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January 1989

Report of the Research Strategies Advisory Committee

Review of ORD's Core Research Areas

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

January 31, 1989 EPA-SAB-RSAC-89-013

Dr. John A. Moore
Acting Administrator
U.S. Environmental Protection Agency
401 M Street SW
Washington, D.C. 20460

OFFICE OF
THE ADMINISTRATOR

Dear Dr. Moore:

The Science Advisory Board (SAB) has reviewed the December, 1988 draft document ORD's Core Research Program--A Proposal. Our report, generated by our recently established Research Strategies Advisory Committee (RSAC), is attached.

The RSAC was formed at the request of Mr. Thomas to advise the Administrator on matters associated with the Research Strategies Council (RSC), a group of senior managers at EPA and chaired by the Administrator. The information in the accompanying report was shared with Mr. Thomas at the first meeting of the RSC on January 10, 1989.

The SAB applauds the Agency's efforts to restructure and redefine the basic approach to and conduct of environmental scientific and engineering research. This action is in accord with recommendations contained in the Board's September, 1988 report: Future Risk: Strategies for Environmental Research in the 1990s. The Board encourages that even broader, bolder strokes be taken in presenting these issues to a even larger audience. The effort should be viewed in the context of an overarching goal of risk reduction, which include anticipating future problems, as well as reacting to current conditions, and enlisting the contributions of the social sciences, as well as utilizing the resources of the traditional environmental sciences and engineering. These concerns are amplified in 11 specific recommendations in the report.

The RSAC members found the Agency to be open, receptive, and forthcoming throughout the review. We are aware that some of the SAB's comments have already been addressed in later drafts of the document. We believe that the augurs well for the future success of the RSC and the Agency's environmental research program.

We appreciate the opportunity to conduct this review and look forward to a formal response from you on your reaction to the contents of our report.

Sincerely,

Alvin Alm
Chair
Research Strategies Advisory Committee

Raymond C. Loehr
Chair
Executive Committee

SCIENCE ADVISORY BOARD
REPORT OF THE RESEARCH STRATEGIES ADVISORY COMMITTEE (RSAC)
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ABSTRACT

The Agency's Office of Research and Development (ORD), in following the recommendations outlined in the SAB's Future Risk report, has taken great strides in restructuring and redefining the basic approach to and conduct of environmental research at EPA. The RSAC applauds these efforts and encourages even broader, bolder strokes that will address fundamental changes in the way in which the entire Agency, the Federal government, and the nation perceives and reacts to environmental problems. The effort should be viewed in the context of an overarching goal of risk reduction, which includes anticipating future problems, as well as reacting to current problems, and enlisting the contributions of the social sciences, as well as utilizing the resources of the traditional environmental sciences and engineering. The emerging challenges, on a national and global scale, demand no less.

RSAC Review of ORD's Core Research Areas
January, 1989

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I. EXECUTIVE SUMMARY

In September, 1988 the Science Advisory Board (SAB) published its report on environmental research strategies in the 1990s, Future Risk. The EPA Administrator immediately took steps to implement many of the recommendations in the report. Among other actions, he asked the SAB to establish a permanent committee to advise him on matters associated with research planning at the Agency. In response, the SAB established the Research Strategies Advisory Committee (RSAC). The Administrator also established and chaired the Research Strategy Council (RSC), composed of top policymakers in the Agency, to advise him on broad policy directions for the EPA's research program.

A first order of business for the RSC is consideration of ORD's response to an SAB recommendation that the Agency develop and maintain a vigorous core research program. In preparation for the first meeting of the RSC, RSAC reviewed ORD's position as expressed in ORD's Core Research Program--A Proposal. This RSAC report is the result of that review.

The RSAC was impressed by the distance ORD has come in describing a rational, coordinated plan of core research. However, the Committee encourages the Agency to take broader and bolder steps in implementing the recommendations of Future Risk. As one Committee member noted: "This document is more important than ORD thinks", meaning that the core research program--the way it is structured and the way it is articulated--can set the direction and tone for much of what EPA will be doing in the future.

The RSAC made the following specific recommendations:

a. The document should discuss the ORD program within a larger context that is comprehensible to the many different audiences who will be participating with EPA in addressing these environmental problems, both old and new.

b. The document should include a discussion of the core research areas within the overall concept of risk reduction as the new directing principle in Agency, including the hierarchy of activities. Consequently, the document would be improved by a relatively brief introduction that explains the fundamentals of risk reduction and a continuing reference to risk reduction as the guiding criterion. This commitment to a new approach should be reflected more directly in the allocations of the budget.

c. To have maximum impact on the intended audiences, the document should answer a limited number of fundamental questions of "Why and how?" and contain a sufficient number of illuminating

illustrations that the major points are not lost on readers outside of ORD.

d. The document should acknowledge the split responsibility in regard to non-traditional, non-technology research areas and provide
some indication of how ORD plans to integrate its work with that of OPPE and OTT to deal with these critical issues within its core research activity.

e. The document should indicate how ORD's core research program will interact with the new staff office (OTT) and OPPE in identifying and dealing with newly identified problems in the not-so-distant future.

f. The document should describe the procedures that ORD will follow to insure that input from the broader scientific community is gathered and incorporated into its research plans.

g. Each section of the document should be presented in such a manner that the rationale leading to the priority selection and linking of the various elements is clearly delineated.

h. The Health Risk Assessment Section should be presented within a logical framework that rationalizes the activities cited, describes EPA's activities vis a vis those of related institutions, describes how the data will be used, and discusses the role of human studies in the Agency's conception of core research areas.

i. The RSAC particularly applauds the Ecological Risk Assessment research plan as a positive departure from the past. However, improvements can be made in manner of presentation. At some point, there will have to be a detailed discussion of the role to be played by the Environmental Research Institute in this core research area.

j. The RSAC encourages the use of Risk Reduction as an overarching theme. Its importance should be reflected in increased funding for the elements of Risk Reduction, particularly pollution prevention. The "non-traditional, non-technology" areas of research described in Future Risk should be more fully discussed in this document. Specific suggestions were made regarding the elements on Source Characterization Containment, Biological Processes and Pollution Prevention.

k. The cross-cutting issue of exposure assessment should be more clearly identified as simply another view of some of the data previously presented in the three core research areas. In addition, an appropriate balance must be struck between the future development of new predictive exposure methods, validation of existing methods, and direct measurement of exposure levels.

The Agency is in a time of transition. This document can do much to capture and sustain the new vision of environmental protection as articulated in Future Risk. If the Agency does not expand its vision accordingly, no one else will. If this document does not expand its vision, a golden opportunity will have been lost.

2. INTRODUCTION

2.1 Charge and Process

In October, 1988, at the request of the Administrator of EPA, Mr. Lee Thomas, the Science Advisory Board (SAB) established the Research Strategies Advisory Committee (RSAC) to advise him on the nature and scope of the Agency's research program. The RSAC has been charged with advising the Administrator on matters that come before his Research Strategies Council (RSC), a group of high level EPA policymakers which decides on the tone and direction for research at the Agency.

Mr. Thomas convened the first meeting of the RSC on January 10, 1989. A principal item on the agenda was a discussion of the Office of Research and Development's (ORD's) Core Research Program--A Proposal--December, 1988. This document was prepared in response to the Administrator's request that the office project a long-term, core research program along the lines called for in an earlier SAB report, Future Risk: Research Strategies for the 1990s.

As background for the RSC meeting, the Administrator asked that RSAC review the Core Research Program. The RSAC participated in two fruitful planning meetings with ORD in November and December of 1988. The committee conducted an in-depth review of the document itself on December 21, 1988. A draft RSAC report was circulated to members during the last week in December. Committee members' comments were incorporated into a second draft which was distributed to the Administrator and the RSC on January 9, 1989. The draft report was later circulated to members of the SAB Executive Committee for review and action at their quarterly meeting on January 30-31, 1989. With minor modifications, which are included in this final report, the Executive Committee approved the RSAC report.

2.2 Background and Overview

Even as our nation makes progress in cleaning up our environment, we are discovering both additional complexities of old problems and increased complexities of new problems, which demand more informed, more sophisticated approaches to finding answers. More than ever, there is a need for research--broadened and redefined--to provide a strong basis for action.

While evidence of the first generation of environmental problems can still be seen clearly across our national landscape (e.g., dumpsites, smokestack emissions, polluted streams), demonstrable progress has been made in reversing, or at least slowing, the downward trends so prevalent only 15 years ago. Now-traditional technologies, which were developed and honed by environmental research programs, are being improved and exploited to address many of these most obvious, localized environmental

insults. However, the legacy of previous pollution continues to pose challenges to our efficient use of resources in redressing these past insults; cf., the estimated $100+ billion to clean up selected defense sites. Additional research information is needed to determine the methods and extent of clean up that are most appropriate to a given site.

In addition, we are now becoming aware of a second generation of environmental problems that are less obvious, more pervasive, and potentially much more devastating and irreversible than those with which we have become familiar. These insults (e.g., global climate change, indoor radon gas, and coastal zone degradation) are generally not amenable to traditional command-and-control regulatory approaches or end-of-pipe technological fixes--those products of traditional, media-specific, technology-based environmental research which have served us so well in the past. Research initiatives, both of substance and approach, are needed to help us address these new problems.

Our current situation was described and specific recommendations offered in a report of the SAB on strategies for environmental research in the 1990s (Future Risk 1988). Since the issuance of that report just a few months ago, more than 6000 copies of the document have been distributed, resulting in considerable interest in Congress, professional circles, and the trade and popular press.

At the direction of EPA Administrator Lee Thomas, ORD has been redesigning its research program along the lines recommended in the SAB report. The goal has been to articulate a comprehensive, integrated research plan which will respond to the challenges of the coming decade. The resulting product, ORD's Core Research Program--A Proposal (December, 1988), was reviewed by the SAB's Research Strategies Advisory Committee (RSAC) in anticipation of the first meeting of the Research Strategies Council (RSC) meeting on January 10, 1989. This report summarizes the results of the RSAC reaction to the ORD document.

RSAC applauds the creative effort and hard work that have gone into the production of the ORD draft report. To our knowledge, the document has the potential of being the most complete, rationale articulation of environmental research in the history of the Agency. As such, it is a major first step in addressing the challenges that now confront us.

In no way meaning to undervalue the significance of ORD's document, this RSAC report identifies specific ways in which the ORD effort can be improved. A strategic context is recommended within which to view the separate ORD suggestions. Specific research directions are identified that should be extended and investigative areas are discussed which should be enlarged. The message is one of congratulations on the efforts to date and of encouragement to be broader and bolder in pressing on even further.

In Section 3 of this report the RSAC discusses four major aspects for which they recommend changes to the overall Core Research Program document. In Section 4 the Committee provides reaction to each of the separate parts of the ORD document. The final Section of the report contains concluding observations by the Committee.

3. MAJOR ISSUES

3.1 Purpose of and Audiences for the ORD Document

The current draft appears to be written about ORD, by ORD, and for ORD. The purpose is too narrow and the audience too parochial. Under the circumstances, RSAC can understand and appreciate how the document came to take on its current form. In fact, the exercise represents a major rethinking of ORD's structure and function within EPA. Therefore, it is imperative that clear communication take place within the ORD organization so that everyone contributing to the mission of the Office has a clear vision of the "big picture" and of his/her role within that organization. The apparent purpose of the document, then, is to define ORD's research program for ORD scientists and engineers so that their respective roles can be easily identified and agreed upon.

The RSAC, however, urges that a much broader and bolder view be taken of what is needed and of EPA's place in the total mosaic of a national response to environmental problems. Of course, the document should clearly be focused on the Agency's research operation, but its message should be understandable to a broader audience. That is, in keeping with the SAB Future Risk Report, the message should be delivered within a context that recognizes, in at least a general way, the activities and contributions of other segments of society--other Federal agencies, state agencies, academia, industry, the public, etc.--that will be needed in order to respond to the current complexities and emerging environmental challenges. Such a context will provide a backdrop upon which to project the specifics of the EPA program as described in the current document. Viewed against this broader background, the EPA program should be seen as more logical, significant, and needed.

The document should recognize both the residue of old problems we have (e.g., the potential of huge Superfund bills) and the novel nature of the new problems we face. Research is needed to guarantee that the massive amounts of money that will be expended to address past issues are effectively spent and that the more global and potentially more irreversible aspects of the emerging issues are adequately addressed.

In summary, the document should discuss the ORD program within a larger context that is comprehensible to the many different audiences who will be participating with EPA in addressing these environmental problems, both old and new.

3.2 The Need for a Clearly Stated Context of Risk Reduction as an Outgrowth of the Agency's Work on Risk Assessment

The current document does a fine job of identifying the three core research areas and discussing the elements underlying each of those areas: Health Risk Assessment, Ecological Risk Assessment, and Risk Reduction. The conceptual framework of risk, as articulated by the National Research Council (NRC, 1983), has served the Agency well as an integrating thought for the past five years. To extend the risk concept into the research areas also makes good sense and provides a logical tie-in to the rest of the risk-based regulatory program within the Agency.

However, the document should follow the lead of the SAB's Future Risk and extend the "risk" notion by placing a major emphasize on risk reduction as a fundamental change in the way the Agency does its business. In the current draft, risk reduction seems to play a minor role, compared to its prime billing in the SAB report. Future Risk calls upon the entire Agency to adopt a risk reduction point-of-view by shifting its focus in a number of ways; e.g., from "end-of-pipe" controls to pollution prevention, from "command-and-control" disincentives to positive incentives for action. The ORD program can and should lead the way in demonstrating that an emphasis on risk reduction will lead to truly profound changes in Agency approaches to environmental problems. Specifically, the final research program should reflect the hierarchy of risk reduction activities that can be used to guide and prioritize action; i.e., pollution prevention, product recycling/reuse, pollution control, and exposure minimization.

As described in the ORD document, risk reduction is a pale image of the vision projected in Future Risk. In the core research program risk reduction is portrayed as primarily an industrial waste and engineering issue. There is little or no mention of pollution prevention from all sources (e.g., air emissions and pesticide application) or preventive measures beyond engineering responses (e.g., changing the mindset of people, removing barriers, and providing incentives for risk reduction behavior).

In addition, a properly designed risk reduction-based research program will address risks posed by alternative substances/ processes, as well as those of initial concern; e.g., what are the risks of asbestos substitutes? The goal should be to reduce net risk, not simply reduce old risks without clearly considering new risks which might be introduced as a consequence of targeted action by the Agency. In the same way, the risk reduction research program should be able to withstand scrutiny on the basis of comparative risks; i.e., expending appropriate levels of effort to address appropriate levels of risk. Risk reduction research should also contain program elements for

anticipating and addressing future risks before they develop into crises.

Given the overarching importance of risk reduction in Future Risk, it is hard to understand the relatively small percentage of overall resources which are being devoted to this area. While the projected percentage increase for risk reduction core research is 100% over the next eight years, that research will still command only 10% of the total research dollars; which is roughly the same percentage it commands today. It is difficult to describe such a situation as a major shift in the way the Agency does its business.

In summary, the document should discuss the core research areas within the overall concept of risk reduction as the new directing principle in the Agency, including the hierarchy of activities. Consequently, the document would be improved by a relatively brief introduction that explains the fundamentals of risk reduction and a continuing reference to risk reduction as the guiding criterion. (See Future Risk and, particularly, its Appendix E.) This commitment to a new approach should be reflected more directly in the budget allocations.

3.3 Improved Presentation

As noted in 3.1 above, the current document appears to have been written with an ORD audience in mind. However, the true audience (the next EPA administration, the Congress, the public, etc.), are less familiar with the current program and would benefit from a more pedantic, logical presentation of the core research areas.

We suggest that the document present each of the core areas and research elements within those areas so that the following questions are answered:

a. "Why should this research be conducted? That is, what is the rationale for the priority given this research?"
b. "Why should EPA be the party that conducts this research?"
c. "What questions will be answered by this research?"
d. "What are the possible consequences if EPA does not conduct this research?"
e. "What is the Agency's strategy for conducting research in this area? That is, what other parties/avenues are there for conducting some of this research, and how does the Agency intend to enlist the active participation of those groups and integrate their results with those of the Agency?"

In a more general vein, the RSAC encourages the use of brief, but specific, examples to illustrate the points made in the document. For example, descriptions of successfully applied

structure-activity relationships, biomarkers, ecological field evaluation, etc. provide greater insight and interest for the intended audience than some of the current technical generalizations found in the document.

In summary, the RSAC recommends that, to have maximum impact on the intended audiences, the presentation should answer a limited number of fundamental questions of "Why and how?" and contain a sufficient number of illuminating illustrations that the major points are not lost on readers outside of ORD.

3.4 Missing Elements

The ORD document describes the Office's response to most of the issues raised in Future Risk. However, there are three major areas identified in the SAB report that receive little attention in the current document.

First, there is only passing reference to the need for research in what might be called the "non-traditional, non-technology" areas. These areas include, but are not limited to, the following:

a. Research into approaches to transferring technology from those who develop it to those who use it; e.g., the states, private industry, and the general public.
b. Research into the barriers (institutional and personal) that inhibit users from taking action on the information which has been provided to them; i.e., the "You can give a horse appropriate technology, but you can't make him plug it in" syndrome.
c. Research into approaches to effective, two-way risk communication, perception and public input.
d. Research into non-technology risk reduction strategies, such as integrated pest management, accident and spill prevention, right-to-know programs, transportation control plans, and zoning to protect aquifers."

Research in these non-technology, non-traditional areas is important for several reasons. Such research will help to identify which approaches are truly effective in reducing risk. Without this data, various approaches will continue to be applied on an empirical basis, with inadequate evaluation. Therefore, the public and political acceptance--or lack thereof--will be based on something other than a solid technical basis. Currently, little, if any, research of this type is being conducted by the private sector or the states.

As currently addressed by the Agency, these non-traditional, non-technology areas involve offices in addition to ORD; specifically, the Office of Policy, Planning and Evaluation (OPPE) and the new Administrator's Staff Office of Technology Transfer (OTT). At a minimum, the ORD document should acknowledge the split responsibility in these areas and give some

indication of how ORD plans to work with OPPE and OTT to deal with these critical issues as a part of its core research activity.

Second, the current document is relatively quiet in regard to emerging problems. By contrast, Future Risk emphasizes the need to improve the Agency's ability to foresee problems before they become crises. Therefore, the SAB recommended that the Agency establish a small staff office with the responsibility of "looking over the horizon" and, in an annual report, calling attention to those emerging problems. In his memorandum of September 26, 1988 implementing many of the SAB's recommendations, Mr. Thomas directed that such an office be established to, among other activities, "flag...issues for research". In addition, OPPE has played a role in identifying areas that may presented special problems to the Agency in the future.

Therefore, the document should indicate how ORD's core research program will interact with the new Staff Office and with OPPE in identifying and dealing with these newly identified problems of the not-so-distant future.

Third, Appendix E of Future Risk describes the importance of the Agency's continually reaching beyond itself for insights on approaches to structuring/restructuring its research program. As noted above, EPA's program should be seen and justified as a unique part of a total mosaic of research activity in the country. It is only by being open to and actively soliciting suggestions from the broader scientific community on a continuing basis that the Agency can assure itself and others that its research program is focused on those problems are most needed and most effectively addressed by EPA.

Therefore, the document should describe the procedures that ORD will follow to insure that input from the broader scientific community is gathered and incorporated into its research plans.

4. SPECIFIC CORE AREAS

4.1 General Comment on Rationale for Priority Selections

In addition to the broad concerns discussed in section 2, the RSAC has identified specific issues within each of the core research areas. While the Committee generally agreed with each of the individual elements within each of the sections, the members noted an absence of a logical framework that would help the reader to understand the selection of each of the elements, to the exclusion of others which might have been considered.

Therefore, RSAC urges that each section be presented in such a manner that the rationale leading to the priority selection and linking of the various elements is clearly delineated.

4.2 Comments on Health Risk Assessment Section

The Health Risk Assessment Section would benefit from inclusion of the logical framework referred to in 3.1 above. As it stands, a cynical reader might conclude that "This is just more of the same". In fact, the RSAC understands that the intent is to describe the unique and critical role that health research has in EPA, located as it is on the interface between fundamental research investigations and directed applications of research results to environmental problems.

In this regard, the document should briefly describe the relative positions and activities of EPA health research and health research conducted by other institutions in the country. For example, Future Risk explicitly refers to the complementary work performed by the National Institute for Environmental Health Sciences (NIEHS). As a part of its overall strategy (See Section 2.3 above), ORD should describe how the investigations and resources of these other institutions (public and private) will be coordinated so as to reach the Agency's goals most expeditiously.

Currently, the document could be viewed as simply describing a number of data gathering exercises. As a part of the logical framework that would knit this Section together, ORD should include some discussion of how the data from these studies, once gathered, will be used to achieve the greater goals. ORD should also consider how it will make use of data collection activities of others; e.g., the National Health and Nutrition Evaluation Survey (NHANES), various tumor registries, and the increasing number of birth defect registries being established across the country.

Finally, one of the SAB's recommendations in Future Risks called for an increased emphasis on epidemiological studies. In the current document there is little reference to epidemiological or clinical studies. The concern is that human studies are

uniquely suited to answering questions about humans and that Agency activity, particularly in epidemiological research, has fallen to a low level following some unpleasant experiences more than a decade ago. There may be good reasons why ORD disagrees with the SAB recommendation; if so, the document should articulate these reasons, however briefly, rather than ignoring the issue.

In summary, this Section should be presented within a logical framework that rationalizes the activities cited, should describe EPA's activities vis a vis those of related institutions, should describe how the data will be used, and should discuss the role of human studies in the Agency's conception of core research areas.

4.3 Ecological Risk Assessment Section

The RSAC found the program described in this Section to be very exciting, full of promise, and closely patterned after the SAB's recommendations. The presentation would benefit from inclusion of a logical context within which to discuss and evaluate the separate research elements and the work of other institutions.

More notably missing from the document was any substantive discussion of the Environmental Institute described in Future Risk. The Institute has been envisioned as a means whereby long-term research activities can receive some measure of protection from the vicissitudes of modern-day budgeteering. Therefore, the core research areas will play a big role in the activities of the Institute, should it come into being. This document should discuss, at least briefly, the implications of the formation of the Institute.

In summary, the RSAC applauds especially the ecological risk assessment research plan as a positive departure from the past. However, improvements can be made in manner of presentation. At some point, there will have to be a detailed discussion of the role to be played by the Environmental Research Institute in this core research area.

4.4 Risk Reduction Section

As noted above (Section 3.2), the RSAC encourages greater use of risk reduction as a new, integrating concept to guide EPA programs, including research. The risk reduction concept, including its hierarchy of activities, can provide the logical framework which is missing from the current document.

Members of the RSAC expressed concern about what they saw as a disproportionately small percentage of the total research budget being directed toward and by risk reduction activities. (See Section 3.2) During our discussion, ORD referred to several ongoing activities which they have assigned to the program-

related, rather than the core, research areas; e.g., the Superfund Innovative Technologies Evaluation (SITE) program. The Committee members were left with the impression that a more complete discussion of the total research program (core plus program-oriented activities) would reveal the greater importance accorded risk reduction in the overall ORD strategy. Without additional information, the RSAC cannot comment on that suggestion but remains concerned, in part, due to the absence of any substantive discussion of the non-traditional, non-technology research areas that figured so prominently in Future Risk. (See Section 3.4)

Three program elements drew specific comment. First, the Source Characterization element appears to be addressed to conventional sources of pollution. Greater emphasis should be placed on identifying and characterizing those emerging sources which may become even greater problems in the future. Second, the Containment element projects the idea that, in principle, we "know all the answers" about isolating pollutants from the environment and that it is just a matter of applying creatively those principles to specific situations. Experience has shown us repeatedly, however, that we are better served by moderate humility rather than by excessive confidence when approaching this problem. It is for this reason that minimizing exposure to the environment remains an important component of the risk reduction strategy, albeit the fourth tier. Finally, the RSAC believes that promising approaches, such as biological processes and pollution prevention, should be given increased attention and funding as soon as possible--relative to mature technologies, such as combustion--since it is in these under-explored and under-exploited areas that dramatic, technology-altering breakthroughs in risk reduction are more likely to occur.

In summary, the RSAC encourages use of risk reduction as an overarching theme. Its importance should be reflected in increased funding for the elements of risk reduction, particularly pollution prevention. The "non-traditional, non-technology" areas of research described in Future Risk should be more fully discussed in this document. Specific suggestions were made regarding the elements on Source Characterization, Containment, Biological Processes and Pollution Prevention.

4.5 Exposure Assessment

The RSAC understands the importance of Exposure Assessment within the Agency and its appearance in each of the core research areas. Even to the informed reader, however, the Exposure Assessment Section can be interpreted as having an independent, co-equal status with the three core research areas. Therefore, the document should more clearly present this useful information on exposure assessment for what it is: a hybrid combination of elements from each of the core research areas.

The RSAC is concerned about the appearance, at least, of devoting greater resources to approaches for predictive exposure assessment than to efforts to validate those approaches and/or obtain direct exposure measurements. Several commenters in the recent past, including the Executive Committee of the Science Advisory Board at its meeting in November, 1988, have noted with favor the Agency's innovative use of computer modelling as a means of predicting environmental exposure associated with site-specific environmental releases of pollutants. These computational approaches mark potentially useful advances. At the same time, however, they need to be subjected to rigorous validation procedures in order to determine the extent to which the mathematical projections are reflected in actual results in the field.

In summary, the RSAC suggests that the cross-cutting issue of exposure assessment be more clearly identified as simply another view of some of the data previously presented in the three core research areas. In addition, an appropriate balance must be struck between the further development of new predictive exposure methods, validation of existing methods, and direct measurement of exposure levels.

5. CONCLUSION

The RSAC has been impressed by the manner in which ORD has developed a set of core research areas that will form the basis of environmental research during the next decade. Clearly, a great deal of creative thinking and hard work have gone into the production of the ORD document. With this foundation, the Agency should be able to build a research program for the 1990s that will address our major environmental concerns and adjust itself to the problems uncovered as the program is carried out. The effort to date must certainly be marked as a success.

At the same time, the Committee has identified some concerns which find the document falling short of providing the level of foresight and guidance that the research program--and the rest of the Agency--needs. One comment made at the meeting may well capture the sense of the Committee: "This document is more important than ORD thinks", implying that the document should be seen as the first concrete step in implementing the far-reaching recommendations contained in Future Risk that calls for a fundamental change in the way in which the Agency does its business. As such, the document should be both farsighted and specific, both radical and practical, and both strategic and tactical.

The Committee is aware of the time pressure confronting the Agency at this time in the budget cycle and that there is pressure to push this document forward in the near term. And yet, the RSAC urges ORD to expend the effort necessary to assure that this document covers all of the appropriate issues in roughly the appropriate manner. The charter of the Research Strategy Council calls for readdressing these issues each year, and if history is any guide, this first document will be the guide for future analyses of these issues. Therefore, it is important that the appropriate breadth and tone be established in this first effort, with internal polishing and improvements being made in subsequent years.

The Agency is in a time of transition. This document can do much to capture and sustain the new vision of environmental protection as articulated in Future Risk. If the Agency does not expand its vision accordingly, no one else will. If this document does not expand its vision, a golden opportunity will have been lost.

U. S. ENVIRONMENTAL PROTECTION AGENCY

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