation's fisheries would be met on the na-

tional scale they deserve and not left splintered to be treated in fragmentary fashion only when immediate resuscitation becomes an urgent necessity.

The effort made by the Task Force was notable for the breadth of alternative options considered and for the diligence with which constituent opinions and experience were sought in a major effort to prepare for its acceptance once a plan was approved and issued. In the course of these meetings and discussion—which we are told involved thousands of people—whole ranges of options were defined and estimates of their consequences prepared.

What remained was the difficult task of making the hard choices between different options and it is at this stage that the draft has been working its way through the various stages of approval required before issuance.

NACOA has generally kept touch with progress through Member contact and formal and informal discussion, but in the past year it took advantage of a request by Secretary Richardson to comment on a number of specific major issues by formally reviewing the progress of the task.

NACOA convened its fisheries panel which prepared a reply and reported to the full Committee which responded to the Secretary through the Chairman. The Chairman informed Secretary Richardson that NACOA was highly and favorably impressed by the effort that had gone into the development of the "Framework for a National Plan for Marine Fisheries." He reported NACOA's conviction that the deliberate and patient effort to tap grass roots opinions would contribute to fishery community readiness to accept more active conservation and management than had been true in the past.

NACOA noted, however, that a most important change had come about since a Plan had first been called for. That was the passage of the "Fishery Conservation and Management Act of 1976" which extended U.S. jurisdiction over coastal fisheries to 200 miles. This Act also sets up Regional Councils, authoritative bodies who will be in a most favorable position to respond flexibly to regional differences without fracturing into locally conflicting approaches and procedures.

NACOA felt that the effect on the requirement for a national fisheries plan was to ease the need to make national choices and to shift some of the burden of choosing options to the Regions. NACOA felt that the draft, however, provided a valuable source of choices and their consequences for the Regional Councils on whom the responsibility for developing plans now fell. NACOA proposed that the draft "Framework" be published in full as a "Framework for Marine Resource Plan-

ning" and felt encouraged that so large a share of the preparatory work had been done.

As we said in our Foreword, NACOA will be following with great interest and full attention the ways in which the 200-mile extended fisheries jurisdiction legislation is put into practice and how it influences the well-being of the United States coastal fisheries.

Offshore Assets

As the United States builds more facilities seaward, and civilian activities in an extended resource zone increase, protection of these assets, supervision of these activities, and matters of safety become of greater interest than in the past.

These are relatively unattended matters which NACOA believes could be quite important. NACOA is examining alternative policies and their likely consequences having to do with the risks involved and means of coping with them. We expect this effort to continue during the coming year.

Coastal Zone Management

NACOA has continued to pay close attention to the progress of efforts to safeguard the coastal zone against adverse impact from the many converging interests in this region. This past year, the beginning of movement to open up the so-called "frontier areas" of the Outer Continental Shelf to oil exploration, where little or no previous activity had taken place, sharpened the concern and increased the urgency of such safeguards.

Activity has progressed strongly on two major fronts. On the one hand the States have become deeply involved in the development of their coastal programs, and on the other, a significant set of amendments to the basic Coastal Zone Management Act of 1972 were near legislative enactment in June 1976. One of the major new provisions of the legislation is to create a coastal facilities impact fund to assist States and communities in dealing with the onshore social, environmental, and economic impacts of the location and operation of energy facilities.

NACOA provided testimony and correspondence on pending legislation modifying the Coastal Zone Management Act and the Outer Continental Shelf Act on a number of occasions this year. We have generally supported measures that would permit States to accept the prospect of offshore oil development more readily than in the past through the strengthening of protective measures and the provision of funds to ameliorate damage or compensate States for the costs involved.

This legislation, if enacted, would greatly increase the duties and responsibilities of the Office of Coastal Zone Management at the Federal level and of the corresponding offices at the State level, and could produce a shortage of personnel trained in coastal zone matters. However, we are encouraged by the progress to date. We particularly note the beginning of the transition of the national coastal zone management program from the planning phase into the operational management phase with Federal approval for the program of the State of Washington. By the close of fiscal year 1976, all 30 of the coastal States had received at least two annual coastal zone management program development grants and a dozen States had received three. This crucial transition period will be examined closely and with considerable interest during the next several years since its successful passage will have a major impact on the success and utility of this nationally (regionally and locally) important program.

The basic Coastal Zone Management Act requires that States have the legal authority and organization to implement their management programs. Both the States and the Office of Coastal Zone Management are aware of possible delays associated with ensuring adequate legal authority at the State and local level for this purpose. There is a possibility that some States may require a number of years or conceivably may not enact the legislation that is required. NACOA concludes that it is not too early to consider the implications of and the alternatives for such possibilities.

Appendix I

Public Law 92-125
92nd Congress, H. R. 2587
August 16, 1971

An Act

85 STAT. 344

To establish the National Advisory Committee on the Oceans and Atmosphere.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, There is hereby established a committee of twenty-five members to be known as the National Advisory Committee on Oceans and Atmosphere (hereafter referred to in this Act as the "Advisory Committee").

National Advisory Committee on Oceans and Atmosphere, Establishment.

SEC. 2. (a) The members of the Advisory Committee, who may not be full-time officers or employees of the United States, shall be appointed by the President and shall be drawn from State and local government, industry, science, and other appropriate areas.

(b) Except as provided in subsections (c) and (d), members shall be appointed for terms of three years.

(c) Of the members first appointed, as designated by the President at the time of appointment—

(1) nine shall be appointed for a term of one year,
(2) eight shall be appointed for a term of two years, and
(3) eight shall be appointed for a term of three years.

(d) Any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed only for the remainder of such term. A member may serve after the expiration of his term until his successor has taken office.

(e) The President shall designate one of the members of the Advisory Committee as the Chairman and one of the members as the Vice Chairman. The Vice Chairman shall act as Chairman in the absence or incapacity of, or in the event of a vacancy in the office of, the Chairman.

Chairman and Vice Chairman

SEC. 3. Each department and agency of the Federal Government concerned with marine and atmospheric matters shall designate a senior policy official to participate as observer in the work of the Advisory Committee and to offer necessary assistance.

Senior policy official.

SEC. 4. The Advisory Committee shall (1) undertake a continuing review of the progress of the marine and atmospheric science and service programs of the United States, and (2) advise the Secretary of Commerce with respect to the carrying out of the purposes of the National Oceanic and Atmospheric Administration. The Advisory Committee shall submit a comprehensive annual report to the President and to the Congress setting forth an overall assessment of the status of the Nation's marine and atmospheric activities and shall submit such other reports as may from time to time be requested by the President. Each such report shall be submitted to the Secretary of Commerce who shall, within 90 days after receipt thereof, transmit copies to the President and to the Congress, with his comments and recommendations. The comprehensive annual report required herein shall be submitted on or before June 30 of each year, beginning June 30, 1972.

Duties.

Reports to President and Congress.

Pay.

SEC. 5. Members of the Advisory Committee shall, while serving on business of the Committee, be entitled to receive compensation at rates not to exceed $100 per diem, including traveltime, and while so serving away from their homes or regular places of business they may be allowed travel expenses, including per diem in lieu of subsistence, in the same manner as the expenses authorized by section 5703(b) of title 5, United States Code, for persons in Government service employed intermittently.

80 Stat. 499.

Department of Commerce and other agencies, assistance.

SEC. 6. The Secretary of Commerce shall make available to the Advisory Committee such staff, information, personnel and administrative services and assistance as it may reasonably require to carry out its activities. The Advisory Committee is authorized to request from any department, agency, or independent instrumentality of the Federal Government any information and assistance it deems necessary to carry out its functions under this Act; and each such department, agency, and instrumentality is authorized to cooperate with the Advisory Committee and, to the extent permitted by law, to furnish such information and assistance to the Advisory Committee upon request made by its Chairman, without reimbursement for such services and assistance.

Appropriation.

SEC. 7. There is hereby authorized to be appropriated to the Secretary of Commerce $200,000 for the fiscal year ending June 30, 1972, and each succeeding fiscal year to carry out the purposes of this Act.

Approved August 16, 1971.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 92-201 (Comm. on Merchant Marine and Fisheries).
SENATE REPORT No. 92-333 (Comm. on Commerce).
CONGRESSIONAL RECORD, Vol. 117 (1971):
May 17, considered and passed House.
Aug. 2, considered and passed Senate, amended.
Aug. 5, House concurred in Senate amendments.

Public Law 92-567
92nd Congress, H. R. 15280
October 25, 1972

An Act

86 STAT. 1181

To amend the Act of August 16, 1971, which established the National Advisory Committee on Oceans and Atmosphere, to increase the appropriation authorization thereunder.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 7 of the Act of August 16, 1971 (Public Law 92-125; 85 Stat. 344), is amended to read as follows: "There are hereby authorized to be appropriated to the Secretary of Commerce, for the fiscal year ending June 30, 1973, and for each of the two fiscal years immediately thereafter, such sums, not to exceed $400,000, as may be necessary for expenses incident to the administration of this Act, and for succeeding fiscal years only such sums as may be authorized by law.".

National Advisory Committee on Oceans and Atmosphere. Appropriation. authorization, increase. 33 USC 857-12.

Approved October 25, 1972.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 92-1467 (Comm. on Merchant Marine and Fisheries).
CONGRESSIONAL RECORD, Vol. 118 (1972):
Oct. 11, considered and passed House.
Oct. 13, considered and passed Senate.
WEEKLY COMPILATION OF PRESIDENTIAL DOCUMENTS, Vol. 8, No. 44:
Oct. 28, Presidential statement.

Public Law 94-69
94th Congress, H. R. 5447
August 5, 1975

An Act

To amend the Act of August 16, 1971, as amended, which established the National Advisory Committee on Oceans and Atmosphere, to increase and extend the appropriation authorization thereunder, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 7 of the Act of August 16, 1971, as amended (Public Law 92-125, 85 Stat. 344; Public Law 92-567, 86 Stat. 1181), is amended to read as follows: "There are hereby authorized to be appropriated to the Secretary of Commerce such sums as may be necessary for expenses incident to the administration of this Act, not to exceed the following amounts: (1) $400,000 for the fiscal year ending June 30, 1973, and for each of the 2 fiscal years immediately thereafter; (2) $445,000 for the fiscal year ending June 30, 1976; (3) $111,250 for the transitional period (July 1 through September 30, 1976); and (4) $445,000 for the fiscal year ending September 30, 1977.".

National Advisory Committee on Oceans and Atmosphere. Appropriation authorization. 33 USC 857-12.

SEC. 2. Section 4 of such Act (33 U.S.C. 857-9) is amended—

(1) by inserting after "review of" and before "the progress" the following: "national ocean policy, coastal zone management, and"; and

(2) striking out "the President." at the end of the second sentence thereof and inserting in lieu thereof "the President and the Congress.".

Reports to Congress.

Approved August 5, 1975.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 94-222 (Comm. on Merchant Marine and Fisheries).
SENATE REPORT No. 94-268 (Comm. on Commerce).
CONGRESSIONAL RECORD, Vol. 121 (1975):
May 19, considered and passed House.
July 11, considered and passed Senate, amended.
July 24, House concurred in Senate amendments.

THE SECRETARY OF COMMERCE
Washington, D.C. 20230

September 22, 1976

The President
President of the Senate
Speaker of the House of Representatives

Sirs:

I have the honor to transmit, in accordance with Public Law 92-125, August 16, 1971, the Fifth Annual Report of the National Advisory Committee on Oceans and Atmosphere (NACOA).

Enclosed also are my comments and recommendations that are required by the Act. These comments are also submitted in satisfaction of the requirement of section 6(b) of the Federal Advisory Committee Act (5 U.S.C. App. I).

Sincerely,

Elliot L. Richardson

Enclosures

COMMENTS OF THE SECRETARY OF COMMERCE ON THE FIFTH ANNUAL REPORT OF THE NATIONAL ADVISORY COMMITTEE ON OCEANS AND ATMOSPHERE

PREFACE

Public Law 92-125, which established the National Advisory Committee on Oceans and Atmosphere (NACOA) requires that the annual report of the Committee "shall be submitted to the Secretary of Commerce who shall within 90 days after receipt thereof transmit copies to the President and to the Congress with his comments and recommendations." Accordingly, I have reviewed the Fifth Annual Report of NACOA and have incorporated the viewpoints of all interested Federal agencies in these comments and recommendations.

INTRODUCTION

I welcome the views of the National Advisory Committee on Oceans and Atmosphere (NACOA) on the diverse oceanic and atmospheric problems confronting our Nation. This diversity reflects the growing importance of the oceans and atmosphere to the economic, social and environmental welfare of the Nation. The Fifth Annual Report addresses problems of energy development, environmental quality, and environmental hazards. It considers a variety of oceanic and atmospheric issues, and comments on some of the institutional problems associated with ocean policy formulation. These are all important questions, and the views of the Committee are most welcome. They will be given the most serious consideration as we formulate our policies and programs in the years ahead.

As in prior years, my comments are organized in the same sequence as the chapters of the Fifth Annual Report. As in the case of previous reports, where the Committee has made recommendations pertaining to the work of a specific agency, I have asked the head of that agency to provide comment.

Section I—Policy and Planning for Marine Affairs

> NACOA, FINDING that events affecting our prospective uses of the sea are developing more rapidly than the policy, plans, and organization to cope with them, and FINDING ambiguity in scope among existing approaches to formulating national marine policy and supporting plans, RECOMMENDS that:
>
> - An ad hoc task force be established by legislation to formulate a comprehensive marine affairs policy, plans, and an adequate coordination mechanism;
> - The scope of the policy and plan should cover: (1) use of ocean space; (2) development and conservation of marine and coastal resources; (3) protection of the marine and coastal environments; (4) support and conduct of marine-related environmental research, ocean engineering development, surveys, and technical services; (5) training of personnel; and (6) support for national defense ocean technology.

In the light of the importance of marine affairs to the Nation, a strong focus for planning and policy formulation is an essential requirement of a dynamic national ocean effort. I find that the planning goals outlined by the Committee, with some expansion to insure adequate consideration of marine transportation and marine environmental services, offer a good framework. In particular, the Secretary of Transportation would like to "emphasize the point that planning goals should be categorized and prioritized by the actual, functional levels of economic activity."

I doubt that any nation in the world has given as much attention to ocean policy *per se* as has the United States. I doubt that any nation has as diverse and active a set of mechanisms for debating and establishing oceans policies. If my sense is correct, we are setting the pace.

One need only examine the new ocean legislation of the past five years to realize just how pioneering and innovative our ocean policies have been. Enactments such as the Federal Water Pollution

Control Act Amendments of 1972, the Deepwater Port Act of 1974, the Marine Protection Research and Sanctuaries Act of 1972, and the Coastal Zone Management Act of 1972, as amended, comprise as comprehensive a set of policies for sound utilization and protection of the oceans as exist anywhere. Further, our national fisheries policy has undergone an historic shift with the passage of the Marine Mammal Protection Act of 1972, the Endangered Species Act of 1973, and the comprehensive Fishery Conservation and Management Act of 1976. And, marine transportation policy has been radically changed as a result of the enactment of the Merchant Marine Act of 1970.

Internationally, we are currently engaged in negotiations with 144 other nations in the Law of the Sea Conference. It is our hope that we can achieve broad international agreement on the limits of national jurisdiction over the oceans as well as on rules for the management of marine resources.

These policies have resulted from a process of healthy interaction among and within the Congress, the Executive Branch, a multitude of advisory bodies, affected constituent groups, and other countries.

Thus, it is not the lack of policies that is the issue; rather, the problem is the lack of a comprehensive approach to setting ocean policies. Certainly, the policies we adopt for the use of the coastal zone should be consistent with those we adopt for fisheries management and for the development of our Outer Continental Shelf (OCS) oil and gas resources. Policies with regard to OCS resources should in turn be consistent with those for the control of ocean pollution. And, policies with regard to our merchant marine or deep seabed interests should be consistent with our security and international economic and political interests.

Since our ocean activities relate to so many different national interests, a number of cabinet-level groups deal with different aspects of oceans policy. Questions on the Law of the Sea are treated within our National Security Council; protection of the ocean and coastal environment in the Domestic Council; and OCS development and Coastal Zone Management in the Energy Resources Council. A measure of consistency has been achieved because each of the policy councils has a large degree of common membership.

I believe it would be useful for those principally concerned with different aspects of oceans problems to review periodically oceans questions as such, rather than simply as one item on an agenda. I firmly believe that a cabinet-level group serving the President, constituted to interact with other concerned cabinet-level policy bodies, is essential to assist him in establishing policy objectives and priorities. Such a group could also be useful in assuring coordination of oceans programs.

The Committee's principal proposal for improved planning is the establishment of a joint Executive/Legislative task force to oversee a national ocean planning effort. While the idea is novel, I believe that the more traditional modes of cooperation between the Executive Branch and the Congress are to be preferred. This is not to gainsay the need for close cooperation between the two branches of Government in formulation of legislation.

I believe that the former Presidential Commission on Marine Science, Engineering and Resources established by Congress and composed of representatives of the Executive Branch and the private sector, with liaison members from the Congress, was a good example of the establishment of a one-time national policy planning and coordination review mechanism. This kind of Commission mechanism can be effective when there is an absence of broad-scale efforts to conduct reviews. However, I am struck by the fact that there are already many planning mechanisms in place which were not active at the time of the Stratton Commission. There is no reason why the National Advisory Committee on Oceans and Atmosphere under its charter cannot itself undertake long term advisory planning efforts. The National Ocean Policy Study of the Senate has performed an important planning and policy formulation role in the Congress. I have already mentioned the various policy mechanisms within the Executive Branch which are concerned with oceans policy.

Section II—Energy from Offshore Sources

NACOA, FINDING that we are moving as through an obstacle course in developing our domestic oil and gas resources, especially offshore, and that technological safeguards for drilling procedures and submerged completions exist (and can be enforced) which permit the environmentally safe development of these fields, and

URGING an increased effort to diminish the adversary interactions between industry, governments, and those most actively interested in environmental protection where it serves only the negative function of delay, RECOMMENDS that:

- As a nation we recognize the need to explore and develop offshore oil and gas resources consistent with enforceable, environmentally safe procedures and the need for maintaining strategic reserves, and that we reconcile the process with an economic atmosphere suitable for development.

The development of offshore energy resources is primarily the responsibility of the Department of the Interior. It is assisted in this role by many other agencies of the Federal Government, including the Department of Commerce, Department of Transportation (DOT), Energy Research and Development Administration (ERDA), and Environmental Protection Agency (EPA). Secretary of the Interior, Thomas Kleppe, has submitted the following comments on the recommendations of the Committee:

I welcome and endorse the balanced middle course between environmental, national security and economic considerations which NACOA advocates in this recommendation and in the text of its report. I am especially pleased with the Committee's approach to the subject of offshore oil and gas as it should help dispel persistent and widespread misunderstanding of some aspects.

The NACOA recommendation and discussion raise fundamental questions about the amounts and location of offshore fossil fuel resources. At present, there is no way to get firm answers to these questions, except through exploration drilling. Experiences of the past few years have provided some big disappointments in areas that both we at Interior and the oil industry considered promising. In light of these disappointments, we consider it essential that our Government encourage industry to proceed with exploration drilling at a maximum responsible rate and to obtain at least preliminary answers to our questions in order that we may avoid costly decisions that subsequently prove unwise or misdirected.

One purpose of the accelerated oil and gas leasing program on the OCS has been determination of amounts and location of oil and gas available to the Nation. The schedule, which was further advanced in mid-1975, has provided significantly more sales each year even though the process leading to the sales has been extended from twelve to nineteen months to accommodate greater detail and thoroughness in assessments of potential impacts on coastal and marine environments. Thus far, additions to the re-

source inventory have been limited; however, we look to greater success as industry intensifies exploration drilling in frontier areas of recent and planned lease sales.

At Interior, we agree with the Committee that industry has technological safeguards for environmentally safe exploration and development of offshore oil and gas, and believe that we have achieved the capability within the U.S. Geological Survey to assure their proper use. In saying this, we do not mean to imply that environmental conditions can be neglected. On the contrary, proper use of safeguards includes responsible evaluation of environmental data, avoidance of environmental hazards, and adaptation of technology and procedures to specific environmental conditions. We lay stress on gathering environmental information for these purposes in programs conducted by the Survey and those supported by our Bureau of Land Management, especially for areas where the data base is weak. The latter, involving several Federal agencies, the States and many others, include baseline studies and preparation of pre-lease sale statements to satisfy requirements of the National Environmental Policy Act. Where results of these efforts identify known or suspected geologic hazards that might exceed capability of technological safeguards, we withhold leasing of tracts that contain them in order to add assurance of safe operations.

Like NACOA, we recognize large differences in the kinds and amounts of environmental data needed to make lease decisions as contrasted to those required to formulate and evaluate development and production plans following oil and gas discoveries. The latter involve much greater specific detail and, as noted by the Committee, some facts take much time to gather. Insofar as possible, we attempt to anticipate and incorporate these long-range needs in our research programs and the baseline studies, and through collection of public and industry data in order that development of discoveries not be delayed.

Like needs for environmental data, impacts of the exploration and development efforts differ significantly. Here the recently enacted amendments to the Coastal Zone Management Act and the creation of an energy impact fund should help a great deal in allowing States to meet demands placed on them by discoveries on the adjacent OCS.

We are concerned with the clause in the NACOA recommendation, "maintaining strategic reserves", as it might be misunderstood by some who fail to read the supporting text and who could interpret it as endorsement of Government entry into oil and gas exploration and production. The Department does not support this interpretation. Instead, it believes that Government should set goals, provide economic incentives, and let our economic system develop means of achieving the goals.

In passing, I would like to note a program that we initiated through our Geological Survey during mid-July to drill a number of holes to obtain environmental information on sediments that compose the upper layers of our Atlantic Continental Margin. This activity has received substantial support from the adjacent coastal States, as indicated by assignments of personnel from their geological and water resource agencies to aid in the collection of data, that is expected to have use in development of coastal resources, such as groundwater, as well as evaluation of environmental conditions for the Shelf beneath both OCS and territorial waters. I think of this effort as a good start on the kind of program that NACOA encourages.

In closing, it is a pleasure to note significant progress toward achieving goals of the recommendations made by NACOA in 1975: reasonable State input into OCS planning, expeditious development of oil and gas resources, consistency with State coastal zone plans, and assistance to States to plan for OCS-associated onshore effects. As noted in the foregoing paragraphs, I am confident of realizing comparable progress for this year's recommendation.

The Administrator of EPA generally concurs with the views of the Secretary of the Interior, but wishes to introduce a note of caution on several related matters:

I continue to support the view that it would be a beneficial incentive to more effective and more economical offshore energy development to separate the environmental impact assessments into phases of exploration and development. However, I cannot wholly agree with the Committee's view, "that the technical ability exists to safeguard the marine environment in drilling." I again express my concern that our present knowledge of marine ecological processes and our present technology is of doubtful adequacy to establish or protect oceanic environmental norms. Offshore energy development should proceed only with full recognition of the need for obtaining the scientific information and technology necessary to assure that decisions for offshore development are environmentally sound.

I also generally concur with the Secretary of the Interior, but would agree with the Administrator of EPA to the extent that it would be useful to separate exploration and development environmental impact assessments.

Section III—The Sea Grant Influence

NACOA, FINDING that the Sea Grant Program's unique contribution to a balanced national effort in marine resource develop-

ment and use and marine environmental protection is of increasing importance, but that after 10 years its goals, priorities, guidelines, management, and relationship to other Federal programs need some modification RECOMMENDS that:

- Funds be increased over the next 3 to 5 years from the present $23 million per year to a minimum of about $40 million, in order to enable Sea Grant to maintain a strong local and regional orientation for its educational activities, applied research, and advisory services as an integral part of an effort directed toward national needs;
- The Sea Grant Act be amended to permit responsiveness to Federal-level requirements through provision of additional earmarked funds free of the matching funds requirement;
- Special attention be paid by the Administrator of NOAA to improving the operation of the program, clarifying its goals, and setting its priorities within the national context; and
- Steps be taken by the Office of Sea Grant to improve its proposal review process, and to clarify the function, composition, and tenure of the Sea Grant Advisory Panel.

The Committee finds that the program provides a unique contribution to a balanced national effort in marine resource development and use, and marine environmental protection. I agree that all programs need continuous modification to make them responsive to new needs as they arise. Sea Grant has performed well over the first decade of its existence, but I concur with the Committee, that there is a need for a hard look at some of the procedures that are being followed.

I wish to assure the Committee that it remains the goal of the Department of Commerce to assist in the development of an adequate network of institutions with marine research capabilities throughout the coastal regions of the United States. Nevertheless, any extension of the Sea Grant program will depend upon the national picture and the level of funding for similar marine resource research and development activities. I note that the Congress, as a result of its review of the Sea Grant program during the past year, of the report and comments of the National Advisory Committee on Oceans and Atmosphere, and of the comments of others who have been interested in the future of the Sea Grant Program, has decided to increase the funding of this program by $4 million for fiscal year 1977.

The Committee has noted and supported the idea that for certain programs of high national interest, as well as for certain international efforts, non-matching funds be provided. I believe that we must take great care to insure that the basic purposes of the Sea Grant Program continue to be directed primarily towards local and regional problems and that its funding continue to remain of a matching nature.

The Committee has made several suggestions about improving the operation of the program and I am directing the Administrator of the National Oceanic and Atmospheric Administration to review the program's procedures, to make needed revisions to accomplish the objectives set forth by the Committee. In particular, I have asked him to look at improved project review procedures and improved ways of more closely integrating the work of the Sea Grant Program with the other activities of the National Oceanic and Atmospheric Administration, as well as with the activities of the other Federal agencies.

The Sea Grant Advisory Panel, in my view, has performed outstandingly since its inception. I have not found that the Panel's dual functions of advising the Administrator and myself on policy aspects of the Sea Grant Program, as well as advising the Sea Grant Director on operating characteristics of the program, has detracted from its effectiveness. On the contrary, I have felt that this has been one of the strengths of the Advisory Panel. The dual functions assure sufficiently detailed knowledge of the program so that policy recommendations to the Administrator and myself are grounded in the realities of the program.

I do agree, however, that it is desirable to have a system of rotation of the panel members and I am asking that such a system of panel member rotation be instituted as soon as possible.

Section IV—Energy Research and Demonstration

NACOA, FINDING undue emphasis on haste in establishing R&D programs in energy resource development whose payoff is a long way off, and that the outpouring of legislation and funds for research, development, and demonstration creates pressures on ERDA not easily solved by the advocacy approach to R&D, which can be wasteful of funds and of time, RECOMMENDS that:

- There be established in ERDA a Directorate for Oversight of Energy Research whose function it would be to act (in a manner

analogous to the Director of Defense Research and Engineering of the Defense Department), as R&D advisor to the Administrator and as a group with no stake in any particular R&D approach, so that it can balance the many simultaneous avenues now being explored, and assist in shifting the priorities and keeping them current as information develops.

The recommendations of Section IV entitled "Energy Research, Development, and Demonstration" were directed to Dr. Robert C. Seamans, Administrator of the Energy Research and Development Administration. He has indicated to me that the balanced program approach endorsed by NACOA is essential if ERDA is to perform its mission properly. In fact, the function of the proposed Directorate for Oversight of Energy Research is already embodied in the current ERDA organization. There are two relevant internal groups—one under the Assistant Administrator for Planning, Analysis and Evaluation and the other contained in the recently formed Office of Programs Integration. These groups are staff organizations and are not responsible for development of particular technologies or management of individual programs; rather, they are responsible for planning, analysis and evaluation of programs, and it is their role to ensure that programs are properly balanced to meet the needs of existing and prospective commercial users of energy technology. There is also an external review group known as the General Advisory Committee. This latter group is responsible for providing the Administrator with a broad policy overview and can recommend organizational and programmatic changes based upon its assessment of changing conditions and priorities.

Section V—Air Pollution Research and Development

NACOA, FINDING that the accomplishment of longer term basic research by EPA is inadequate, due in part to the intense short-time pressures on EPA because of the urgent need for scientific data to support immediate regulatory decisions, RECOMMENDS that:

- EPA continue to maintain a strong R&D capability in direct support of its near-term regulatory functions; and that EPA conduct longer term basic research, to the extent that resources permit;
- Lead agency designation be accorded in each of three major environmental areas, and that the following agencies accept

the prime responsibility for leadership in assuring that there are no major gaps in the overall Federal program of longer-term environmental research directly involving:

- human health and disease—National Institute of Environmental Health Sciences
- the atmosphere and the oceans—National Oceanic and Atmospheric Administration
- plant and animal life on land and inland waters—Department of the Interior

- Council on Environmental Quality (CEQ) lead a high level interagency coordinating committee to assure appropriate policy guidance, establishment of priorities, and coordination of the several long-range research programs and of these programs with the EPA.

The Committee has made several suggestions with respect to the research programs of the Environmental Protection Agency, as well as comments on the institutional needs of the Federal Government for mounting and coordinating environmental research in different fields.

Mr. Russell Train, Administrator of the Environmental Protection Agency, has submitted the comments that follow on the recommendations as they pertain to the research and development programs of the Environmental Protection Agency:

> The Committee has questioned the adequacy of the scientific information base for air pollution regulatory and control decisions. It concluded that the Environmental Protection Agency (EPA) was so concentrating its research on meeting the immediate pressures for regulatory actions that it has been forced to largely neglect long-term or basic environmental research for future national needs.
>
> We in EPA agree that there is not adequate scientific effort on the Nation's longer-range problems of pollution control and environmental management. We have long recognized that within the limits of its resources, the EPA has not been able to properly conduct a full-range research program to meet all the important past, present and future environmental problems that are even now apparent. The EPA has never expected to meet all of its research needs, neither short-term nor long-term, exclusively through its own programs. We have urged, and continue to urge, that any agency that has the necessary authority undertake whatever environmental research is within its competency. All three of the agencies NACOA has recommended for lead responsibility have not had, in the past nor at present, any obstacle save resources and initiative to do what NACOA has advised.

> The Committee seems to imply that because EPA's research and development is oriented toward support of the EPA mission, that its direction is dictated by the regulatory programs. I wish to make it clear that the EPA R&D program is responsive to the agency mission needs, but its content, formulation and direction is the exclusive responsibility of my Office of Research and Development.
>
> Within the next few weeks, my Science Advisory Board will consider a study by its members, all external to the EPA, on evaluation of the application of long-term ecological research to the EPA mission. I look forward to the support of NACOA in obtaining the assistance of other agencies that could carry out any needed work identified by this study.
>
> In this connection, we note that the terms "long-range or basic" research and "lead responsibility" would require clear definition were NACOA's recommendations to be implemented. . . .

The Committee has expressed its concern about the institutional aspects of long-range research on environmental problems. In particular, the Committee has recommended that lead agencies be designated in three areas of long-term environmental research. The three areas selected are human health and disease, the atmosphere and the oceans, and the plant and animal life on land and inland waters. It has recommended that the Department of Health, Education and Welfare/National Institutes of Environmental Health Sciences, the Department of Commerce/National Oceanic and Atmospheric Administration, and the Department of the Interior, respectively, act as the lead agencies for each of these areas. Finally, the Committee has recommended that the Council on Environmental Quality undertake to fill the gap which it feels exists in the coordination of long-range environmental research by establishing an interagency body to ensure that policy guidelines and priorities are established, and that the programs of all the agencies mesh with those of the Environmental Protection Agency.

As the Committee points out, environmental research is carried out by almost every agency of the Federal Government. The Committee also recognizes that designation of a lead agency cannot eliminate the need for each agency to undertake the research necessary for the fulfillment of its mission. Likewise, agencies should not necessarily be assigned lead roles solely on the basis of topic areas but rather on the basis of mission and end product desired.

I appreciate NACOA's recommendation that the coordination function should be assumed by the Council on Environmental Quality. Again, I would like to point out that this function has always been within the authority of CEQ.

I would like to indicate that no coordination mechanism can be truly effective without some positive means to force action or correction of the program gaps and overlaps that are exposed through a review process. With the recent passage of the National Science, Engineering, Technology Policy, and Priority Acts, I expect that there will be a review of all the science and technology coordinating mechanisms within the Federal Government. It would be my hope that this review would result, *inter alia,* in a discussion of NACOA's recommendations and means to achieve their thrust.

Section VI—Weather and Air Safety

NACOA, NOTING that weather-related aircraft accidents continue as a significant proportion of the total (especially with general aviation) and FINDING that division of responsibility for the provision of aviation weather service between the National Weather Service and the Federal Aviation Administration has taken too much weather out of the air traffic control and too much aviation out of weather forecasting, RECOMMENDS that:

- The Federal Aviation Administration put greater emphasis on the early recognition of deteriorating weather situations in civilian pilot training and on the requirement for weather knowledge in pilot certification;
- The National Weather Service improve the quality of air weather information by computer checks on observations, by post-mortems on forecasts, and by training in format and enunciation for voice communicators;
- Aviation weather expertise be put back into the traffic control environment and, especially, that the Kansas City Test (integrating controllers and professional weather personnel) be extended and developed throughout the Nation (for controlled flights) and the Enroute Flight Advisory Service (largely for general aviation) also be extended throughout the Nation.
- The agreements between, and the directives to, the National Weather Service and the Federal Aviation Administration, splitting the responsibility for aviation weather service, be reviewed and updated and the requirements for aviation weather service be reviewed in the light of technological advance on a broad front.

The comments of the Committee on weather and air safety are timely. The provision of weather information for the safety of aircraft operations and effective control of the national airspace is a matter of deep concern to the Department of Commerce/National Oceanic and Atmospheric Administration and the Department of Transportation/Federal Aviation Administration.

We welcome the suggestions of the Committee for improved aviation weather services. The kinds of services recommended by the Committee are technologically feasible now, but do require substantial new Federal investments in manpower, communications, and equipment. Accordingly, they will require careful budgetary review.

The present arrangements with the Federal Aviation Administration, for the joint provision of aviation weather services to the aviation community, have been worked out over the years to take fullest advantage of the unique capabilities of both organizations. Recent aircraft accidents, in which weather was a factor, have prompted us to review jointly with the Federal Aviation Administration additional steps that need to be taken to improve our aviation weather services.

Priorities were established to expedite Significant Meteorological Information (SIGMET) and Terminal Forecasts into the National Airspace System (NAS). In accomplishing this it was proposed that:

- A significant thunderstorm airport alert test be undertaken for selected New York and Washington area airports.
- A National Pilot Report (PIREP) system be implemented into the NAS, with assistance from the National Weather Service, Air Transport Association, Aeronautical Radio, Inc., Department of Defense, and the Federal Aviation Administration.
- A joint National Plan be prepared for better aviation weather dissemination, which includes the Transcribed Weather Broadcasts (TWEB), the Pilots Automatic Telephone Weather Answering Service (PATWAS), and the Public Broadcasting System (PBS).
- Greater emphasis be placed on weather education for pilots and air traffic control specialists.

All of the above and other priorities are now ongoing. In addition, an Enroute Flight Advisory Service (EFAS) program is being implemented as fast as resources and training schedules will permit.

Twenty EFAS units are operational and the remaining 24 locations will be commissioned by 1977. Participation in this program by air carrier pilots is very encouraging. Their PIREP contribution enables the EFAS Specialist to provide better service to general aviation pilots.

The FAA is considering the establishment of a Satellite Data Test program at three flight service stations to evaluate the effectiveness of this tool in providing briefing information.

The Committee has recommended much improved education and training for pilots so that they can deal with hazardous weather situations effectively. I agree that this is needed. I am pleased to report that the FAA and NOAA are working on present standards for weather instruction to pilots and controllers, to insure adequate weather education. Section 61.105 (revised) of the Federal Aviation Regulations requires that an applicant for a private pilot certificate must have logged ground instruction from an authorized instructor, or present evidence showing that he has satisfactorily completed a course of instruction in the recognition of critical weather situations from the ground and in flight, and in the procurement and use of aeronautical weather reports and forecasts. This requirement is in preparation for an applicant taking a written test.

To further increase weather coverage, new Parts 61 and 141 of the Federal Aviation Regulations place greater emphasis on practical application of such knowledge in the new private pilot written examinations. Under revised Part 61, both the private and commercial pilot flight tests stress weather information. "The applicant shall demonstrate that he knows what weather information is pertinent and how best to obtain this information, and that he can interpret and understand its significance with respect to his proposed flight."

Additionally, the FAA has instructed their field personnel to be particularly aware of the emphasis given to weather instruction in pilot school courses. Further, they have completed and distributed to their accident prevention specialists a slide/tape presentation, "Weatherwise GO or NO GO," which is being shown to the public at accident prevention meetings and is made available to flight schools during sessions on meteorology. The FAA has also encouraged industry advisory groups, such as the General Aviation Manu-

facturers Association and the National Association of Flight Instructors, to publicize further through their member companies and in-house publications the involvement of weather in general aviation accidents.

The Committee has also made a number of recommendations with respect to the quality of weather information. Some of its recommendations are highly technical. The National Weather Service recognizes the need to assure the quality of aviation weather observations and agrees that the checking of these observations for errors should be done by computer. Work is underway to devise computer programs and adapt climatological data files to perform quality control checks automatically on aviation weather observations. National Weather Service forecasters, when beginning a duty shift, routinely review their past forecasts for quality and this practice will be continued. At Weather Service Forecast Offices a Weather Service Evaluations Officer is responsible for evaluating the quality of forecast services on a continuing basis.

One of the areas in which both the Federal Aviation Administration and National Oceanic and Atmospheric Administration have worked extensively over the past several years involves improving weather service to pilots in flight. The need to improve these services has led the FAA and NOAA, together with the Air Force, to institute an experimental program at the Kansas City Air Route Traffic Control Center (ARTCC) to provide direct weather communications to pilots in flight. We believe that this experiment has much merit, but before it can be extended to the entire United States, further tests are required. It is our intention to conduct such further tests before deciding on a nationwide extension of this program.

Additional evaluation of this program will be accomplished by expanding it to the Fort Worth and the Washington ARTCCs. The Washington ARTCC has a collocated Flight Service Station (FSS) containing the EFAS function which itself is equipped with the same type radar equipment as the weather unit in the Kansas City Center. This system enables the FSS to communicate with and provide weather data on the common meteorological frequency (122.0 MHz) to all types of civil aircraft, whether they are under Instrumental or Visual Flight Rules. With the addition of a Very

High Frequency (VHF) channel to communicate with military aircraft, all aircraft would have one source for real time enroute weather information. All controllers, when appropriate, could then advise pilots to contact the EFAS position for hazardous weather information. This would be in addition to alerting all pilots to the existence of a SIGMET.

I believe it is in the best interest of aviation that the provision of aviation weather services continue to take full advantage of the unique capabilities of both the FAA and NOAA. We believe that in this way the most cost effective use can be made of the equipment and facilities of both agencies. The agreement and directives for provision of aviation weather services now covering the work of these two agencies are being revised and updated in the light of the Committee's comments.

Section VII—Some Marine Matters

NACOA, FINDING that there are serious deficiencies in research related to diver physiology, and in the development of safe proven decompression tables, RECOMMENDS that:

- Research be directed towards the development of tables and procedures to allow more rapid decompression of divers, based on safe physiological considerations, and towards significantly increasing our understanding of both the long- and short-term physiological effects due to work under hyperbaric conditions. An additional $3.5 million should be directed towards these research efforts.

The concerns and recommendations of the Committee on the diverse set of marine activities discussed in this chapter are noted. The Committee feels the present U.S. effort in diving physiological research is inadequate and needs additional funding.

It is important to note that the U.S. Coast Guard and Occupational Safety and Health Administration (OSHA) of the Department of Labor have been jointly addressing the question of occupational safety and health matters pertaining to diving operations, as well as the preparation, promulgation and enforcement of diving safety standards. The U.S. Coast Guard has a statutory basis under both titles 14 and 46 USC for underwater safety activities, and is currently monitoring diving safety as a part of its responsibilities for underwater technology. The Coast Guard plans a systematic

approach to the investigation of physical limitations for diving and the standardization of diving systems including hardware systems for underwater sensing, monitoring, equipment placement (i.e. permanent buoy anchors), and ultimately underwater rescue. However, I concur that research directed toward the development of comprehensive decompression theory and the development testing of tables and procedures allowing more rapid diver decompression is needed. We will give the recommendations of the Committee due consideration as we formulate appropriate underwater programs in the future.

In its listing of facilities, we note that the Committee did not make mention of the Navy's deep diving biomedical research facility currently under construction at the Naval Medical Research Institute at Bethesda, Maryland. Further, the Secretary of Defense has asked that I communicate that the Navy will be placing increased emphasis (beginning fiscal year 1977) on investigations of the medical aspects of diving decompression leading to 1) better employment of divers working underwater, 2) improved decompression schedules, and 3) improved prevention and treatment of decompression accidents.

The Committee also has recommended that increased funds on the order of $3.5 million be made available for diving physiological research in connection with the civil applications of diving. Of particular importance to this recommendation is the fact that Navy funding of diving medical research is expected to increase by approximately $3 million over the next 3 years. A limiting factor, however, is the number of scientists available to work in this particular field. Fortunately, the location of Navy research programs at large educational centers encourages recruitment and training of new scientists. It is, therefore, imperative that civil programs in diving research both recognize and coordinate with similar Navy efforts.

Navy Environmental Research—Technical Capabilities

NACOA, FINDING indications of increasing Defense Department reliance on non-DOD sponsored ocean research in areas of technical importance to defense, and cautioning that excessive dependence on the efforts of civilian agencies could seriously weaken

Navy technical strengths, erode its capabilities, and make it vulnerable to technological surprise, RECOMMENDS that:

- DOD ensure that increasing reliance on non-DOD sponsored research does not have a deleterious effect on Navy technical posture.

I have asked the Secretary of Defense to comment on the recommendations of NACOA on environmental research in the Navy. His comments follow:

The Secretary of Defense is gratified that NACOA recognizes the uniqueness of DOD environmental support and the need to maintain the high level of in-house technological skills. We concur with NACOA that the development of any national ocean policy or other environmental policy must recognize the unique factors necessary to the maintenance within DOD of a truly effective military oceanographic and atmospheric environmental capability. As NACOA also recognizes, however, responsible management requires we take cognizance of the research of others in shaping our plans from year to year. The DOD will consider NACOA's comments in its program formulation.

Navy/Academic Exchange

NACOA, FINDING that there is a marked lack of involvement of younger academic faculty in DOD research and development and that DDR&E has recognized this problem and has a small corrective program underway in the Army and Air Force, RECOMMENDS that:

- The Navy initiate efforts to increase the direct involvement with its laboratories and operational facilities of younger faculty members in areas of oceanography and atmospheric R&D.

These recommendations are directed to the Navy and I have asked the Secretary of Defense to provide his comments which follow below:

The Director of Defense Research and Engineering recognizes the need for increased involvement of the academic community with the DOD laboratories and operational facilities. Several alternatives are being examined to improve relations with and the involvement of the academic community. We welcome the Committee's attention to this issue.

Section VIII—Some Atmospheric Matters

NACOA, FINDING that our capability for incorporating cliatic assessments into planning related to food, energy, and water

is not being exploited as effectively as it might be because no single Federal agency has the clear resposnibility for doing so, and FINDING that research directed toward developing a capability for prediction of climatic fluctuations is not being vigorously pursued, again because no agency has the clear responsibility, RECOMMENDS that:

- The Congress enact legislation such as H.R. 10013, the "National Climate Program Act of 1976," to: provide for a program of climate watch, development of improved climate forecasting, and conduct of climate research; and to authorize the Secretary of Commerce to coordinate the efforts in the field of the various concerned Federal agencies.

The Committee has reiterated the recommendations contained in previous reports on climate and weather modification. I concur that there is a need to develop a better understanding of the dynamics of climate and the techniques for improving our ability to anticipate climate changes. There has been a substantial increase in the climate programs of the National Science Foundation (NSF) and NOAA, although the need to maintain tight fiscal controls on Federal spending during the past two years has, to some extent, limited the support of climate related work. The recommendations of the Domestic Council Subcommittee on Climate for a National Climate Program provide a useful framework within which we are attempting to support and fund individual efforts in the field of climate. We believe that these are the highest priority activities which are consistent with the state of basic knowledge in this area.

We are pleased with the Committee's views on the Global Atmospheric Research Program, and the need to move ahead with it as an important means of advancing our ability to predict climate change. We have continued to give this program the strongest support within the World Meteorological Organization. At the meeting of the Executive Committee of the World Meteorological Organization (WMO) in June of 1976, the WMO agreed to move ahead as rapidly as possible with the next major step in the Global Atmospheric Research Program. The first global experiment will be undertaken in 1978 and 1979.

The World Meteorological Organization also stressed the need to accelerate the development of an oceanographic program for the global experiment. The Executive Council of the Intergovernmental

Oceanographic Commission (IOC) at its meeting the following week agreed with WMO and approved IOC action toward that end.

Weather Modification

> NACOA, FINDING that the fragmented Federal effort in weather modification places too much emphasis on operations, with insufficient attention to the basic research which is needed before weather modification can become a reliable operational tool, and FINDING that enough studies have been conducted to permit a decision to be made as to how to proceed, RECOMMENDS that:
>
> - Action be taken now, by the Executive Branch or by the Congress, to give NOAA the responsibility for coordinating and managing a coherent Federal program of weather modification research and experimentation.

The continued interest of the Committee in a sound program of research in weather modification and in the institutional arrangements for the conduct of the national weather modification effort is much appreciated. The report of the Domestic Council's Subcommittee on Climate Change, which reviewed the status of the field of weather modification in the United States and made a series of recommendations with regard to the Federal role in this field, is still under review within the Executive Office of the President. The Committee's views on this problem are similar to those expressed in the Domestic Council Subcommittee's report. I share the Committee's views expressed in the report that there is a need for more basic research in weather modification.

The United States is pursuing the international aspects of weather modification within the context of the World Meteorological Organization and the United Nations Environment Program. We have supported proposals for the establishment of an international weather modification experiment in precipitation enhancement in which many countries of the world would participate.

The Department of Commerce is moving ahead with its hurricane modification work under Project Stormfury. We are now examining the possibility of conducting the Stormfury experiment in the Eastern Pacific Ocean, as well as in the Atlantic Ocean. As the Committee is aware, we have made substantial investments in equipping the necessary aircraft. The Project should be in a position

to resume operations by 1978. I concur with the Committee's views that more attention needs to be addressed to the environmental, economic and social impacts of weather modification.

Section IX—Shorter Comments

GLOMAR EXPLORER

The views of the Committee on the use of the GLOMAR EXPLORER are appreciated. The uniqueness of the GLOMAR EXPLORER with its unmatched capabilities for ocean research, exploration and engineering are recognized. The views of the Committee will be taken into consideration as decisions are made with regard to the future of the vessel.

FRAMEWORK FOR MARINE RESOURCES PLANNING

I am deeply gratified by the comments on the progress being made with the National Plan for Marine Fisheries, first stimulated by recommendations of NACOA. I would like to take this opportunity to thank the Committee for its assistance and advice in this matter. I have involved myself in the final policy decisions on this plan, and have forwarded the Department of Commerce's recommendations thereon to the President.

Many of the critical policy issues reflected in the original draft of the National Plan for the Marine Fisheries have now been resolved by the Congress in connection with the enactment of the Fishery Conservation and Management Act of 1976. The impact of the passage of the Fishery Conservation and Management Act of 1976 upon the National Plan has been taken into account in the Fisheries Program which I have recommended.

We welcome the Committee's close attention to the manner in which the Department is implementing the provisions of the Fishery Conservation and Management Act of 1976. The Department of Transportation and the Department of State also have indicated their interest in a continuing review by NACOA of the progress being made in the implementation of this Act.

I have also welcomed the passage by the Congress of the 1976 Amendments to the Coastal Zone Management Act of 1972. These amendments, worked out cooperatively between the Executive Branch and the Congress, represent significant new steps to assure the wise use of our coastal areas and offshore waters. I believe that the new Energy Impact Fund provides a unique mechanism to assist States to accommodate the impacts of energy development in coastal areas. I also believe the Fund will be helpful in accelerating the development of offshore energy resources while at the same time preserving those coastal values that we hold so highly. We appreciate the attention which the Committee has given to the problems of the coastal zone over the past five years, and feel that its advice and recommendations have been instrumental in the development of the policy decisions which have led to the kind of legislation which we must now implement.

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