



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

March 30, 1988

SAB-EC-88-024

OFFICE OF
THE ADMINISTRATOR

Honorable Lee M. Thomas
Administrator
U. S. Environmental Protection
Agency
401 M Street, S. W.
Washington, D. C. 20460

Dear Mr. Thomas:

The Science Advisory Board's (SAB) Research and Development Budget Subcommittee has completed its third annual review of the President's proposed budget for the Office of Research and Development and is pleased to transmit copies to you and Congressional committees that authorize and appropriate funds for this office.

The President's proposed research budget for Fiscal Year (FY) 1989 for the Office of Research and Development (ORD) is \$375.0 million and 1,848 workyears, and increase of \$22.7 million and 17 workyears above the level for FY '88. The proposed budget provides for important research projects and management developments, including a modest expansion of the in-house research capability, a direction strongly encouraged in last year's Subcommittee report and reiterated this year. Much of the proposed overall increase is somewhat illusionary, however, due to reductions in FY '88 appropriated funds and new programs mandated by Congress with no additional resources provided.

In the scope of its inquiry, the Subcommittee examined four general issues: 1) trends in research budget; 2) human resources issues, 3) the need for early problem identification; and 4) 18 specific research programs, serving six separate areas in the Agency.

The demands placed upon the Agency for new knowledge through research continue to grow at a faster pace than the increases in funding. Concern is expressed about the age structure of ORD and the inadequate infusion of junior scientists, a problem which could be alleviated by the institution of training grant programs. Specific proposals are made for mechanisms to improve the Agency's ability to detect potential problems while they are still "over the horizon". Finally, each of the research programs is discussed in terms of the resources recommended to address the program's mission.

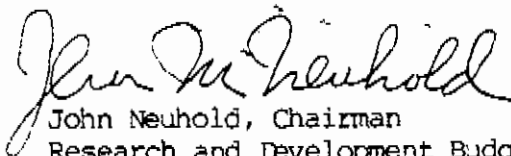
The Subcommittee and the SAB Executive Committee believe that the enclosed report adds to the range of points of view that the Administration and Congress should consider in reaching budgetary decisions. Scientists and engineers have a responsibility to present their thoughts and evaluations of the needs for research in the area of environmental science, and we appreciate the opportunity to do so.

We request that the Agency respond to the advice and recommendations in the report.

Sincerely,



Norton Nelson, Chairman
Executive Committee
Science Advisory Board



John Neuhold, Chairman
Research and Development Budget Subcommittee
Science Advisory Board

cc: A. James Barnes
Vaun Newill
Donald Barnes

REVIEW OF THE PRESIDENT'S PROPOSED BUDGET
FOR EPA'S OFFICE OF RESEARCH AND DEVELOPMENT
FOR FISCAL YEAR 1989

Research and Development Budget Subcommittee
Science Advisory Board
U. S. Environmental Protection Agency

March 1988

U. S. ENVIRONMENTAL PROTECTION AGENCY

NOTICE

This report has been written as a part of the activities of the Science Advisory Board, a public advisory group providing extramural scientific information and advice to the Administrator and other officials of the Environmental Protection Agency. The Board is structured to provide a balanced expert assessment of scientific matters related to problems facing the Agency. This report has not been reviewed for approval by the Agency and, hence, the contents of this report do not necessarily represent the views and policies of the Environmental Protection Agency, nor of other agencies in the Executive Branch of the Federal government, nor does mention of trade names or commercial products constitute a recommendation for use.

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I. Executive Summary

The President's proposed budget for Fiscal Year (FY) 1989 for the Environmental Protection Agency (EPA) requests approximately \$4.8 billion and 14,570 workyears. Of this total, \$375.0 million and 1,848 workyears are requested for research and development, an increase of \$22.7 million and 17 workyears above the levels for FY '88 enacted during the recent Bipartisan Agreement between the Administration and the Congress.

Approximately \$197 million of the proposed research budget is earmarked marked for the extramural (research and development) account, with \$110 million devoted for in-house (salaries and expenses) needs. Additionally \$67 million is allotted for Superfund work (\$56 million extramural, \$11 million intramural) and \$0.8 million for work on leaking underground storage tanks. The intramural funding level continues the modest expansion of the in-house research capability, a development strongly encouraged in last year's Subcommittee report and reiterated this year.

Some continuing core needs of EPA's research program highlighted in last year's Subcommittee report merit re-emphasis. These include the increasingly diverse skills required to research EPA's growing number of new regulatory and policy priorities, and the need for a more formal mechanism to define emerging public health and environmental problems. For example, at present, the Agency has few researchers with stature in the scientific community who are knowledgeable about the ecological effects of stratospheric ozone depletion. This illustrates the continuing dilemma of EPA's research program having to catch-up to regulatory problems, and needing several years to acquire the requisite talents to formulate creative research programs to address those problems. The 18 programs specifically addressed by the Subcommittee this year are in the Table of Contents.

The Subcommittee recommends that an in-house group be established to identify new (and escalating) ecological and environmental health problems. This in-house group, composed of people from varying scientific and policy-related disciplines, should prepare an annual report of potential new problems and recommend needed research. The group could examine monitoring data, survey literature and conferences; hold workshops; and, prepare scenarios of assumed future social and technological conditions as means of identifying new and rapidly escalating problems.

The Research and Development Budget Subcommittee of the Science Advisory Board is encouraged by the recognition of stratospheric ozone depletion, radon mitigation and Superfund research centers as priorities. In addition, resources are proposed (not as part of the research budget) for upgrading certain technical facilities. On the other hand, much of the proposed overall increase for research is somewhat illusory because of the general reduction of \$15.2 million for the Office of Research and Development in the final FY '88 appropriation, and the new Congressionally mandated program (\$3M in FY '88 and \$10 million in FY '89--with no additional resources provided) to reduce uncertainty in risk assessment (RURA). The Subcommittee strongly recommends that the Congress appropriate new monies when it adds new requirements for EPA research.

The demands placed upon the Agency for new knowledge through research continue to grow at a faster pace than the increase in funding. This is reflected in comments in a number of areas in this report.

II. Introduction

During the past several years, EPA's research programs have encountered many different challenges. They face the continuing need to provide scientific support for on-going regulatory decision making in EPA's major program areas. At the same time, the research programs are attempting to address newer environmental problems such as global climate change and indoor radon, and to respond to augmented requirements enacted by the Congress through amendments to the Safe Drinking Water Act, Clean Water Act, Resource Conservation and Recovery Act and Superfund. In managing the resources available to it and maintain research productivity, the Office of Research and Development confronts continuing problems in ensuring that it has adequately trained personnel that possess both the skills and the equipment to carry out these responsibilities. The latter area, in particular, has seen a continuing erosion over the past decade such that EPA research facilities often do not possess a state-of-the-art capability to detect or assess environmental problems. Finally, there are notable disparities between EPA's research needs and the resources it has to conduct and/or sponsor research in such areas as incineration technologies, global climate change, land disposal and exploratory research.

Scientists and engineers, of course, have an obligation to help set research priorities to better match needs with resources, but their ability to rationally select priorities is hampered by Congressional restrictions on the flexible use of existing resources, the unpredictability of a budgeting process that leads to constantly changing priorities and the mandating of new responsibilities in the absence of commensurate resources. Despite these difficulties, the President's proposed budget to EPA's Office of Research and Development maintains a commitment to continued funding of certain key research programs. These and other issues are discussed in this report.

This is the third annual report of the Research and Development Budget Subcommittee of the Science Advisory Board. In previous years, the Subcommittee has sought to identify continuing core needs for maintaining productive and high quality research at EPA, while highlighting specific needs for individual research programs. This year's report continues that effort. The current report resulted from a Subcommittee meeting on February 11-12, 1988 at EPA headquarters, in which members received background briefings on the ORD and EPA-wide budget proposal for FY '89. The Subcommittee prepared an initial draft of its findings and recommendations at the meeting and completed its report by mail. Following approval by the SAB Executive Committee, the report was simultaneously transmitted to the EPA Administrator and the Congress.

This report is part of a series of actions in which the Science Advisory Board attempts to improve the quality, direction and support of research at EPA. Other activities include:

- o Formation of a Research Strategies Committee (the Alm Committee) to develop a strategy which will identify and communicate to EPA program offices, the Congress, the Office of Management and Budget, the scientific community and the public the research opportunities and needs related to EPA's mission in the 1990's, and to identify mechanisms to continually update such research across media lines.

- o Review of individual research programs that in the past year has included land disposal, stratospheric and tropospheric ozone, waste minimization, radon mitigation, drinking water disinfectants and their by-products, pollutants in the water distribution system and municipal waste combustion.

- o Evaluation of scientific assessment documents and methodologies for risk assessment that provides a scientific basis for regulatory decision making.

It is the Board's hope that, by presenting these views directly to policy makers in the Executive Branch and the Congress, scientists and engineers can articulate some of EPA's most important research needs and, by doing so, persuade policy makers to allocate the resources necessary to fund research to resolve environmental problems and achieve our common objective of protecting the public health and the environment.

III. Some Generic Issues in Managing EPA's Research Program

A. Research Budget Trends

The total amount of resources available for research and development stems from four major accounts: Salaries and Expenses (S & E--in-house monies available for research, salaries, equipment purchases, and maintenance of scientific infrastructure such as animal care in laboratories); research and development (extramural funds devoted to research grants and contracts); Superfund; and the Leaking Underground Storage Tank (LUST) Trust Fund. For FY '89 the proposed budget recommends the following amounts in each category:

	(Dollars in Millions)	
Appropriation	1989 Total Dollars	Change from 1988 Level
Salaries & Expenses	\$110.4	+\$3.7
Research and Development	197.0	+10.6
Superfund	66.8	+ 8.4
<u>LUST Trust Fund</u>	<u>0.8</u>	<u>---</u>
Total	\$375.0	+\$22.7

The Subcommittee highlights two specific issues related to these budget recommendations. They include:

o Support for the in-house (or S&E) program shows modest yet continued growth in support for the in-house program. As noted above, approximately \$3.7 million additional dollars are made available for in-house research. The Subcommittee, as in previous years, supports this trend, but observes it barely meets the cost of living increases.

The Congress can expect that a real expansion of the in-house program will not only improve EPA's internal research capabilities but will also enhance the ability of Agency scientists to interact more effectively with the scientific community and improve their management of extramural (R&D) resources. Such developments, if sustained, should improve EPA's overall research productivity and credibility.

o Growth in the in-house program combined with two other developments, can begin to alleviate one of EPA's major chronic problems--aging equipment and facilities. Beginning last fiscal year the Congress authorized the use of extramural funds of up to \$2 million for equipment purchases. This is a welcome step that provides additional flexibility in managing research resources. The problem of obsolescent equipment is becoming acute in certain EPA laboratories. For example, its water research laboratory in Cincinnati currently lacks the instrumentation to identify potentially hazardous chemicals resulting from the by-products of disinfection technologies used as a substitute for chlorination.¹ This occurs at a time when regulations developed by EPA's Office of Drinking Water encourage the shift to disinfection alternatives. A second factor influencing the capability of the in-house program stems from proposed improvements to selected research facilities. Resources (not taken from the ORD budget) are proposed for reconstruction of field stations in Newport, Oregon (\$12.2 million) and Edison, New Jersey (\$5.6 million), and an architectural and engineering study for the Chapel Hill North Carolina Clinical Facility (\$1.7 million). EPA, the Administration and Congress should recognize the relationship between equipment and facility improvement and research productivity. The Subcommittee recommends that the Congress require EPA to prepare a study of scientific infrastructure needs by January 1, 1989 to enable the executive and legislative branches of government to provide sustained support for equipment and facility enhancement. To avoid this responsibility is to witness a deterioration of unique physical assets that serve the national interest.

EPA's research program is subdivided into ten major components, not including resources provided for management and support. The following table present the recommended funding levels for each program category, and the change from the FY '88 appropriation:

(Dollars in Millions)

Research Program	1989 Total Dollars	Change From 1988 Level
Air	\$72.5	+\$6.7
Water Quality	25.1	+ 0.4
Drinking Water	22.0	- 0.5
Hazardous Waste	41.3	- 3.4
Pesticides	14.4	+ 1.5
Radiation	4.0	+ 1.1
Interdisciplinary	34.2	+ 7.2
Toxic Substances	26.6	- 0.2
Energy/Acid Rain	55.5	- 0.1
Superfund/LUST	67.6	+ 8.4
<u>Management & Support</u>	<u>11.8</u>	<u>+ 1.6</u>
Total	\$375.0	+\$22.7

Section IV of this report presents the Subcommittee's evaluation of each of these program elements.

B. Human Resource Issues

The Full Time Equivalents (FTE) recommended for ORD, 1,848 workyears, remains approximately the same as the FY '88 level of 1,831 workyears. The Science Advisory Board expresses its concern once again that a human resource problem is emerging in ORD, although its origins do not lie in the overall size of ORD's workforce. Rather, it stems from the fact that the age structure of the organization is becoming top heavy with mid-level managers and an inadequate infusion of junior scientists to meet the demands of attrition and aging. Furthermore, the corps of young people being trained in the environmental sciences has been declining since the mid-1970s to a level where an insufficient supply will emerge to fill the needs of the Agency as its longer tenured scientists reach retirement age or otherwise leave the Agency. The drinking water research program, for example, has lost nearly a half dozen senior scientists in recent years, one of whom was a member of the National Academy of Engineering. This represents significant reduction for this particular research group and is only one instance of a broader problem.

Congress and the Agency could avoid a potential crisis in this area by instituting training grant programs at the universities, much as was done in the 1960s and early 1970s. Based on enrollments in environmental programs, shortages will exist in environmental engineering, chemistry, ecology, and epidemiology. Training programs implemented now will produce trained people within three years, in time to avoid a crisis.

At the same time EPA confronts this problem, it has an apparent oversupply of mid-level research managers that it is seeking to assign elsewhere. The Agency needs to find ways to effectively use the accumulated skills

of these managers. To date, it has sought to voluntarily relocate mid-level technical staff to EPA regional offices. For FY '88 ORD has assigned personnel in three regional offices and plans to expand this career alternative to all ten regions. The Subcommittee endorses this approach, for it can simultaneously improve the scientific capability of the regional offices and create opportunities to bring younger people with new skills into ORD headquarters and laboratory programs. This alternative alone is unlikely to solve this ORD problem.

C. Early Problem Identification

As discussed in the Subcommittee's review of the FY '88 budget, early identification of potential emerging and escalating environmental problems should take its place along with risk assessment and risk management as a central part of EPA's mission. The proposed research budget provides no funds specifically earmarked toward this objective. This is disappointing in view of the number of issues--such as radon, stratospheric ozone depletion and global climate change--that have only recently risen to the top of EPA's policy agenda but which were known to the scientific community for a number of years. It is also surprising because of the relatively high risks and the rising priority for those "newer" problems discussed in EPA's February 1987 report entitled Unfinished Business: A Comparative Assessment of Environmental Problems. While admittedly not a scientific study, this report provides a rationale for follow-up investigations that need to be pursued, if only to minimize future surprises and ensure that resources are better matched to significant sources of public health and environmental risk.

The Subcommittee recommends that an in-house group be established to identify new ecological and environmental health problems, with input from many outside sources so the in-house group does not become too inbred in its thinking. This group, composed of people from varying scientific and policy-related disciplines, should prepare an annual report of potential new problems and recommend needed research. The group could survey existing literature and prepare scenarios of assumed future social and technological conditions as a means of identifying new problems. This effort also needs the participation of external experts. One mechanism is to utilize the National Academy of Sciences to assist in marshalling leading scientists, engineers, sociologists, and others to participate in a series of workshops to identify potential and emerging ecological and health stressors. Such participation would require new money.

The need to identify problems also requires international cooperation. The increased internationalization of technology and trade also creates environmental problems that transcend national boundaries. There is a need to work with Canada concerning acid deposition and Great Lakes water quality.

There is a need to work with Mexico on water quality degradation of the Colorado River water in Mexico due to U.S. agricultural discharges and air quality degradation in the U.S. due emissions of a very large Mexican copper smelter. The saga of the barge carrying Islip, New York and New York City's commercial solid waste up and down the east coast and around the Carribbean Sea demonstrates that problems previously regarded as domestic are international in scope. On an even larger scale, the issues of stratospheric ozone depletion and global climate change require greater integration among scientific assessment, policy analysis and mitigation efforts that any previous environmental problems to date. It is particularly important for the U.S. government to maintain a capability to evaluate the magnitude of these issues and to identify others like them.

IV. Comments on Specific Research Programs

The Subcommittee has evaluated the research budget proposals in each of the major program categories. The Subcommittee prepared its comments by examining the rationale contained in budgetary documents that justify funding increases or decreases, and compared this rationale to the conclusions of SAB reviews of research programs conducted in the past year. The expertise of Subcommittee members was also a primary source of information for preparing the following comments.

A. Air and Radiation

1. Criteria Air Pollutant Research

The proposed decrease in FY '89 funding on research in support of criteria pollutants (National Ambient Air Quality Standards, or NAAQS) reflects the fact that the effects of such pollutants are more widely understood in comparison with many other problems confronting EPA. However, there remain many unresolved technical issues for NAAQS, which are among the most costly regulations developed by EPA. This Subcommittee focused, in particular, on needs related to short-term effects of nitrogen dioxide and chronic effects of ozone. For nitrogen dioxide, the Agency has not supported the research needed to enable it to meet the Congressional mandate to either set a short-term NAAQS or to demonstrate that one was not needed. For ozone, the SAB's Clean Air Scientific Advisory Committee research recommendations call for greatly increased emphasis on the effects of chronic exposure on lung structure.² This extremely important aspect of ozone health effects has received too little attention in the past and will need augmented research funding to generate the data base needed for a policy decision on whether to establish a long-term ozone standard. Given the fact that a major fraction of the U. S. population lives in areas of the country that do not attain the current ozone standard, ozone exposure will remain a high priority issue for many years to come.

The proposed FY '89 budget also does not address another need for research on criteria pollutants, i.e., the health effects of acidic aerosols. The recent issues paper prepared by ORD and the Office of Air Quality Planning and Standards provides evidence of the rising importance of this issue. The Agency will need much more data on the nature of population exposures and responses as it moves to evaluate whether to consider a new NAAQS for these pollutants.

2. Air Toxics

The \$1 million decrease in research funding for hazardous air pollutants proposed for FY '89 is troublesome in view of the potential impacts such pollutants can have on human health, the dearth of data on current population exposures and the need for more reliable risk assessment methodologies. In the absence of sufficient resources to support a new emphasis on exposure and effects assessment, and on the nature and impact of sudden massive releases of chemicals to the environment, the current emphasis on risk assessment is appropriate.

3. Indoor Air Pollutants

The 14% increase proposed for FY '89 for research on indoor air pollutants will permit a significant expansion of the Agency's ability to communicate risks to the general public based on current knowledge concerning health effects and control resources. However, it will only begin to provide a basis for the substantial increase in the knowledge base which is needed.

4. Stratospheric Ozone

The signing of the Montreal stratospheric ozone protocol by the United States and other nations represents a major international achievement. Embedded within the protocol is a commitment to initiate scientific assessments of the ozone depletion problem in 1990 and 1994. There is a wide recognition within the scientific communities of many nations, including the United States, that more research is needed to better establish the scope of the human health and environmental effects of concern and the levels of Ultraviolet-B (UV-B) radiation exposure at which they occur.

During its review of the EPA document, An Assessment of the Risks of Stratospheric Modification, the Science Advisory Board's Stratospheric Ozone Subcommittee concluded that "the potential impacts on aquatic and terrestrial food chains, and the potential effects on the equilibrium of plant and animal assemblages, are just as important as the more intensively studied human effects."³ Subsequent to that Subcommittee's transmittal of its report, the Office of Management and Budget solicited its further advice on research needs and priorities.⁴ Subcommittee members responded by proposing research that focused on a number of endpoints, particularly aquatic and plant systems.⁵

The FY '89 budget proposal provides a substantial increase of approximately \$7 million for stratospheric ozone research. The program will focus upon such issues as assessing the effects of ozone depletion upon plants, marine ecosystems and air quality. The Research and Development Budget Subcommittee welcomes this commitment to a vigorous research program and recommends that it continue over a series of fiscal years because of the continuing domestic and international policy decisions for which research support is needed.

5. Global Climate

The issue of global climate change is likely to be even more complex than stratospheric ozone depletion as a scientific problem and in terms of the policy issues requiring resolution. In recognition of this, nations such as the United States and the Soviet Union, as well as the United Nations, are beginning a more formal process of scientific evaluation of this problem. Thus, the need for a well-designed, funded and sustained research program to address the host of interlinked scientific and policy questions related to global climate change is compelling.

Therefore, the \$493 million increase in EPA's proposed FY '89 research budget for this problem is welcomed. The Subcommittee supports this increased funding and suggests that new resources at least equivalent to those earmarked for stratospheric ozone depletion should be made available.

The Subcommittee also recommends that EPA prepare a research plan to demonstrate its capability to wisely use additional resources, and that such a plan should identify research needs for a period of at least a decade. External scientific experts should be called upon to assist in preparing and reviewing such a plan.

6. Radon Mitigation

Last year, the President proposed a major reduction in funding for radiation research with most of the decrease taken from the radon mitigation program. In last year's report, the Subcommittee concluded that, as a result, "The radon mitigation program cannot achieve its previously stated objectives of developing and publishing acceptable mitigation techniques that will apply to the variety of problems facing American homeowners."

The FY '89 proposal recommends an increase of approximately \$1 million for radon with the majority of funds devoted to demonstration and evaluation of techniques to prevent and mitigate radon in homes, and to analyze the results of such efforts.

The Subcommittee applauds this change. The SAB's Radiation Advisory Committee has maintained a continuing scientific oversight of this research program and is favorably impressed with both the quality and direction of EPA's efforts to date.⁶ The proposed increase should solidify and enable EPA to build on the progress achieved to date.

The proposed radiation research budget also includes funds for radiological monitoring and surveillance services for the Department of Energy's Nuclear Testing Program, and a radiochemical analytical quality assurance program for making radioactivity measurements at Federal, State and local laboratories. Both of these programs merit continued support.

B. Water

1. Water Quality

The proposed budget for water quality research increases \$347,000 for a total of approximately \$25 million. In addition to continuing with research on water quality criteria and standards, developing use attainability analyses and implementing water quality based standards, and the Great Lakes, the Agency proposes research on the problem of the loss or degradation of wetlands.

With the support of the scientific community, the trend in water quality criteria development and standard setting has evolved towards a regional framework, based upon the recognition of region-specific environmental needs, and using geological and ecological principles. The Subcommittee endorses the Agency's recognition of the need for furthering the ecoregion approach, but it believes that, with additional resources, many more important scientific insights can be obtained.

In its FY '88 budget report, the Subcommittee commented on the need to begin to focus attention on non-point water pollution sources. ORD has initiated the planning of research efforts into sediments, which are a latent source of pollutants and which cannot be attributed to a single source. Because of the huge impact of non-point sources on water quality, this effort should be seen as only the beginning of a research program that should also address non-point inputs from surface runoff and direct atmospheric sources.

The important area of ground water research receives approximately a 1% increase over the FY '88 budget, or \$76,300. Since much of the Nation's water supply comes from groundwater sources, it is imperative that the assessment programs proposed on sources, transport, transformation of groundwater contaminants be emphasized.

2. Drinking Water

The proposed FY '89 research funding of \$21.9 million represents a 2% reduction below FY '88 levels and about a 4% reduction below the FY '87 appropriation.

This past year the SAB Environmental Health Committee reviewed three major drinking water issues: research on drinking water disinfection and disinfection by-products⁷; research on pollutants in water distribution systems⁷ and a review of the scientific data base for the proposed rules for surface water treatment and coliforms.⁸

There is a growing recognition among scientists, engineers, governmental officials and water supply providers of the public health risks associated with the continuing incidence of waterborne disease, and the increasing need to investigate the public health implications of the use of alternative disinfection techniques and their by-products.

At present, EPA's disinfection work is almost wholly focused on chlorination and chlorination by-products. More attention should be devoted to the potential toxicity problems that could arise from alternatives and/or adjuncts to chlorination such as chloramination, and the use of ozone, chlorine dioxide and other disinfectant processes. As treatment systems turn to the use of alternative treatment approaches, it is necessary to expand the research focus to determine which treatment methods protect public health most effectively, and to compare the relative effectiveness and risks associated with each treatment technology. Microbiological research in water systems is also an area that merits additional support, particularly studies of assimilable organic carbon which may be used as an indicator of growth or absence of growth of microbiological contaminants in water distribution systems. Lack of funding seems to be the basis for reduced work on corrosion. This is short-sighted because there are a number of unresolved scientific and policy issues related to the public health threat posed by the leaching of lead and the corrosion of asbestos pipe. For all of the above reasons, the proposed budget of approximately \$3.3 million for the disinfection by-products and water distribution system programs should be greatly increased.

C. Hazardous Wastes/LUST/Superfund

The large economic commitment of the United States toward proper management of hazardous wastes and remediation of existing waste sites warrants the development of a sound scientific basis to ensure that clean-up efforts are both cost-efficient and effective. The combined hazardous waste/LUST/Superfund research program in FY '89 shows an increase of \$5 million above FY '88 levels, for a total of \$108.9 million.

1. Superfund Innovative Technology Evaluation (SITE)

The SITE program, which evaluates new remediation technology largely on a demonstration scale, is budgeted at \$20 million for FY '89, not including cost-sharing by industry. Approximately \$1 million is earmarked for emerging technology and another \$1 million for monitoring method components. At present, there are 22 SITE projects underway. The Subcommittee believes that the SITE program has made steady progress since its inception and can effectively use the recommended resources.

2. Waste Minimization

Preventing or reducing the generation of wastes is important for many reasons. These include: a) pollution control technologies are not 100% reliable and some releases inevitably result; b) some control technologies transfer contaminants to different environmental media and create new environmental problems; and c) siting new waste management capacity is very difficult, if not impossible.

Although a few companies and a few states have aggressively pursued waste minimization, many have not. Interest in waste minimization is growing, however, as evidenced by an expanding number of reports, conferences, and legislative proposals devoted to this subject.

Waste minimization deserves substantial visibility and commitment at the highest levels of EPA. Although the Agency has made some progress in its awareness of the need for waste minimization, its current programs and budgets are far too limited to realize the potential benefits. In part, this reflects the difficulty EPA has concerning its role as a pollution "prevention" agency.

In a review of EPA's waste minimization research strategy, the SAB's Environmental Engineering Committee concluded that it should encompass a variety of on- and off-site, in-process, and post-generation waste management options that reduce the hazard of a waste, including waste treatment.⁹ The Committee recommended that EPA's waste minimization program could initially focus most productively upon waste prevention (source reduction) and waste recovery/reuse/recycling. The Committee agreed that waste prevention is the most desirable option. It is the option that the Agency's waste minimization program should strongly emphasize, but which has not been directly supported to date. From a practical standpoint, however, EPA may choose to include waste recycling and reuse in the program because, in many instances, this option will provide economic benefits to waste generators. The waste minimization research program should not include waste treatment because it is already addressed by other research programs.

Initially focusing the program on hazardous waste prevention (source reduction) and recycling was reasonable. The goal of the program, however, must remain protection of human health and the environment, rather than changes that merely result in avoiding the regulatory classification of a "hazardous waste."

Given these and other substantial research opportunities, the FY '89 budget proposal seriously underfunds the most promising opportunities to reduce the Nation's hazardous waste disposal problems. The program could effectively utilize double or triple the recommended level of resources.

3. Land Disposal

Although not widely acknowledged, land disposal must continue to be an integral part of the nation's waste management strategy. Other waste management options exist and should be used, but land disposal has a continuing, inevitable, and important waste management role for EPA and for the nation.¹⁰

EPA needs a strong and continuing land disposal research program to address such important issues as: a) the land disposal of ash from the incineration of hazardous and municipal solid wastes, very small quantity generator wastes, residues produced by best demonstrated available technology (BDAT) treatment of hazardous wastes, and large volume wastes; b) the proper design of Subtitle D facilities, including municipal landfills and industrial non-hazardous waste landfills and surface impoundments; and c) appropriate methods for the closure and post-closure

care of hazardous and non-hazardous landfills, surface impoundments and waste piles.

There is a need to evaluate and understand the long-term performance of what are now considered environmentally sound land disposal practices and the associated monitoring methods to assure that these practices are environmentally sound over many decades.

These needs are not recognized by the Congress and the EPA, and EPA does not have a waste management strategy that defines the continuing role of land disposal. Unless this is corrected, EPA and the nation will lack the scientific and technical knowledge necessary to the ongoing development of scientifically sound land disposal guidance and regulations. Congress and the EPA should provide adequate support for the Land Disposal Research Program so that it can continue to provide land disposal data and information and develop a mechanism so that individual shifts in Agency-wide priorities do not leave it devoid of an important capability. The proposed budget of \$2.5 million to support implementation of land disposal regulations essentially maintains the level of funding from the previous fiscal year. It also delays the Agency's capability to respond in a scientifically responsible manner to the growing number of land disposal-related problems that confront it.

4. Municipal Waste Combustion

The technology of municipal waste combustion has emerged as a major alternative to land filling for solid waste disposal in a number of urban areas. A number of scientific uncertainties, however, are associated with this technology including the characterization of emissions, including metals, from existing combustor stacks; identification of the products of incomplete combustion; ash disposal; determination of the transport, transformation and fate of emissions; exposure assessment and potential risk to humans and ecosystems.

In the past year, ORD has prepared a municipal waste combustion research plan. A SAB Subcommittee has reviewed the plan and concluded that because of budgetary constraints important areas are either omitted (such as evaluation of ecological effects) or are addressed in a superficial fashion.¹¹

The FY '89 budget proposal includes \$2.5 million for research on municipal waste combustion that will support efforts to develop emissions standards. This will enable ORD to conduct emissions tests at some existing facilities and to research various ash disposal techniques such as solidification. These represent important research needs, but they will not, taken alone, resolve the host of scientific questions and public concerns surrounding the siting and use of this technology. As a result, controversy and lack of public confidence in EPA decision making will persist, making it increasingly difficult to solve the nation's municipal waste disposal problem.

D. Pesticides/Toxic Substances

Research funding for pesticides and toxic substances in the FY '89 proposal has increased over the FY '88 appropriation. Individual research programs change also within the overall ceiling. An increase of \$1.4 million addresses pesticide research for destruction and disposal of pesticides that have been cancelled and suspended under FIFRA. Resources have been decreased by \$322,600 for development of asbestos monitoring and control technologies, a program scheduled for Science Advisory Board review later this year. A re-examination of the risks involved with the various alternatives for management of the asbestos problem is needed before major expenditures on removal and reconstruction is mandated by Agency rules.

1. Superfund Amendments Reauthorization Act (SARA) Title III Research (community right-to-know)

No new research monies were allocated in support of SARA Title III, although releases to the environment and inventories of chemical stocks in process will become public knowledge beginning in the last half of 1988 for several hundred chemicals handled in certain industrial categories. Congress should expand EPA's resources devoted to the development and interpretation of information on these chemicals in a form that can be communicated in response to questions from the public.

2. Biotechnology

Resources for biotechnology and microbial and biochemical pest control agents have remained at essentially at the same level since FY '87, or approximately \$6.9 million (\$4.1 in toxics, \$2.8 in pesticides).

The Biotechnology Research Review Subcommittee of the Science Advisory Board has just completed a review of the Office of Research and Development's Biotechnology/Microbial Pest Control Agent Risk Assessment Research Program.¹² The major recommendation of the Subcommittee is that EPA redefine its focus to emphasize three areas: 1) investigating and analyzing environmental effects, 2) developing control strategies for containment and mitigation, and 3) refining further applications such as protocols, microcosms, models and field tests. In light of the significant accomplishments of the program to date, primarily in developing methods for enumeration, identification and protection, the continuity in funding should enable this shift in focus to be made. Research is also recommended for determining the potential for environmental change that may result as genes may transform naturally occurring organisms.

3. Adipose Tissue Bank

The Agency currently plans to drop this non-ORD \$2 million program because of budgetary constraints. In the past, it has served as

an authoritative source of information on the accumulation or reduction of chemicals in the human body. It has reported, for example, the declining levels of polychlorinated biphenyls in human fat. The Subcommittee believes there is a national interest in maintaining the program. Whether samples need to be collected and analyzed on an annual or other basis should be formally evaluated by EPA in a report that should be submitted to the Congress. EPA should consider, for example, whether it is technically feasible or desirable to conduct periodic assessments similar to the National Health and Nutrition Evaluation Survey (NHANES).

E. Interdisciplinary Research

1. Reducing Uncertainties in Risk Assessment (RURA)

Research to support risk assessment is a primary function of ORD programs. Over the past several years Congress, the Science Advisory Board and EPA have recognized the need to modify or initiate research projects into a conceptual framework whose integrating theme is risk assessment. In the FY '88 Bipartisan Agreement, Congress mandated the establishment of a \$10 million research program to reduce uncertainties in risk assessment (RURA) but provided no new monies to conduct the research. This requirement has added considerable budgetary uncertainty to the task of reducing scientific uncertainty. EPA research managers, beginning in the summer of 1987, have invested enormous amounts of time planning scenarios to cancel or redefine existing productive research projects into order to conform to the budgetary requirements of RURA.

The FY '89 budget proposes an increase of \$7 million for this effort (\$3 million in FY '88) for a total of \$10 million. Since this increase results from the diversion of funds from other program categories, it is somewhat illusionary. To date, EPA has developed plans for defining priority research areas under RURA and prepared criteria for selecting projects. The plans and objectives for the RURA program might be usefully reviewed by the Science Advisory Board or another external peer review body.

The Subcommittee believes that research to reduce risk assessment uncertainties is a vital Agency-wide need. However, Congress mandated the program and the forced manner that EPA must adopt to ensure compliance with the Congressional objective does not give the Subcommittee a high level of confidence that good science will be produced. Changes of this magnitude often require a change in skill base and sudden changes can be disruptive to people and expertise now in place.

2. Exploratory Grants and Centers Program

Many of EPA's recent crises or priorities are issues for which there exists no consistent background research generated by ORD. These issues include, for example, stratospheric ozone depletion, the incineration of municipal solid and industrial chemical wastes, and residential radon exposures. Scientists have long-recognized the importance of these and other issues, but their efforts did not receive the necessary support, in part because they were not immediate regulatory priorities.

Many of these unanticipated issues have been addressed in research proposals prepared by scientific investigators at EPA funded academic centers and in individual research grant proposals submitted to the Office of Exploratory Research. Peer reviewers have judged these proposals to have scientific merit. Investigator-initiated research under the Grants program is predicted on the sound assumption that the scientific community has valuable ideas as to what needs to be done and has a good chance of providing information of an innovative nature. Unfortunately, the levels of financial support available for these proposed projects has been much too low for the past five years, and only a small fraction of the highly regarded and highly relevant proposals have been funded. This accounts, at least in part, for the lack of relevant data for decision makers where "new crisis issues" emerge. This development will continue to hobble EPA's ability to respond to new problems until a means is found to adequately fund research beyond the immediate regulatory needs. The proposed FY '89 budget fails to remedy the inadequate level of support for research grants.

The Congress has mandated that a portion of the Superfund research program be directed to the establishment of five centers for the exploration of hazardous waste site impacts. The FY '89 budget proposes approximately \$5 million for these centers, or a level of about \$1 million per center per year. This amount should provide a critical mass of resources necessary to attract qualified proposals from the university community and should lead to a productive research program. EPA should widely solicit research proposals for these centers (which will be managed by ORD's Office of Exploratory Research) and make the final selection on an independent, peer reviewed and competitive basis.

It is unfortunate that EPA's existing research centers, which were established to meet needs in areas as diverse as ecology, ground water, epidemiology, and control technology are being funded at levels deemed marginal by the scientific community. The Science Advisory Board, for example, has several times in the past recommended that the average funding level of these centers be increased from their current average of \$540,000 to a minimum of \$800,000 - \$1,000,000 per center. In view of the FY '89 funding proposal for the Superfund centers, and the productivity of the existing centers program, the Administration and the Congress should adopt a policy of parity and appropriate \$1 million for each of the existing centers.

F. Multi-Media and Energy Research

1. Acid Deposition

The ten-year research program mandated by the Acid Precipitation Act of 1980 is reaching closure, and this is reflected in the leveling off of funding for acid deposition research. From FY '87 to FY '88 EPA's program sustained a reduction of \$3 million, while proposed funding for FY '89 remains even at \$52 million, out of a total Federal research

budget of approximately \$83 million. EPA assumes that, by the end of FY '90, two thirds of the projects in the existing acid deposition research program will be completed.

The Subcommittee has two reactions to this evolution of events. First, it has supported a consistent funding base for acid deposition research because of the large scientific uncertainties and large societal costs associated with mitigating this environmental problem. Second, many other research priorities have emerged that also merit research support.

Under almost any set of assumptions, funding for acid deposition research will change and/or decline. The rate and direction of change should consider several factors. These include:

- o Much of the acid deposition research is linked to other environmental problems. The lake and stream surveys for example, provide a baseline for future research on these sensitive ecosystems.

- o Development of monitoring programs provide a capability, if continued, for establishment of "early warning" systems to detect ecological changes, and longitudinal analyses of acidic flux.

- o The acid deposition program can provide a scientific basis for a transition to a broader "ecosystems" research effort that could be used to better define sensitive ecological endpoints, develop and verify ecological risk assessment methods and evaluate ecosystem productivity.

The Subcommittee recommends that EPA prepare a research plan to identify options for the future role of acid deposition research and its relationship to other environmental research problems and opportunities. At the same time, Congress should support the level of funding proposed in the FY '89 budget.

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