REPORT OF THE AD HOC COMMITTEE TO REVIEW THE NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM (NAPAP)

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NOTICE

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I. Executive Summary

This is the final report of the Ad Hoc Committee to Review the National Acid Precipitation Assessment Program (NAPAP). The Committee has met over a five-month period to review the activities of this important research effort with special emphasis on scientific quality, the scope of the research effort, adequacy of the research plan and its relevance to policy concerns, and research management.

The Review Committee is acutely aware of the need both to provide information to policy makers in the short run, and to accumulate knowledge over the long term which will provide improved understanding of the relationship between emissions and environmental effects. The Committee's recommendations are aimed at strengthening NAPAP's ability to meet both of these objectives.

The present NAPAP system has important strengths and weaknesses. On the one hand, the Review Committee was favorably impressed with the progress that NAPAP has made since its establishment in 1981, the manner in which the interagency process is working to coordinate research projects in the participating agencies and the scope of the present research effort.

On the other hand, the Committee has found several weaknesses in the program which should be repaired. First, insufficient resources are being provided to NAPAP given the enormous breadth and complexity of the technical issues involved. Moreover, the resources are allocated to the participating agencies in a manner which competes with declining agency research budgets and does not give part-time task group leaders authority over the technical program for which they are responsible. Second, the present decentralized interagency management process is not likely to be capable of undertaking several important functions: systematic integration of research results, management of large scale projects, and technical support for policy formulation. Third, insufficient multi-year, indepth studies of the atmospheric consequences of emissions and ecological effects of acid deposition on lakes and streams, watersheds, forests, soils, and biota are underway to provide an adequate basis for verifying "system" models which are needed to meet credibly the 1985 and 1987 NAPAP assessment milestones. Substantial additional resources will be required over time to answer important technical issues. Key areas requiring additional emphasis are integrated assessments, indepth studies of aquatic and terrestrial effects and verification of source-receptor models. Additional aspects of the NAPAP program which need strengthening are mentioned in the body of this report.

The report also notes some technical areas which need greater emphasis and resources. These include air monitoring, accelerated development of techniques for dry deposition monitoring, more precise determination of resources at risk, and attention to the relationship of acid deposition to other air pollution phenomena. The need for additional research on mitigation strategies is also noted as well as the need for a greatly expanded program on control technologies to be carried out by the Department of Energy (DOE) outside the NAPAP program.

The principal recommendations of the Review Committee address management changes, revised budgeting procedures, key areas requiring additional resources, and the need to improve the scope and quality of the basic science effort underlying the entire NAPAP effort. There should also be greater cooperation with foreign countries facing the acid deposition problem.

The recommended management changes involve the addition of a full-time Director of Assessment who would be an Assistant Administrator or Deputy Assistant Administrator of EPA. This individual would be the EPA representative on the Joint Chairs of the NAPAP Interagency Task Force, and he or she would be responsible for the functions of (1) technical support for policy development, (2) integration of research results and technical assessment, (3) broad research guidance to the NAPAP Research Coordination Council, and (4) the management of new, large scale projects. The existing NAPAP interagency process would be maintained to carry out the bulk of the research effort.

The principal budget recommendation concerns changing the manner in which resources are provided to agencies participating in NAPAP. Any additional funds allocated above the FY'84 budget levels should be provided as "new" money to the participating agencies. The Director of Research, task group leaders, and the proposed Director of Assessment must have control over the NAPAP approved research budgets for which they are responsible.

The Review Group believes that it is essential to strengthen and expand the fundamental science component of the NAPAP program. A standing, external scientific advisory committee for NAPAP is proposed and increased emphasis is recommended for publication of scientific results in the peer reviewed scientific literature to provide a mechanism for debate on controversial issues. A fundamental research effort is essential to clarify many questions about the environmental impact of acid rain. Therefore, the basic research must be protected from the budgetary demands of more

short-term research efforts and larger projects. To insure broad participation by qualified scientists, an external research grant program, open primarily to industry and universities, should be established as a matter of high priority with an anticipated funding level of $10 million per year in new funds.

II. Introduction

This is the final report of the EPA Science Advisory Board's Ad Hoc Committee to Review the National Acid Precipitation Assessment Program (NAPAP). The Committee was established on August 17, 1983 at the request of the Secretary of Agriculture John Block, Environmental Protection Agency Administrator William Ruckelshaus and National Oceanic and Atmospheric Administration Administrator John Byrne. The membership of the Review Committee is presented in Appendix A.

The charge of the Committee was "to review and evaluate the technical quality of the national program and suggest future research". The review included an examination of the plans and objectives of the program, program implementation, and how well the planned program will pursue key scientific questions relevant to decision making. The complete terms of reference are included in Appendix B.

There have been several recent technical reviews pertinent to the NAPAP program. In addition to the peer reviews undertaken semi-annually by the NAPAP program, pertinent studies have been undertaken by the National Academy of Sciences, the Office of Science and Technology Policy, the Office of Technology Assessment of the Congress, the Electric Power Research Institute, Jason, and Working Groups under the US-Canada Memorandum of Intent. A list of these studies is included in Appendix C.

The present review differs substantially from these prior efforts. This Committee saw as its principal task to conduct a "top-down" review of the research management of the NAPAP program. Thus, the Committee's principal objective was not to review NAPAP on an individual project basis (a task which is satisfactorily carried out by the NAPAP peer review process) but to assess the adequacy of NAPAP plans and programs for producing scientific knowledge to improve the scientific basis for decision making. Most of the Committee's recommendations are directed toward this end. The reason for adopting this posture is the recognition that the fundamental purpose of the NAPAP research program should be to provide scientific information needed to make more informed regula-

tory decisions and to accumulate scientific information which will reduce technical uncertainty over time. The present Committee represents the first systematic external review of the adequacy of the NAPAP program and its plans for meeting policy concerns.

A. Policy Expectations for the NAPAP Program

The Review Committee is strongly aware of the sharp tension which exists between policy expectations and the prospects for delivering scientific answers with adequate confidence. On the one hand, the decision maker confronts a serious public issue which requires political resolution. In this circumstance, it is understandable that the decision maker will seek to establish a research program which will be responsive to short-term policy concerns and which will yield results that will permit more informed decisions to be made on a cost-effective basis. On the other hand, the scientific community is mindful of the great complexity of the acid deposition problem and the need for a longer-term research program which will provide reliable scientific knowledge. No matter how large the commitment of resources to acid rain research, some information is beyond the reach of scientists on a time scale which matches the needs of policy makers.

There are several reasons for this judgment. First, some of the key scientific questions, e.g., effects on soils, forests, biological species, watersheds, and materials and structures, require very long periods of time to document. Second, the physical, chemical, meteorological, and biological phenomena involved in acid deposition are remarkably complex; many years of scientific study will be required to understand the phenomena adequately, especially if one requires verification of models and laboratory prediction by field study. Third, the resources and time required to design and develop improved control measures and to appreciate the response of ecosystems to change are also considerable. Finally, there is growing realization that acid deposition is just one of a class of interrelated problems, e.g., ozone, trace metals, carbon dioxide, visibility, solid waste disposal, and water quality, that society must confront over the long term if the quality of the global environment is to be preserved and enhanced.

Accordingly, the Review Committee takes the position that continuing investment in a long-term research program is required regardless of the policy decisions which are taken or are not taken during this decade. The Committee's recommendations are designed to improve the long-term effectiveness of the research program. Policy makers should clearly understand that a sustained program,

requiring resources substantially in excess of current levels, is the only course of action which will produce information of practical value in the short-run and which will also generate knowledge in the long-run that will provide a comprehensive basis for dealing with the problem of acid deposition.

B. Review Committee Procedure

The Ad Hoc Review Committee held five meetings for a total of nine days. The Committee reviewed past studies on acid deposition (see Appendix C), and met with representatives of the Joint Chairs (Department of Agriculture, Environmental Protection Agency and National Oceanic and Atmospheric Administration) of the Interagency Task Force on Acid Precipitation. Extensive briefings were provided to the Committee by the NAPAP program office staff and by each of the ten NAPAP Task Groups. In addition, the Committee met the Chairman and the review panel leaders of the two NAPAP peer reviews which have been held. The Committee also benefitted from a briefing on the research activity of Electric Power Research Institute (EPRI) and this organization's views of the NAPAP program, the need for expanded research, and the prospects for improved control technologies.

Throughout the Review Committee's deliberations, all of the agencies and individuals involved in the NAPAP program were extremely cooperative. The Committee is greatful for this cooperation and wishes to thank especially Dr. Chris Bernabo, Executive Director of the NAPAP program, for his efforts in arranging constructive meetings with all of the participants in the NAPAP program.

C. Outline of this Report

The body of this report consists of three major sections. Section III consists of a description of how the present interagency NAPAP system works and discusses its strengths and weaknesses. Section IV is devoted to discussion of some outstanding technical issues in the NAPAP program which the Review Committee believes are not receiving adequate attention. The changes recommended by the Committee to the NAPAP program are presented in Section V separated into the areas of management changes, revised budgeting procedures, key areas requiring expanded resources, control technology, mitigation strategies and improving the quality of NAPAP's basic science component. An Executive Summary of the Committee's conclusions and recommendations is provided in Section I of the report.

III. Description of the Present NAPAP Program

A. How the present interagency system works

The NAPAP program is run by an Interagency Task Force composed of twelve agencies. These include the Departments of Agriculture (DOA), Commerce (DOC), Energy (DOE), Health and Human Services (HHS), Interior (DOI), State (DOS), and the Council on Environmental Quality (CEQ), Environmental Protection Agency (EPA), National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), National Science Foundation (NSF), and Tennessee Valley Authority (TVA). The business of the Task Force is conducted by the "Joint Chairs" filled by representatives of the heads of three agencies, DOA, EPA and NOAA. There is an interagency Program Coordination Office, housed in CEQ, which manages the interagency program and provides staff support. support. In addition, there is a legislative requirement for four public members and representatives from four national laboratories: Argonne, Brookhaven, Oak Ridge, and Pacific Northwest. An organizational chart of the interagency program is included in Appendix D.

The work of the NAPAP program is carried out by ten Task Groups each of which is chaired by a representative of a "coordinating" agency. The ten task groups and the coordinating agencies are:

Task Group	Coordinating Agency
A. Natural Sources	NOAA
B. Man-made Sources	DOE
C. Atmospheric Processes	NOAA
D. Deposition Monitoring	DOI
E. Aquatic Effects	EPA
F. Terrestrial Effects	DOA
G. Effects on Materials and Cultural Resources	DOI
H. Control Technologies	EPA
I. Assessment and Policy Analysis	EPA
J. International Activities	DOS

There is a Research Coordination Council, composed of the task group leaders and agency representatives, which oversees the work of the task groups and coordinates their activities. The Council is responsible for developing the NAPAP research plan and for preparing an annual interagency budget request.

1. The present research plan--Participants in the interagency process are responsible for developing the objectives and research plans of the NAPAP program. A ten year "National Acid Precipitation Assessment Plan" was prepared in 1981 as were supporting documents on "Research Goals and Objectives" and "Major Deliverables." These documents describe the results expected from the research activity and how the outputs of the individual task groups relate to each other. The 1982 NAPAP Annual Report to the President and Congress summarizes the program in some detail and establishes three important milestones for integrated assessments to be prepared in 1985, 1987, and 1989. In general, the existing NAPAP research plans adopt relevant objectives and define the important research issues involved in the origins and effects of acid deposition.

2. Management of the research activities--The process of establishing research objectives and plans is carried out by an interagency process. The work plans of the individual task groups are determined through a negotiating process between the coordinating interagency process and the participating agencies. Thus, the NAPAP program is technically decentralized, with the research effort determined by compromising what the Research Coordination Council views as important and what each participating agency views as important. This situation results in part from legitimate concerns of the various participating agencies about those aspects of the acid deposition problem that are most closely related to their agency's mission, about their own research priorities and the need to maintain their in-house research organization. In part, the decentralization results from the method of funding the NAPAP program, discussed below.

In principle, the technical direction for the NAPAP program comes from the Joint Chairs and the task group leaders meeting at the Research Coordination Council. It is important to realize that none of these individuals devotes full time to the NAPAP effort. However, there is an Executive Director who is full time and has a staff of four individuals.

3. Technical review process--The NAPAP program has built a high quality system of independent peer review. There is an open annual meeting at which all of the projects undertaken by NAPAP

are reviewed by a panel which is organized according to the task groups. To date, three program peer reviews have been held: in Fredericksburg, VA in September 1982; Raleigh, NC in February 1983; and Boston, MA in August 1983. They not only provide a technical review of all ongoing projects but, equally important, these meetings are an opportunity for informal communication among the scientific researchers in the NAPAP program.

The Review Committee believes that these periodic technical reviews are of great value and should be continued. An important question about the periodic peer reviews is the manner in which the recommendations of the review panels should be implemented. There is a need to strengthen the process for following up the recommendations of the peer review panels and assuring that meritorious suggestions are addressed and actually adopted. The present interagency structure does not possess sufficient authority over the agency programs to enforce many of the reasonable recommendations made by the peer review panels.

4. The funding mechanism--At present, the budget for NAPAP is established by OMB review of a joint interagency submission. The interagency submission is constructed from requests from the participating agencies through the task groups and the Research Coordination Council. When OMB approves a budget level and associated program, the agencies are required to carry out the program within their existing agency research resources.

The consequences of this practice are far reaching and very detrimental to high quality research on acid deposition. The reason is simple: each agency is effectively funding, out of its research base, an interagency research program over which it has only partial control and interest. At a time when the research base of most of the participating agencies is eroding, the NAPAP program is viewed to be a not entirely welcome competition for resources which address other research and development issues of importance to the agencies. The inevitable result is that (a) the agencies seek to substitute work and research performers, i.e., their in-house laboratories, which are not central to key acid deposition research or of the highest quality, and (b) the agencies are reluctant (EPA is an exception) to propose or accept pertinent new work for fear that it further erodes their base research program. The outcome is that the NAPAP research proram is far less effective and less flexible than it should be to achieve its goals.

A serious consequence of this funding method is that the task group leaders effectively do not have authority over the research program that they are expected to direct. Several task groups have

projects funded by several agencies, e.g., in FY'83 Task Group D, Deposition Monitoring, had its $4 million budget split between four separate agencies. The fact is that the research program of each task group is limited by what the individual agencies are willing to do and willing to support. This means that the task group leaders and the Interagency Task Force have little ability to select work or change direction when it would be in the best interest of the overall research effort. Such authority is essential to maintain quality control.

Thus, the present funding and budgetary control procedure is a fundamental flaw in the NAPAP program. It should be revised to provide (a) "new" research funds to the participating agencies so that the NAPAP program is not seen as competing with existing agency research needs, and (b) authority for the task group leaders to carry out the research program approved by the Interagency Task Force through its Joint Chairs to permit the best research to be undertaken by the most qualified research performer.

In sum, while the existing joint submission of an interagency budget with OMB review is an excellent way to formulate an integrated program which involves diverse scientific disciplines and agency interests, the present manner by which the budget support is provided effectively removes authority from the task group leaders, who are responsible for the research program, and impairs the effectiveness of the overall research effort.

B. Strengths of the present approach

The NAPAP program has been in existence for over two years. The progress which has been made during that time is good. Such progress is not easy, and the NAPAP program is respected both by this Review Committee and by much of the external scientific community.

The interagency process which has been established to manage NAPAP has many advantages. In particular, an effective forum has been established to coordinate the views and research activities of the various agencies. Such coordination is absolutely essential to the success of the program, which must integrate diverse research results which are sponsored by many different agencies. The Review Committee believes that the interagency process is particularly appropriate for the research activity of NAPAP, especially an activity composed of relatively small projects. The process is less satisfactory for the functions of integrating research results, assessment, and technical analysis to support policy formulation and for the design and execution of larger-scale, multi-year projects.

C. Weaknesses of the present approach

The NAPAP research program has made commendable progress durin, its relatively brief existence, but there are some important weaknesses. Repairing these weaknesses will lead to a more effective research program over the long-term.

Perhaps the central weakness of the NAPAP program is that there is no single technical individual in charge of the entire effort with both the responsibility and the authority to execute and integrate the program. It is noteworthy that neither the Joint Chairs nor the task group leaders devote full time to their NAPAP responsibility or view NAPAP as their principal job. The lack of NAPAP management control over funds has been discussed above. Such a decentralized, interagency program is not likely to be capable of undertaking major projects which require disciplined attention to schedule and costs. Nor is the present structure likely to be capable of integrating diverse research results in a manner which addresses, in a timely fashion, the short-term concerns of the policy maker. The problem is aggravated by the inordinate expectations of policy makers as well as the lack of "new money" at a time when larger projects, e.g., survey of resources at risk, monitoring, large-scale experiments, are being proposed.

The pressure to undertake large, more short-term projects at a time when agency research budgets are shrinking results in both inadequate attention to basic science in the program and a tendency to favor in-house laboratories at the expense of the broader scientific community in industry and especially universities. Moreover, the effort to stretch inadequate resources to cover the vast array of acid deposition problems has resulted in projects that are underfunded and too short in duration. A research program which is characterized by such sub-critical projects cannot be expected to attract the highest quality technical people.

D. General findings on the present NAPAP efforts

The judgments of the Review Committee about the present NAPAP effort largely follow from the strengths and weaknesses of the NAPAP program mentioned above. Some of the salient findings of the Review Committee follow:

(1) The assessment milestones of the NAPAP plan in 1985, 1987 and 1989 are unlikely to be met in a satisfactory way. Given the level of resources provided, the complexity

of the acid deposition problem and the need for indepth systematic field study, the present NAPAP milestones as summarized, for example, in the 1982 NAPAP Annual Report are too ambitious.

(2) Insufficient attention is being given to the verification of atmospheric process models (which relate emissions to deposition) and to the development and verification of biological effects models. Since these models are key to the evaluation of trends in acid deposition and proposed control strategies, inadequate attention to veritification is most serious. A principal reason, which leads the Committee to believe that adequate assessments will not be available in 1985 and 1987, is the absence of a field measurement program which would need to be in place now if verified models were to be available in 1987. Also, field confirmation will take considerably more time than has been allotted.

(3) Insufficient attention is being devoted to the integration of the research results of the various task groups into an overall assessment. At present, relatively little intellectual effort is underway to combine research results in a manner that will lead to understanding at a higher level of aggregation than individual projects. Up to the present, Task Group I (Assessment and Policy Analysis) has spent most of its effort in assembling research material rather than in doing research which builds on the results of the other task groups. This circumstance is an inevitable result of the NAPAP interagency process. Intellectual leadership is required here.

(4) The NAPAP program is devoting too little attention to international cooperation on acid deposition research. The Review Committee believes that more could be learned by additional international cooperation, especially with Canada, England, Germany, Sweden, Norway and Japan. Other nations have done more research than has the United States (US) on some subjects, e.g., Sweden has an extensive liming program, and Norway and Germany have been studying the effects of acid rain on forests for many years. Moreover, if understanding of acid deposition is to be considered satisfactory, the models should be transportable to other areas and still provide reliable predictions with appropriate change of input data. The proposed US program on acid deposition is quite self-contained. It is not planned as a cooperative effort with various European countries, even though acid deposition

problems seem especially severe there. Our research program for 1985 does not explicitly consider this or the European response to it. In some crucial aspects of the ecological impact problem this is especially regrettable. Thus, German and central European forests have been subjected to even greater stresses from sulfur oxides and other atmospheric pollutants than have our own. Understanding the relationship of this pollution to widespread forest damage in those countries would seem to be critical to understanding what may be or become at risk here to unmanaged soils and forests.

(5) The status of atmospheric modelling remains primitive. Present models for acid deposition are forced to use rather rough parameterizations because of insufficient knowledge of relevant atmospheric chemistry, dry deposition, cloud physics, upward transport out of the mixing layer, etc. Therefore a priori confidence in the detailed predictions of models is not yet warranted. Rather, a record of successful testing and evaluation of various extensive data bases on air and precipitation chemistry taken simultaneously over several years would be needed to "verify" a model. Except perhaps for sulfate and nitrate in precipitation, however, such data bases are not yet available. Although very general features and trends for acid in precipitation should be reasonably described, particular source-receptor correlations for emission changes are much more questionable. Models should play a more crucial role both in the design of experiments and in data analysis. Support is needed for such developments and for incorporation of deeper understanding of extended data bases as they become available. But, in the absence of such, the use of present models with the intent of quickly offering detailed answers for near-term policy decisions is risky.

(6) Control technology is a central component of the acid deposition problem and is currently not included in the NAPAP program. The Federal funding level for development and demonstration of new control technology should be increased substantially to complement on-going industry commitments. The development of new and improved, retrofitable, emission control technologies followed by successful pilot- and demonstration-scale testing, is of key importance in the potential long-term mitigation of acid deposition.

A number of improved control technologies to reduce source emissions are under development at various scales of operation. All have incremental associated capital and

operating costs which must be compared to the present scales of development and accumulated operating experience. The urgent need for a technically sound basis to evaluate the benefits and costs of these control options and tightened regulations requires an accelerated national program of development and demonstration over at least the next five years.

These developmental processes include (a) physical and chemical coal beneficiation (cleaning) prior to use, (b) combined SO_2 and NO_x removal, either though furnace sorbent injection (limestone, dolomite, etc.) in conjunction with staged combustion or though development of improved flue gas cleanup (scrubbing) processes, (c) modification of pulverized coal furnaces to fluidized bed combustion having much lower SO_2 and NO_x emission characteristics, and (d) intensive coal cleanup through conversion to clean synthetic petroleum or solid fuels. In addition, increased research emphasis should also be placed on the impacts of these retrofitable processes on water quality, and the quantity and the quality of solid waste produced.

Because control technology is integrally related to combustion system design and because of the magnitude of the required R&D effort, the Review Committee recommends that the federal focus for this national program be the DOE and that it be planned and implemented in conjunction with the private sector. EPA should maintain its current support role in technology development, thus avoiding conflict of interest while maintaining a strong information base for regulatory decision making.

A major Federal program (several tens of millions of dollars per year) for development and demonstration is needed in addition to basic research support for longer-term fundamental studies. These studies include the general areas of coal clean up, combustion control, post-combustion monitoring, effluent identification, and novel techniques for cleanup.

Both furnace sorbent injection and fluidized bed conversion are two promising process developments which particularly require expanded development and demonstration efforts. This will resolve remaining engineering uncertainties and will provide confidence on commercial application to both new and existing combustion sources by the end of this decade.

The importance of this expanded emission control development and demonstration program is underscored by the fact that approximately 40% of the total cost of a coal-fired power plant today is related to environmental control. The results of the proposed program will support accelerated resolution of this perceived conflict between coal and the environment, while avoiding unnecessarily expensive and inefficient solutions which freeze control technologies in today's plants.

(7) Mitigation--The subject of mitigation is not adequately treated in the current program. Scientific feasibility studies of mitigation strategies prior to possible field implementation should be developed. Mitigation programs for aquatic, terrestrial and materials effects may be carried out in the future. Before extensive experimental mitigation studies, such as lake liming, are undertaken, intensive baseline data collection is required. The appropriate task groups should support such data collection to study the feasibility of mitigation to their corresponding effects. Research additions to the aquatic and terrestrial task groups should be made to fully utilize data obtained from foreign and domestic liming programs currently underway.

(8) Basic science is of great importance to the NAPAP effort and is receiving too little attention. To understand the impact of any environmental change requires information on the magnitude of the change itself, the resources at risk and the resiliency of these resources. All three of these areas have components of applied and basic science that are poorly addressed by the NAPAP. Previous statements in this document have discussed how to improve the applied assessments program of the NAPAP. However, assessments depend upon our basic understanding of how acidic deposition interacts with the receiving systems-aquatic ecosystems, terrestrial ecosystems and materials. If the fundamental knowledge is lacking, the assessments will be weak, improperly formulated and counter productive. To insure that current assessments will be reasonable and that future assessments will be better, the basic science component of the NAPAP must be strengthened. Specifically:

1. The basic science program should be a stable, long-term component of the NAPAP. Since progress in basic science is achieved over longer time scales than are assessment activities, the management of the NAPAP should be structured

so that the basic science program will be protected from interruptions in funding and from the more immediate concerns of the assessment activities.

2. The Federal Interagency Task Force should be involved in the basic science activity. Since our understanding of the interaction of acidic deposition with receiving systems requires the involvement of most scientific disciplines, strong interaction among federal agencies is required to have a balanced research effort. Each task group should have a full time individual, with control of financial resources, who works with other task group leaders and the Director of Research to ensure such an approach is successful. Once the general goals and resource availabilities have been established, the task group leaders should rely on universities to manage and to perform the research.

3. The basic science research program managed by the North Carolina State University (NCSU) Acid Precipitation Program should be expanded and emulated. This program has received high reviews for both the quality of its management and its basic research. It has been the only program of the NAPAP to bring in new scientists in a coordinated manner to address basic questions regarding acid deposition. If future advances are to be made in our basic understanding of the impacts of acid deposition, programs such as the NCSU must be continued on a long-term basis.

The expanded basic science program will improve knowledge of the basic processes and mechanisms occurring in natural ecosystems and accordingly will strenthen the ability to assess the impacts of future environmental changes.

(9) Scientific communication should be strengthened. The NAPAP peer review panels have noted that NAPAP project investigators were not always cognizant of available research results, and that there is not adequate communication between task groups on subjects which are necessarily related. The single most important mechanism to assure both credibility and use of research results is publication in peer reviewed scientific journals. The Review Committee strongly urges that the communications among the task group project investigators be strengthened and that all investigators be encouraged to publish their results in the peer reviewed scientific literature.

In addition to these general conclusions of the Review Committee, there are several more specific technical issues deserving attention that emerged during the Committee's deliberations. These issues are discussed in the next section.

IV. Some Outstanding Technical Issues in the NAPAP Program

Listed below are several technical questions which the Committee believes require greater emphasis within the NAPAP program. In many cases these issues have not received adequate attention because of the limitation on the resources which have been devoted to the NAPAP program. In certain cases, the gap exists because the NAPAP program organization and research plan is compartmentalized. A summary of the budget of the NAPAP program is included in Appendix E. The Committee recommends that the Joint Chairs charge the NAPAP program to evaluate the status of each of the technical issues mentioned below and to recommend steps to repair existing deficiencies.

(1) The resources at risk need to be better defined by detailed geographical surveys; emphasis should be placed on lake watersheds and forests.

(2) High quality, long-term (20 years needed) study of the in situ biological response of fish, forests, and soils are of major importance to the program.

(3) Studies on acid deposition induced chemical effects on lakes and streams, coupled with watershed and soil response, are urgently needed on an ecosystem basis.

(4) Expanded air monitoring is required for model verification; this is a major gap in the program.

(5) Accurate methods for dry deposition monitoring in the field must be developed before establishing a monitoring network.

(6) The present NAPAP effort on man-made sources must be strengthened, especially quality control on the source inventory.

(7) Significant attention should be devoted to the relationship of acid deposition phenomena and effects to other atmospheric pollutants, e.g., ozone, trace metals.

(8) Additional laboratory and field experiments are needed to elucidate the mechanisms of the chemical transformations which occur in the atmosphere; more work on cloud processes is also desirable.

(9) Basic studies of the mechanisms and extent of materials damage by corrosion from acidic substances should be initiated. There have been few significant studies on the influence of acid rain on the mechanical properties of materials. There are no quantitative data on the effects of pH and composition of acid rain or fog, and time and temperature of exposure under conditions of stress, strain and alternating stresses. The least studied of these phenomena is corrosionfatigue of materials in acid rain environments. Corrosion-fatigue will occur even in environments in which stress-corrosion cracking does not occur.

(10) Adequate baseline data should be gathered for the assessment of the effects of possible mitigation strategies, e.g., lake liming.

The preceding list, in conjunction with the general findings presented in Section III D, summarizes the major gaps and deficiencies that the Ad Hoc Review Committee found in the NAPAP program. Most of these gaps and deficiencies can be removed by management attention, additional resources, and time.

V. Recommended Changes to the NAPAP Program

In this section the main recomendations of the Ad Hoc Review Committee are presented.

A. Management changes - A proposed two-tier approach to acid deposition R&D

The limitations of the present decentralized management approach of the NAPAP Program have been discussed in Section III C. These limitations include (a) the absence of a single technical manager with both the responsibility and authority to carry out a research program of high scientific quality which is responsive to key policy issues and the schedule for their resolution, (b) an organization which does not have sufficient technical and administrative support to undertake larger projects and applied studies, and (c) lack of authority and intellectual leadership to address the demanding technical issues of integration of research results and quantitative assessment of alternative courses of action for dealing with acid deposition. The Review Committee believes that strengthening the management and organization of the NAPAP program is an essential prerequisite for realizing major improvement in the acid deposition research effort.

In principle, the Review Committee favors a management structure for an applied R&D program in which a single technical individual is in charge and where the program is located primarily in a single agency. Such an R&D organization is most likely to yield effective research results.

The Ad Hoc Review Committee does not believe that it is feasible to adopt, at the present time, a centralized lead agency approach for the NAPAP program for two reasons. First, the acid deposition problem involves the direct and legitimate interest of too many agencies to permit a single agency to acquire full control of the program. Second, the NAPAP interagency approach is basically functioning well, and it would be a mistake to undertake a major reorganization which would almost certainly interfere with a research process that is gaining strength. Indeed the Review Committee is eager to see steps taken to strengthen the interagency process.

In sum, any management structure proposed for NAPAP must balance a centralized and decentralized approach. Thus, no ideal solution to the management organization is likely to exist. The Review Committee has arrived at a proposed two-tier approach which it believes strikes an appropriate balance and, most importantly, provides the opportunity for a much more effective and high quality research program.

<u>The essential feature of the two-tier approach recommended by the Review Committee is that certain functions be removed from the task group structure and assigned to a new, full-time, high-level technical manager housed in EPA. These functions are</u>:

1. Technical support to policy development.

2. Integration and Program Assessment (presently Task Group I).

3. Broad research guidance to the NAPAP Research Coordination Council.

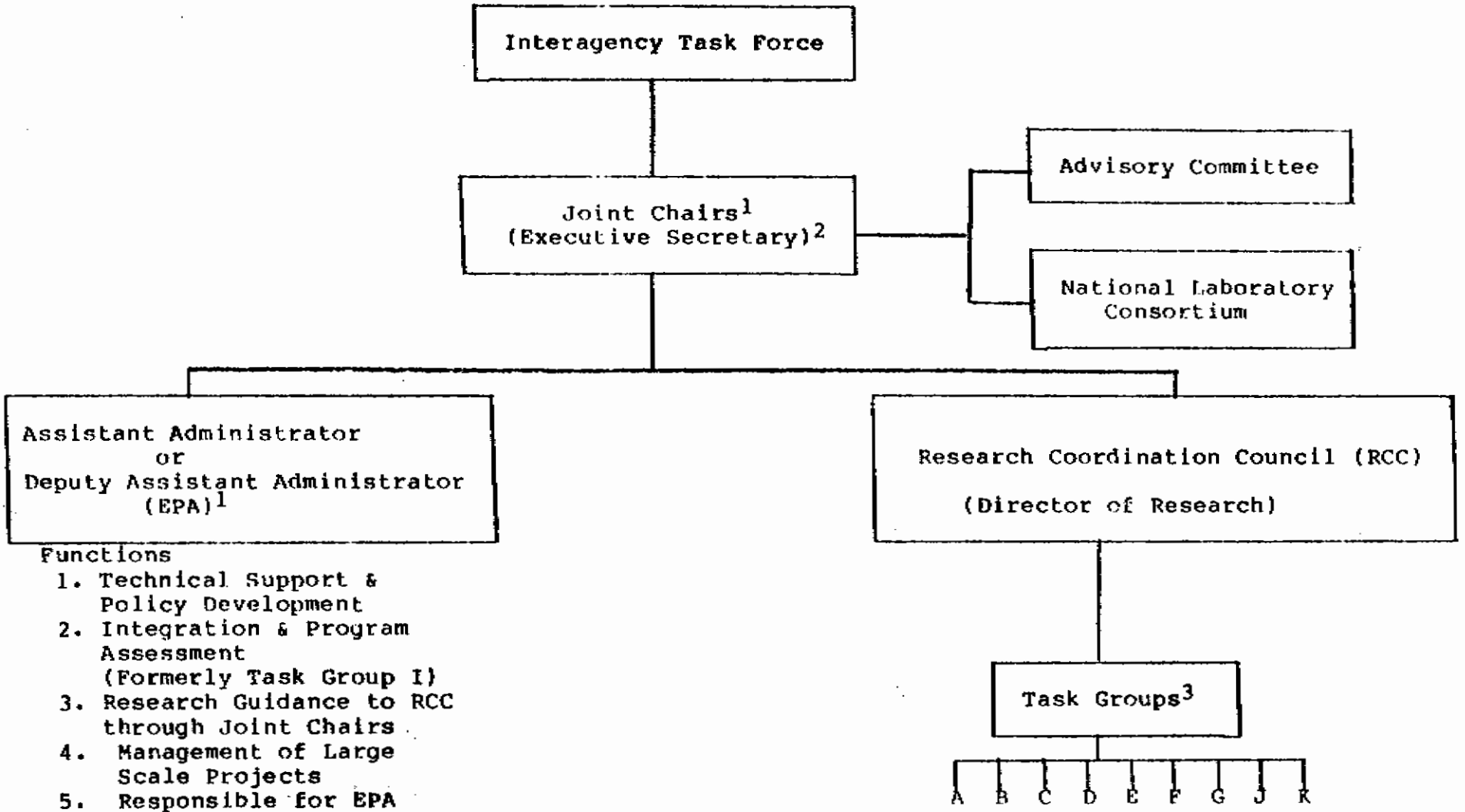
4. Management of large scale projects and research studies which require project management and administrative or technical support.

This new position would be at the level of Assistant Administrator (AA) or Deputy Assistant Administrator (DAA) within EPA, and the individual would be the EPA Administrator's representative at meetings of the Joint Chairs. The title of this new full-time

position should be something such as Director of Assessment of the NAPAP Program. The relationship of the Joint Chairs to the Interagency Task Force would remain unchanged, although the full-time EPA Director of Assessment would act as convenor of the Joint Chairs. In addition, this new EPA AA or DAA would be responsible for the performance of work by EPA under the sponsorship of the task groups. The EPA manager would also be able to draw on EPA administrative resources and external technical support contractors to carry out the functions of (2) program integration and assessment and (4) project management. A proposed NAPAP organization chart is attached.

There are several advantages to the proposed new management structure. With regard to the assessment tier the advantages are first, a single individual would be responsible for many of the technical aspects of the NAPAP program. This person would be in a position to implement larger scale projects, for example, the design and operation of deposition monitoring networks, which are likely to be a progressively greater part of the NAPAP program. Second, the critical function of program integration and assessment would be strengthened and would receive the greater emphasis which this function deserves. Third, a mechanism would be created for providing short-term technical support to policy makers. This function is very badly needed at a time when many different policy proposals are being put forward. But, the function of short-term technical support to policy deliberations must not be permitted to interfere with the on-going research program; the proposed two-tier arrangement avoids this danger. Fourth, the strengthened assessment activity will permit improved research planning and resource management in the NAPAP program. It is anticipated that the new Director of Assessment will be in a better position to provide research guidance to the Research Coordination Council because of the additional intellectual effort that will be devoted to integration of existing research results and to assessments.

Fundamental research should also benefit from the proposed two-tier approach. First, the on-going, largely effective, interagency process for undertaking research would remain in place. To some extent the separation of the assessment function from the research activity should improve the ability of the program to direct its efforts toward addressing key research questions without the distractions of entering into short-run policy debates or attempting to manage larger projects on an interagency basis. Second, the proposed separation should provide some degree of protection for the research budget from the growing demands to fund large scale, more applied projects such as monitoring networks or resource surveys. In sum,



[1]EPA Convenor of Joint Chair Meetings
[2]Executive Secretary--CEQ member liaison to policy makers
[3]Task Group I (Integration and Program Assessment) to DAA EPA; Task Group H to DOE; new Task Group K on Mitigation to DOI

PROPOSED NEW MANAGEMENT STRUCTURE FOR NAPAP

the Review Committee anticipates that the proposed management structure will strengthen the ability the NAPAP research program to address fundamental scientific issues relating to acid deposition without the distraction of short-run policy response. The proposed management structure is intended to facilitate the existing inter-agency process for carrying out research with greater emphasis on long-term fundamental work.

The proposed management structure has some disadvantages which should also be considered. First, there will be some who argue that locating the proposed new Director of Assessment in EPA gives rise to an apparent "conflict of interest" since this agency has a bias toward regulation which will influence its evaluation of acid deposition issues. The Review Committee believes that it is essential for the Director of Assessment to be housed in a single agency to assure that there is adequate support to perform the designated functions. The selection of EPA seems most logical to the Committee, although arguments can be advanced both for and against the choice of another agency.

The second disadvantage of the proposed management structure is that it may be viewed by some as downgrading the interagency process or the research focus of the present NAPAP effort. As discussed above, this is not the intent of the proposal. The main reason for the two-tier approach is to provide a structure for carrying out functions, especially integration and project management, which cannot effectively be carried out by a decentralized, interagency organization. The Review Committee affirms its support for the interagency process to carry out the research program and believes that the present arrangement will lead to a strengthened scientific base over the long-term.

The Review Committee also recommends the establishment of a technical advisory committee for the NAPAP program. Such an advisory committee can be of great benefit to the program. The advisory committee can provide top-down technical advice to the Joint Chairs concerning the effectiveness of the research program. The committee should also have a special responsibility to assure that the level of resources provided for fundamental research is adequate to the long-term objectives of the research program. Most importantly, the advisory committee would function as an important communications link between the scientific community and the national program. This communications function would serve to strengthen the scientific program and to assure both that the concerns of the scientific community were heard by the NAPAP programs and that the purposes of the NAPAP program were better understood by the broader scientific

community. The advisory committee would be of value to the NAPAP program managers and would increase the credibility of the program in the scientific community.

B. Revised budgeting procedure

In Section III.A.4, the present method of funding the NAPAP program was described. From this discussion, it is evident that major changes should be made in the manner by which acid deposition research budgets are provided. If these changes are not put into place the result will be that (1) the participating agencies will progressively refuse to undertake NAPAP work because it displaces significant research activities which they view as more central to their agency's mission and/or (2) the agencies will continue to label work and research performers as "acid deposition related" in order to protect their base research activities or in-house laboratories. Continuation of the present practice of funding NAPAP research out of (declining) agency research budgets will lead to bad research. The present mechanism for funding NAPAP research from agency research budgets undercuts the Administration's stated interest in supporting research on acid deposition.

A second important adverse consequence of the budgetingsystem is that task group leaders do not have effective control of the funds required to carry out their approved research programs. This is because the task group projects are placed into the budgets of several agencies after a negotiation process over which projects and performers will be supported. A task group leader cannot change a project or select a different research performer without the agreement of the agency, which frequently is reluctant to shift resources away from projects that serve agency interests.

A major revision of these budgeting procedures is required. The revision must be based on three premises:

(1) Substantial additional resources will be required to support acid deposition research over the next several decades.

(2) The acid deposition research budget must be provided as "new" money to the participating agency and not from the existing, declining research programs of these agencies.

(3) The task group leaders and the new proposed Director of Assessment in EPA must have control over the NAPAP approved budgets for which they are responsible. They should be dedicated full time to their functions.

The revisions required to achieve these objectives can be made by strengthening the existing interagency budgeting process through OMB. At present, OMB reviews an interagency budget request submitted by the Joint Chairs. The problem with the existing approach is that OMB does not fund the research by adding resources to agency budgets but rather directs that the NAPAP program be carried out within existing agency budget levels. The Review Committee recommends that, following OMB review of the interagency NAPAP budget submission, OMB add the approved funding levels to agency budgets in the final passback to the agency. In this passback the funds added to the agency budgets must be earmarked for exclusive use by the NAPAP program. The expenditure of the funds should be under the authority of the task group leaders and the Director of Assessment, subject to approval by the Research Coordination Council and/or the Joint Chairs. These changes would assure that more effective research would be undertaken with greater flexibility to pursue emerging ideas and to attract the most qualified research investigators.

The FY'84 NAPAP budget level is $27 million. The Review Committee believes that any additions above this level must be provided as "new" money into the participating agency budget and not from the existing research base of the participating agencies.

It is difficult to specify precisely the level to which the NAPAP research program may need to grow. However, the Review Committee is certain that substantial additional resources will be required, over a period of time, to answer the important technical questions. It is of fundamental importance that Administration officials recognize and accept that the research program will require a long-term commitment and that erratic increases or decreases in the allocated budget be avoided. Accordingly, the Review Committee favors a slow but sustained growth of the NAPAP research effort rather than a crash expansion.

The Committee is especially concerned that large projects (estimated total cost in excess of $5 million not be undertaken until the following six steps are taken. These include:

(1) Preparation of a written research plan describing what is to be done, why it should be done, and how it will be done.

(2) Independent technical peer review of the research plan. Preparation of an adequate research plan will typically require significant resources.

(3) Description of how the project will be managed.

(4) Preparation of an estimated cost and time schedule to complete the project.

(5) Designation of a single technical individual who is reponsible for the project.

(6) Provision made for analysis and dissemination of results.

The Review Committee expects that over time the NAPAP program could grow to a level of approximately $100 million per year for several years. However, it will take some time before the NAPAP program can effectively employ such a resource level. The Committee's recommendations for the FY'85 NAPAP budget level have been transmitted separately by letters dated October 21 and November 16, 1983 to the Joint Chairs (See Appendix F).

The manner in which such a resource level should best be deployed depends, in part, upon the research activities undertaken by industry, states, and foreign governments. The Committee encourages the NAPAP program to continue to coordinate its research activities with these entities and with EPRI and to cooperate on particular projects and programs where appropriate.

C. Key areas requiring additional resources

The Review Committee has stressed in this report its view that the acid deposition research program is underfunded relative to the complexity of the scientific issues which should be addressed. In this section, the Committee wishes to draw attention to certain key areas which require additional resources and greater emphasis in the programs. These key areas are:

1. Integrated Assessments;

2. In-depth studies (requiring perhaps 5 to 10 years of field measurements) of aquatic and terrestrial effects particularly soils, forests and watersheds;

3. Verification of source-receptor models, including ambient (ground and elevated) air quality, event wet deposition, and dry deposition monitoring.

D. Control technology

As discussed in Section III.D, little attention has been devoted to control technology within the NAPAP program. Yet controls are essential to coping with acid deposition.

The process of developing new control technologies for coal cleaning, combustion, and clean-up should be central to the design of combustion systems and requires analysis of trade-offs between capital costs, fuel type, etc. The development of a control technology within a combustion system requires substantial R&D (hundreds of millions of dollars) at the required scale (hundreds of megawatts) and substantial time to yield reliable test data on cost and performance. For these reasons, the Review Committee believes that advanced control technology development should be primarily a DOE responsibilty. The Review Group recommends that DOE be given the task, outside of the NAPAP program, to formulate a comprehensive and aggressive program, in cooperation with industry, for advanced control technology development. NAPAP's role in control technology should be limited to awareness of developments in the technology and in the trade-offs possible; the NAPAP program should not undertake control technology hardware programs. The responsibility for developing cost-effective control technologies should be assigned to DOE.

E. Mitigation strategies

The Review Committee believes that before embarking on large-scale liming or other mitigation programs, it is essential to study the effects that such actions have on ecosystems. To prepare for assessing the consequences of possible mitigation programs, a substantial amount of research is needed (including field experiments) by appropriate task groups.

F. Improving the quality of the basic science

The Review Committee is concerned that insufficient emphasis is being given to maintaining the quality of the long-term fundamental research, which must be an important component of any national effort on acid deposition. In particular, the Committee believes that insufficient attention is being given to supporting research of a fundamental nature which is relevant to the long-term objectives of the NAPAP program but which is not narrowly directed to task group needs. Such research is of major long-term benefit to the NAPAP program because it stimulates new ideas that test the mainline NAPAP research approach. Research of this type, which is largely performed in universities, should be supported through a peer

reviewed grants program. The Review Group recommends that a grants program of approximately $10 million per year be established within the NAPAP program with an initial level of $5 million in FY'85.

The Acid Precipitation Act of 1980 included an authorization of $5 million per year to NOAA to fill gaps in the NAPAP. The Committee recommends that this money be appropriated in FY'85 through the existing authorization, which has never been appropriated. The money should be used to fill important basic science needs of NAPAP. The allocation of these funds should be managed by the Director of Research for the Research Coordination Council.

The Committee recommends that in FY'86 and beyond the authorization be increased to $10 million per year.

APPENDIX A

SCIENCE ADVISORY BOARD
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APPENDIX B

Terms of Reference
for the Ad Hoc Committee to Review the National Acid Precipitation Assessment Program

The Administrator of EPA, NOAA and the Secretary of Agriculture have requested that an external group of scientific experts review the National Acid Precipitation Assessment Program (NAPAP) to assess its initial progress and future plans and to make recommendations on how the effectiveness of the program can be improved. The review panel is requested to complete its deliberations and report by 30 December 1983.

PURPOSE - To review and evaluate the technical quality and progress of the National Program and suggest future research.

CHARGE - Evaluate the strengths and weaknesses of the program, particularly the ability of the planned effort to answer the scientific questions most pertinent to policy development. The review will cover an examination of:

- Plans and Objectives: Are the objectives of the program clear, complete, and appropriate given the overall purpose of the research program? Are the objectives realistic? Are the plans responsive to the objectives? Are the resource allocations across and within major research areas adequate, excessive, inadequate? Do the schedules for results seem reasonable? Is there reasonable probability of success in meeting program objectives? Are there any overlaps, duplication, or gaps in the plans? Is there an appropriate balance between basic and applied research efforts?

- Implementation: How well does the management structure and process for planning and implementing work? Are the projects being performed and the various individual agency efforts well coordinated? Do the projects address the program's objectives? How well are the agencies working together? Are national objectives, not just agency mission requirements, being met?

- Applications: Will the planned program address the critical scientific questions most relevant to decision making? Do the plans and projects demonstrate progress toward usable assessments of the problem and possible solutions? Are the proposed assessments well conceived? Will the information generated be useful and of lasting scientific and policy-making value?

PROCEDURE - The Committee will pursue its inquiry through discussion with Federal officials reponsible for the research program, researchers in the program (both in government and non-government laboratories) and external experts. Attention will be given to the relevance of the program's current and planned activities to the urgent needs for better scientific information to develop sound policies.

RECOMMENDATIONS - The report of the ad hoc review panel may address any aspects of the research program. However, particular emphasis should be given to:

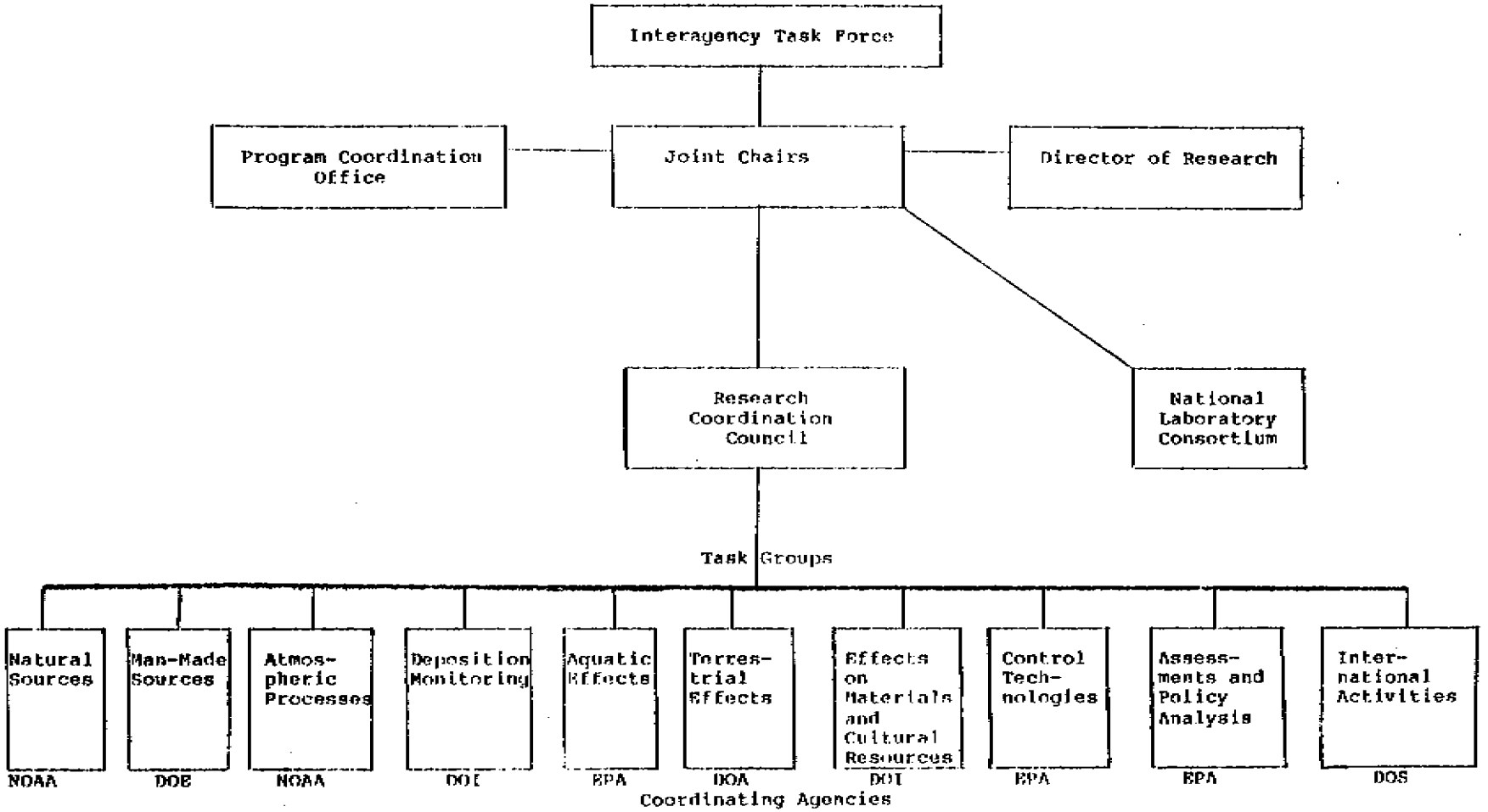
- identifying possible future research in scientific areas most relevant to policy concerns
- suggesting ways of improving the program and its management
- recommending how to ensure the outputs of the program are most effectively communicated and utilized
- indicating ways to strengthen the scientific quality of the program
- suggesting changes in the level and direction of effort in pertinent areas.

APPENDIX C

Some Pertinent Studies Related to NAPAP

1. NAPAP, National Acid Precipitation Assessment Plan, June 1982
2. NAPAP Annual Report, 1982
3. Report of the First Annual Review Meeting of the NAPAP, Fredericksburg, VA, September 1982
4. Report on the Effects Research Review Meeting of the NAPAP, Raleigh, NC, February 1983
5. Report on Atmospheric Review Meeting of the NAPAP Boston, MA, August 1983
6. Office of Technology Assessment Report, July 1982
7. National Academy of Sciences Study a) 1981 b)Calvert 1983
8. Jason Report
9. EPRI R&D plan
10. Working Groups under US/Canada Memorandum of Intent, 1983
11. Office of Science and Technology Policy Report, Executive Office of the President

INTERAGENCY TASK FORCE ON ACID PRECIPITATION



APPENDIX E

NAPAP BUDGETS ($000 BA)

Task Group	FY82	FY83	FY84
A. Natural Sources	600	700	955
B. Man-made Sources	1170	1350	1350
C. Atmospheric Processes	4863	5558	7097
D. Deposition Monitoring	3103	4803	5796
E. Aquatic Impacts	3017	3363	3913
F. Terrestrial Impacts	3583	4437	4437
G. Effects on Materials	485	985	1498
H. Control Technologies	--	--	--
I. Assessment and Policy	1365	1790	2375
J. International	--	--	--
	18,236	22,276	27,418

APPENDIX F

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

NOV 16 '83

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This letter conveys an interim report from your Ad Hoc Committee to review the National Acid Precipitation Assessment Program (NAPAP) concerning our judgments on the FY 85 interagency budget submission. The principal purpose of the review committee is to evaluate the technical progress of the NAPAP program and to make recommendations for change that will strengthen this vital national research program. Our final report, due to you before December 30, 1983, will address the progress of the NAPAP program in detail. This letter reponds to a request to comment on the proposed FY 85 NAPAP budget at a time appropriate for budget cycle consideration.

Throughout the Ad Hoc Committee deliberations we have been impressed with the complexity of the scientific and technical questions which must be answered in order to respond in a cost/effective manner to the acid deposition problem. The required technical program demands a sustained research effort which addresses both policy concerns and fundamental scientific issues. This research effort undoubtably deserves, in light of the potential environmental effects and the economic costs of control, much larger research budgets during the coming years. However many of the key scientific questions, e.g., long term biological and ecological effects, will require many years of research to answer, in part because of the time scale of natural processes; accelerated funding cannot in

all cases lead to better answers sooner. Thus, it is of paramount importance to establish a research program which is of the highest technical quality and recognized to require sustained support. It is essential to avoid the oscillation in research support which all too frequently affects programs that command momentary political attention.

We have reviewed the FY 85 budget from this viewpoint. The NAPAP interagency process has requested $82.027 million at level III and $35.247 million at level II for FY 85 compared to $27.468 million in FY 84. We believe that the program should receive, at most, a 100% increase in FY 85 to a level of about 55 million. Earlier we have advised Ms. Maloley and Mr. Alm as to the extreme importance of providing any increment above the FY 84 NAPAP level as "new" fenced money in the agency passback in order to avoid eroding the existing research base of the participating agencies and to assure that the best technical talent is applied to the unique problems of the NAPAP program. A copy of this letter is attached for your consideration.

The $55 million FY 85 budget which we advise evidently will require a choice among the several NAPAP proposed research projects which the interagency task force recommended as "essential" or "highly desirable" within their level III increment. Our committee has not done the work necessary to reach precise judgments on which of the proposed projects should be deferred. However the Committee wishes to note some projects which it believes would be especially valuable to include in any increment above level I. These projects are:

Task Group B: (1) third party verification of the man-made sources emission inventory;

Task Group C: (2) ambient air quality monitoring (similar in scope to the past SURE project);

(3) provision for participation in a large scale atmospheric field study (this could be either the proposed EPRI MATEX experiment, the DOE non-linear experiment or the EPA source receptor study);

(4) increased attention to laboratory studies which bear an atmospheric chemistry;

Task Group D: (5) augmentation of the wet deposition network;

(6) accelerated development of new reliable methods for measuring dry deposition;

Task Group E: (7) expansion and continuation of the survey of lake water quality and fish resources including watershed parameters;

(8) intensive ecosystem monitoring;

(9) scientific feasibility studies of mitigation strategies prior to field implementation; and

Task Group F: (10) quantification of significant changes in soil and forest productivity and stability due to acid deposition and other potentially damaging pollutants.

In addition, the Committee believes that advanced control technologies are of great importance to the acid deposition problem; this issue will be addressed in detail in our final report.

In the Committee's review it became apparent that the NAPAP program increasingly will be proposing larger projects of longer duration. For these projects (estimated total cost greater than $5 million) it is especially important that a process be established to assure five steps have been taken before project approval:

(1) Preparation of a written research plan describing what is to be done, why it should be done, and how it will be done.

(2) Independent technical peer review of the research plan

(3) Description of the management of the project

(4) Preparation of an estimated cost and time schedule to complete the project

(5) Designation of a single technical individual who is responsible for the project at each stage of development.

Finally, the Committee notes its concern that the perceived need to obtain basic data and answer near term policy concerns is outweighing increased attention to more fundamental scientific inquiry bearing on broader questions involving the mechanisms of pollutant transport, environmental damage, long term biological effects, and new control concepts. Since acid

budget. This will assume both a more effective and higher quality research program that will move this Nation to resolve the substantial scientific uncertainties over the long term.

Sincerely yours,

John Deutch, Chairman
Ad Hoc Committee to Review
the National Acidic
Precipitation Assessment
Program

cc: Mr. William Ruckelshaus
Mr. John Block
Mr. John Byrne
Dr. Courtney Riordan
Dr. Orville Bentley
Dr. Lester Machta
Dr. Chris Bernabo
Dr. Terry F. Yosie