United States
Environmental Protection
Agency

Office of the Administrator
Science Advisory Board
Washington, DC 20460

EPA-SAB/IAQTHE-89-010
December 1989

EPA

Report of the Indoor Air Quality/Total Human Exposure Committee (IAQTHE)

Review of the EPA Indoor Air Quality Implementation Plan

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

December 15, 1988

OFFICE OF
THE ADMINISTRATOR

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

RE: Report on the EPA Indoor Air Quality Implementation Plan

Dear Mr Thomas:

I am pleased to transmit via this letter the final report of the Science Advisory Board's (SAB) Indoor Air Quality and Total Human Exposure Committee (IAQTHE) on its review of the "EPA Indoor Air Quality Implementation Plan" as required under Sections 403(c) and (d) of Title IV of the Superfund Amendments and Reauthorization Act of 1987 (P.L. 99-499). This same report is also being transmitted to the Congress under separate cover as required under Section 403(d) of the Act.

The Committee found the Implementation Plan and its Appendices to be useful and well done. It is clear that the Agency has identified in a rather comprehensive manner the level of our knowledge concerning indoor air pollution. Nevertheless, the Committee was concerned that recommendations of earlier SAB review panels who provided advice on the total human exposure program in 1985 and the indoor air program in 1986 have not been addressed, particularly with regard to program management and strategic planning. These earlier recommendations and how they relate to the present review are discussed in the attached report.

The major conclusions and recommendations of the Committee concerning the Implementation Plan include the need for: development of criteria for establishing research priorities; a full time Director with expertise, authority, and direction to set-up an adequate program; adequate funding to support an effective indoor air quality program; coordination of research with other agencies; increasing the role of research on the sick building syndrome (SBS) and building related illnesses (BRI); more emphasis on strategic planning to address both long and short term goals; and, wide dissemination of EPA's research findings.

The Committee appreciates this opportunity to review and present our views on the Agency's Indoor Air Quality Implementation Plan.

Sincerely,

Morton Lippmann, Ph.D.
Chairman
Indoor Air Quality and Total
Human Exposure Committee

cc: Don Barnes
Erich Bretthauer
Eileen Claussen
Don Clay
Ray Loehr

THE SCIENCE ADVISORY BOARD
INDOOR AIR QUALITY AND TOTAL HUMAN EXPOSURE
COMMITTEE

REPORT ON THE

INDOOR AIR QUALITY IMPLEMENTATION PLAN

(As required by Section 403(d) of the Radon Gas and Indoor Air Quality Research Act of 1986)

December 15, 1988

SCIENCE ADVISORY BOARD
U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC

ABSTRACT

Under the provisions of Title IV of the Superfund Amendments and Reauthorization Act of 1987 (P.L. 99-499), the Science Advisory Board of the U.S. Environmental Protection Agency has established the Indoor Air Quality/Total Human Exposure Committee (IAQTHE) to review the Agency's Indoor Air Quality Implementation Plan and to provide continuing advice to the Administrator on indoor air issues. This is the Committee's first report, reflecting its views on the Implementation Plan forwarded to the Congress in 1987. The Committee's major recommendations include the need for: criteria for establishing research priorities; a full-time Director with expertise, authority, and direction to set-up an adequate program; adequate funding to support an effective indoor air quality program;coordination of research with other agencies; increasing the role of research on the sick building syndrome and building related illnesses; more emphasis on strategic planning to address both long and short term goals; and wide dissemination of EPA's research findings.

Key Words: Indoor Air Quality, Radon

U.S. Environmental Protection Agency

NOTICE

This report has been written as 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 or other agencies in the Federal Government. Mention of trade names or commercial products do not constitute a recommendation for use.

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B. Report of the Radiation Advisory Committee to the Indoor Air Quality and Total Human Exposure Committee

1.0 EXECUTIVE SUMMARY

The Indoor Air Quality and Total Human Exposure Committee of te U.S. Environmental Protection Agency's Science Advisory Board (SAB) was established under Section 403(c) of the Radon Gas and Indoor Air Quality Research Act of 1986.[1] This first report of the Committee concerns its review of the "EPA Indoor Air Quality Implementation Plan" (EPA/600/8-87/031, June 1987).

In general, the Committee found the Implementation Plan and its associated appendices to be useful and largely correct. The Agency has completed a fairly comprehensive review of the level of our knowledge concerning indoor air pollution and has identified numerous research needs. Nevertheless, some of the earlier recommendations concerning indoor air quality made by Science Advisory Board panels have not been addressed, particularly with regard to program management and strategic planning. These are discussed in the body of this report. Based on its review of the Implementation Plan, the Committee has reached the following major conclusions and recommendations.

a) The EPA must set-up criteria for establishing indoor air quality research priorities. Suggested issues include: identification of research gaps best addressed by additional human clinical and epidemiological studies, improved methods for estimating population risk to indoor air pollutants, development of a welfare component, and the possible contributions of other agencies in research efforts not traditional for EPA such as psychosocial research.

b) A full-time Director with specific expertise in indoor air quality is needed with adequate authority and direction to develop a research program in indoor air quality.

c) Adequate funding is needed. The present and proposed budgets are clearly insufficient to support an effective indoor air quality research program.

d) EPA should coordinate its own research program with research done at other agencies (especially within the Interagency Committee on Indoor Air Quality (CIAQ)).

e) The Sick Building Syndrome (SBS) and Building Related Illnesses (BRI) are increasingly being recognized as major components of the indoor air quality issue, and should have larger roles in the existing research effort.

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[1] Title IV of the Superfund Amendments and Reauthorization Act of 1987 (P.L. 99-499).

f) The research program must be developed with more emphasis on strategic planning in order to address short and long term goals.

g) EPA should insure that its indoor air research findings, after appropriate external review, are widely disseminated, especially to the public, and that these findings help form the basis for public policy decisions.

2.0 INTRODUCTION

2.1 Background

In passing the Radon and Indoor Air Quality Research Act of 1986, Congress formalized its recognition of the serious health implications of exposure to radon gas and other indoor air pollutants, and acknowledged its concern that existing Federal research into these pollutants was fragmented and underfunded.

Sections 403(a) and (b) of the Act directed the Administrator of the U.S. Environmental Protection Agency to establish a research program to address these pollutants. The research program was to be designed to include: data acquisition in order to better understand the health implications of radon gas and other indoor air pollutants; coordination of Federal, state, local, and private research and development; and assessment of Federal Government actions to mitigate environmental and health risks associated with indoor air problems. The Administrator was further directed to prepare a plan to implement the research program and to submit this plan to Congress. The preliminary implementation plan was submitted to Congress in April 1987, with the revised and expanded version submitted in July 1987.

Section 403(c) directed the Administrator to establish an advisory committee made up of representatives from the States, the scientific community, industry, and public interest organizations to assist him in carrying out the research program. This statutory advisory committee was formed under the Agency's Science Advisory Board as the Indoor Air Quality and Total Human Exposure Committee (IAQTHE).[2]

This Committee first met on November 19-20, 1987 to review the Implementation Plan, obtain program briefings from Agency staff, and to provide preliminary advice to the Agency concerning the research program. Since the Implementation Plan had already been submitted to Congress at the time the Committee conducted its review, recommendations concerning the Plan were provided

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[2] The Committee has also been charged by the Science Advisory Board with the responsibility for reviewing and providing advice on the Agency's Total Human Exposure Research Program.

orally at the meeting with individual written comments provided by Committee members following the meeting. Initially, the Committee planned to submit its comments to Congress on the Implementation Plan after the Committee completed its review of the report required under Section 403(e) of the Act. Since this latter report has not been made available for Committee review, it is not now possible to complete the Committee review until early 1989, therefore, the Committee has finalized its recommendations concerning the Implementation Plan in the interim in this report.

2.2 Charge to the Committee

Under the provisions of Sections 403(c) and (d) of the Radon Gas and Indoor Air Quality Act of 1986, the Committee has been charged with the following responsibilities:

a) To assist the Administrator in carrying out the research program for radon gas and indoor air quality [Section 403(c)].

b) Review the plan for implementation of the research program on indoor air quality and submit its comments on the plan to Congress [Section 403(d)].

The Committee has taken this charge broadly. Under Section 403(e) of the Act, the Administrator must submit a report to Congress which details his activities under Section 403, making recommendations as appropriate. At its November 19-20, 1987 meeting, the Committee provided the Agency with its comments regarding the preliminary outline of this report. Although not specifically mandated to review this particular document, the Committee recommended that under the provisions of Section 403(c), the Agency provide them with the opportunity to review the report and make appropriate suggestions prior to its submission to Congress. The Committee asked for the opportunity to review this report prior to its submission to Congress.

The Committee views its charge to include providing continuing scientific advice to both the Administrator and the Congress, as appropriate.

2.3 Previous Recommendations by Science Advisory Board Committees and Panels

On September 3-4, 1986, the SAB's Indoor Air Quality Research Review Panel publically reviewed the Agency's indoor air quality research program as part of the SAB's continuing series of research reviews designed to examine the research programs of the Agency's Office of Research and Development (ORD). The purpose of these reviews was to provide the EPA Administrator and the Assistant Administrator of ORD with insight as to their research programs. Specifically, the SAB reviews were to identify whether research was being done in a scientifically sound manner, and whether the research was appropriately targeted

to regulatory needs of the Agency. The present Committee (IAQTHE) is, in part, a successor to that earlier research review panel. With many of the former members serving on the present Committee an excellent link to previous SAB experience and deliberations concerning indoor air quality has been established.

The Indoor Air Quality Research Review Panel reached a number of pertinent conclusions that are appropriate to mention here since they are closely tied to the efforts of the present Committee. Their major conclusions include the following:

a) The Agency should develop and adopt a clear policy statement that indoor air quality is an important and essential part of its responsibility. This statement should clearly define the policy and program goals toward which the research is directed.

b) Responsibility for the indoor air quality program should be assigned to an individual of strong, proven leadership who has appropriate scientific stature and specific experience in this area, who would devote full time attention to this program and to the implementation of a research needs assessment.

c) An effective indoor air quality program must be multi-disciplinary with clearly recognizable goals.

d) The Agency should carefully articulate how it plans to integrate work carried out by other public agencies and private organizations into its own research program.

It appears that although much progress has been made, some of the previous concerns of the SAB have yet to be fully addressed. Through its implementation plan and supporting documents EPA has articulated policy objectives for its approach to characterize and understand human health risks from exposure to pollutions in indoor environments. Nevertheless, a strong program of research must emerge, not just a collection of competent research that is not always linked together.

The Agency has attempted to provide sound leadership for its indoor air research efforts, but still has not identified a single, well qualified individual to lead the program. The several managers who have been shepherding the program thus far are capable and are doing commendable jobs, however, the program would be better served by a full-time manager who is not splitting time with other major responsibilities.

Efforts have been made to provide adequate interdisciplinary links within the Agency to foster indoor air research. Nevertheless, a stronger programmatic strategy is needed to focus it. Such a strategy is only now coming about. Interagency coordination has developed considerably since the previous review, with member agencies of the CIAQ participating more, and with the EPA representative to that group being a senior manager in the indoor air program area within EPA.

2.4 Format of this Report

This report links earlier activities of the Science Advisory Board to the present effort in reviewing indoor air quality research programs. This report contains three sections which are: Policy Objectives and Research Strategies, Program Management and Coordination, and General Comments on the Implementation Plan. Detailed, specific comments from several Committee members concerning the reviewed documents are contained in Appendix A.

Since the SAB has a permanent standing committee on radiation - the Radiation Advisory Committee (RAC) - it decided that the RAC should perform the review of the radon gas portion of the Implementation Plan and provide its comments to the IAQTHE Committee. Three members of the RAC were appointed to serve on the IAQTHE Committee to provide a bridge. The general comments and conclusions of the RAC have been integrated into the present report, however, their complete report is included as Appendix B.

This report constitutes the formal report of the Science Advisory Board's Indoor Air Quality and Total Human Exposure Committee to Congress and to the Administrator of the U.S. Environmental Protection Agency on its review of the Agency's Indoor Air Quality Implementation Plan as required by Section 403(d) of the Radon Gas and Indoor Air Quality Research Act of 1986.

3.0 POLICY OBJECTIVES AND RESEARCH STRATEGIES

Although not specifically charged with responsibility to regulate indoor air pollutants, EPA is still the Federal agency for which indoor air quality is closest to its central mission. The Agency does regulate some indoor air pollutants through other means. For example, household pesticides are regulated under the Federal Insecticide, Fungicide and Rodenticide Act, and toxic chemicals under the Toxic Substances Control Act. While this creates some degree of control over indoor pollutants, it is not an integrated approach to the problem. The ability to enforce regulation of indoor exposures is severely limited by physical, fiscal, and political constraints. Therefore, alternatives such as education and licensing (or authorization or certification) of those responsible for providing indoor air quality should also be considered.

4.0 PROGRAM MANAGEMENT AND COORDINATION

4.1 Internal Management

The U.S. Environmental Protection Agency has completed a fairly comprehensive review of the status of our knowledge of indoor air pollution, identifying a number of research needs

along the way. In order for it to meet its stated policy objectives, it is crucial for the Agency to establish research priorities and design a research strategy which will address short and long term goals. The current research program is one of default, i.e., it was constructed from already existing lines of research. There are few clear directions for the future in the existing program. Although many of the ongoing research projects address important indoor air quality problems, there are also instances in which projects or components of projects are rather peripheral and/or repeat work which has already been done.

It is critical to the success of the indoor air quality program that the Agency appoint a full-time Director for the program with specific expertise in indoor air quality and that he or she be given adequate authority and control of budget to establish research priorities, and to design and implement a strong research program. The fact that the Agency has not yet designated a single director suggests a half-hearted committment to a program which Congress clearly views as important. Because of the limited resources which will be available to this program over the next few years, this Director must also be able to effectively collaborate with other agencies through the CIAQ in order to stretch resources to meet stated goals. Although a single, senior Director is needed to focus the indoor air quality program, we must compliment the current managers for having accomplished as much as they have with such a fragmented and poorly supported effort.

4.2 Interagency Coordination

It is likely that some of the research being performed at other agencies can help to meet national and EPA research needs. Good communications and relations between agencies will be essential in this effort. It would be desirable if other members of the CIAQ provided a listing of indoor air quality research projects for each of their agencies, much like EPA has done in Appendix B of the June 1987 Implementation Plan. This would be useful to EPA in avoiding duplication of research efforts.

4.3 Budgetary Constraints

The EPA indoor air quality budget is simply inadequate to meet the needs of the program as stated by the Agency, even with its present narrow focus. This is a problem that can be traced to inadequate funding from Congress as well as a less than aggressive approach from EPA in seeking expanded funding. For example, in FY88 the budget allocated to the Office of Research and Development was $2.3 million, with an additional $0.3 million going to the Office of Air and Radiation. This issue requires further attention from both Congress and EPA.

A possible mechanism of funding that has not been sufficiently utilized is the EPA's Extramural Exploratory Research Grants Program. For FY 88 and FY 89, this program has about an $8 million budget, reduced from about $11 million in

FY87. This represents a significant reduction from the 1981 figure of nearly $30 million (calculated in constant 1988 dollars) . The Grants program is very useful for funding the more risky long-term and exploratory research that is difficult for the Agency to carry out internally or through cooperative agreements. A major strength of the program is that it is a peer-reviewed process. If the Congress provides increased funding to the Extramural Exploratory Research Grants Program directed towards Indoor Air Quality this would provide a strong stimulus towards innovative research in this area.

5.0 GENERAL COMMENTS ON THE IMPLEMENTATION PLAN

5.1 Radon Gas

From the perspective of radon research, we believe the Implementation Plan is satisfactory. However, we are concerned with recent information regarding the status of the National Radon Survey, which is included as part of the plan and which has been specifically mandated by Congress. At the fall 1988 meeting of the SAB's Radiation Advisory Committee (RAC), it was noted that funding for the National Radon Survey has been eliminated in the budget plan for FY 1989. We can understand that faced with limited funds and unlimited demand, it might be decided that this relatively expensive project should be deferred or even cancelled all together. We find this troublesome, however, since without this authoritative survey, it is going to be very difficult to decide how to attack the indoor radon problem. It is certainly recognized that risk from radon in indoor air ranks highly among total airborne constituents known to be present in most buildings.

We believe that it is essential to obtain a reasonable quantitative estimate on the magnitude of the indoor air radon problem. This step can best be taken with the proposed National Radon Survey. It is therefore strongly recommended that this survey be supported and carried out as soon as possible.

Further detailed comments are contained in the report of the Radiation Advisory Committee to the IAQTHE Committee - See Appendix B. Individual comments from Dr. Samet concerning radon are included in Appendix A (see pages A-4 through A-6).

5.2 Other Indoor Pollutants

The balance of concern is still biased heavily toward residential environments rather than a dual approach that also considers commercial and public sector/public access buildings. We were surprised that the document contained no risk assessments, and the report claimed that risk assessments for populations are not presently possible. Although we agree that such assessments are difficult, they are not impossible as suggested by EPA's Scoping Study on Indoor Air Quality (prepared

by the Office of Program Development (OPD) of the Office of Air and Radiation) which contains a substantial effort to do such assessments. The reader of the two documents is left uncertain if OPD and ORD are communicating with one another.

5.3 Sick Building Syndrome and Building Related Illnesses

Although the sick building syndrome (SBS) and building related illnesses (BRI) are two of the most important aspects of the indoor air quality problem, they were essentially left unaddressed in the document, playing minor roles in the research effort. The importance of SBS for the productivity and well-being of workers in non-industrial environments mandates a high priority. There should be a thorough discussion of the sick building syndrome and its symptoms, building related illnesses and their clinical signs, the multi-factorial nature of the causes of SBS (including psychosocial parameters), the methodology used to study SBS and BRI, and the present inadequate state of knowledge of these manifestations.

5.4 Workshop on Strategy

The lack of a more coherent strategy may be due, at least in part, to the fact that EPA did not fully address the recommendations of the 1986 SAB Indoor Air Quality Research Review Panel. Whatever the reasons, it is important that EPA develop a strategic plan for its research effort. In the document, EPA points out that additional workshops will be held to improve the document. If additional workshops are to be held, we strongly recommend that the next one address the improvement of the research strategy. The Committee is willing to assist EPA in developing such a workshop and is willing to have its members participate in it.

The major goal of the workshop would be to develop an overall strategy for establishing indoor air quality reseach priorities. Topics that should be addressed include: methods for estimating population risk to indoor air pollutants; identification of research gaps in the present program; the identification and role of research not traditionally carried out by EPA, such as the SBS, biological and psychosocial research; methods for setting research priorities using the above information; and the role of other agencies in funding such research.

APPENDIX A

SPECIFIC COMMENTS ON THE IMPLEMENTATION PLAN AND ITS APPENDICIES

Dr. Joan Daisey	A-1
Mr. Seymour Jablon	A-3
Dr. Vic Laties	A-3
Dr. Jon Samet	A-4
Dr. Jerome Wesolowski	A-6

COMMENTS FROM DR. JOAN DAISEY

Appendix A:

p. 1-7: Some relative risk estimation is feasible at present, e.g., radon, VOC.

p. 2-5, Table 2-1: This type of information can be helpful in establishing research priorities. The figure of 4% of the population exposed to gas phase organics, in the table, is ridiculous. The TEAM (Total Exposure Assessment Methology) study as well as others have demonstrated that this figure is more like 100%!

p. 2-29: The last sentences of paragraph 2 and 3 contradict each other.

p. 2-110ff: The whole issue of samplers for VOC needs a critical look. Sampler development must be well integrated with overall EPA research objectives. The cannister sampler has been very strongly pushed for VOC despite the success of the adsorbent sampling method used for the TEAM study. The cannister samplers were originally designed to take grab sampels in remote locations where levels are low. They are very bulky to handle and ship and require expensive controls in order to be used to obtain an integrated sample. The Tenax adsorbent sampler also has some limitations with respect to the compounds which it can collect. However, there are commercially available multi-sorbent samplers which can be used to extend the range of compounds sampled. The multi-sorbent sampler has been used at LBL (Lawrence Berkeley Laboratory) for indoor air studies and shown to have very high accuracy and precision. It is quite feasible to develop sorbent samplers for more reactive and/or polar compounds for use in field studies. Project 13 in the Research Program (Appendix B) is an Assessment of Screening (Sampling, presumably) Techniques for Indoor Air Pollutants. A very critical look at the cost-effectiveness of the various sampling devices available, their specific applications, the need for each application and at their acceptability to the public since they must be used in homes, buildings, etc., is needed. It is not clear why a field test is needed in this project since most of the devices mentioned have already been widely used in the field.

Appendix B:

Project 14 - Why are there plans to develop a method for nicotine? Dr. Hammond has developed a very good sampling and analysis method for this compound.

Project 15 - Are there plans to couple a micro-processor with the realtime NO_2 monitor?

Section I.A.2.a. The strategy for this needs to be discussed.
Section I.B. Item number 1 should be "Scope of the Problem."

COMMENTS FROM MR. SEYMOUR JABLON

Implementation Plan:

Page 5: The very first item under the general heading of 'Indoor Air Policy Objectives and Strategy' refers to the intent to "...refine its assessment of the nature and magnitude of the health ... problems posed by individual air pollutants...". This general intention is specified with respect to radon on page 15 of Appendix C. 'EPA Radon Program.' There, the first item under the heading 'Radon Exposure and Health Risk' is: "Conduct a National Assessment of Representative Structure Types and Geographical Locations."

The EPA clearly realizes that the data presently available concerning the distribution of radon levels in residences, workplaces, schools and other public buildings is inadequate: there are available surveys in particular places, often relying on volunteers, using a variety of measurement devices. Something like ten percent of the housing stock of the country may exceed the recommended guideline of 4 pCi/1 for radon. As the experience with the Reading Prong made plain, there can be large areas where, unsuspected, residents may be exposed to high, and dangerous, levels of radon. The proposed assessment is, therefore, not only highly desirable but needed urgently. In the face of this need, which is recognized by EPA, it is disturbing to learn that despite the fact that the proposed survey has been in the planning and review process for years, there are no funds in the FY 88 budget for the survey. I would point out that the Plan, as reported to the Congress, is apparently not supported by the intention to act, at least not this year. I regard this as very unfortunate, to say the least.

Preliminary Outline:

To my untutored eye, the Outline seems quite thorough and complete. I presume that the Radon Measurement Proficiency Program would come under Volume II, Iv.,B.,1. "Radon Exposure and Health Risks". This is an important program, especially since it seems quite possible that EPA will one day be mandated to certify organizations that offer measurement services and having this program in place, with the kinks worked out, will be very helpful.

COMMENTS FROM DR. VIC LATIES

Implementation Plan: Objectives and Strategy Section (pgs 5-7):

1. The section seems too focussed upon EPA's own intramural activities. Nowhere does it recognize efforts within the

environmental health sciences by other parts of the Agency itself or by other parts of the Federal government. For instance take the first point: "The Agency will conduct research and analysis to further refine its assessment...." This statement, coupled with the appendix outlining what intramural work is being done, pays no attention to EPA's Extramural Exploratory Research Grants and Centers program, which can support research at universities on questions of interest to EPA. I have been sensitized to the role of that effort by service on one of its study sections and think that EPA gives it too little support. This report ignores its role in generating the interest of the larger university community in problems associated with indoor air quality. EPA's intramural scientists however worthy simply can't solve all the many problems in this vast area by themselves.

2. Emphasis on improving exposure data and on modeling seems excessive to me. These are important topics but our knowledge of health effects remains weak for many of the substances important for indoor air quality. No other agency has either the enduring interest in air quality or the in-house expertise to run a program in that area. EPA should support research on the health effects of air quality. If it does not, the whole area is likely to wither away.

COMMENTS FROM DR. JON SAMET

With regard to the "EPA Indoor Air Quality Implementation Plan", I have only brief comments to offer. I concur with the overall objectives, but have some concerns about the approach that will be taken to meet the first objective, "Problem Characterization." The strategies listed are largely directed at describing the overall extent of the indoor air quality problem, largely by combining a description of exposures with risk assessment methodology. Does this strategy represent the appropriate basis for problem-solving or merely provide more elegant descriptions of problems that we already know about? He need strategies for identifying those individuals placed at high risk by their individual exposures; without this capability, interventions to reduce health effects will be unsoundly based.

I see the work scopes described under "Problem Characterization" as not appropriately balanced between studies of exposure and of health effects. Inevitably, a risk projection model will indicate health effects for many exposures that are likely to be measured in U.S. homes. However, these risk assessments will be subject to substantial uncertainty unless appropriate laboratory, clinical, and epidemiological studies are planned and performed.

With regard to Appendix C "EPA Radon Program," I think that the Committee should have access to materials that are mentioned in the document to fully understand the current radon program. The

Committee should review the methodology for assisting states in conducting radon surveys as well as educational materials for the public and for the "Radon Diagnostician" training course. I recognize that the SAB has had involvement with the national radon survey; nevertheless, I would suggest review of materials related to this project as well. Likely of necessity, the description of the radon program is brief, and I think that our Committee needs access to the background documents that I have mentioned.

I agree with the overall goals as described on page 12 of Appendix C. In the face of the extensive evidence on lung cancer already available, the immediate goals must be reduction of exposure in existing homes and the development of strategies to prevent problems in new homes. I am also in agreement with the strategy, as outlined on page 13, and the broad structure of the implementation plan, as outlined on pages 14 and 15. However, I do have comments about specific items within the indoor radon program.

With regard to the proposed national survey, the overall goal of describing exposure in the United States is appropriate. However, if the survey tells us little about the determinants of levels in homes, what will be gained beyond a description of exposure, presumably followed by a risk assessment, that will ultimately document a known hazard? While we do not have data from a soundly based nationwide sample, several data bases, including those reported by Nero and by the Terradex Corporation have provided substantial insight into the distribution of levels. It seems unlikely that the findings in a nationwide sample will be strikingly different from the information already available.

It would be most unfortunate if the national survey were not used to answer important questions related to the determinants of levels in homes. Consideration should be given to using the sample as the basis for more detailed studies, perhaps directed at homes with higher and lower levels. Geology and house characteristics, such as ventilation rate, might be assessed for a more limited sample of homes. A scientific basis for predicting concentrations in individual homes is badly needed for the purpose of mitigation.

I would like to learn more about the state surveys that are being conducted. Have standard methods been developed that are used by all the states? How are the samples obtained? Will the data be merged and analyzed centrally at EPA? Data collected by the states could be quite informative, but might also be misleading if proper sampling procedures have not been followed nor careful quality assurance programs maintained.

Similarly, are measurements made by commercial firms reported to EPA? If not, could EPA consider obtaining such measurements, perhaps as a requirement for certification. The resulting data

base could become quite useful for describing the higher end of the distribution of radon levels.

The introduction to the document on page 12 confuses the concept of attributable risk. For exposures that interact synergistically, such as radon progeny and cigarette smoking, attributable risk estimates may add to greater than 100%. This property of the attributable risk statistic means that even though 85% of all lung cancer deaths are attributed to smoking by the Surgeon General, more than 15% could be attributed to radon. The proportion of lung cancer deaths attributable to radon should not be considered to be the ratio of 5,000 to 20,000, estimated for radon, to the total of approximately 130,000 lung cancer deaths per year.

I have also reviewed the few pages in Appendix A concerning radon. The material on health effects and dosimetry is brief and misleading in some respects. If the document is revised in the future, I would suggest an improved discussion of dosimetry, and inclusion of certain key references in place of those that are used in the present document. The discussion of factors described as influencing radiation dosage to the lung is confused and incorrect in some respects.

COMMENTS FROM DR. JEROME WESOLOWSKI

Appendix A - The Assessment:

General Comments:

In general I found the report contained useful and mostly correct information. However, considering that this is not the first draft, there was a surprising amount of incorrect information. In fact, parts of the report appear to have been written by staff unfamiliar with the field. I trust the following comments will help improve the report.

I was surprised that the report contained no risk assessments and that the authors explicitly state (p.1-14) that ...risk estimates for populations are not presently possible. Although I would agree that risk estimates for populations are very difficult I do not understand why EPA's ORD thinks they are not possible when the Scoping Study on IAQ recently prepared in draft form by OPD of EPA contains a substantial effort at doing just that. For example, there is a table in the Scoping Study of estimated individual lifetime excess cancer risks of volatile organic compounds and pesticides. Perhaps the ORD authors are trying to say that the total risk due to all pollutants cannot be estimated. Nevertheless the reader of these two documents is left with the impression that ORD and OPD have different views on the efficacy of IAQ risk assessment. The two offices should work more closely in the preparation of IAQ documents so that such fundamental differences can be resolved.

Although the so-called Sick Building Syndrome (SBS) is one of the most important aspects of the IAQ problem. it was essentially left unadressed in this document. There should be a thorough discussion of the Syndrome, the symptoms, the multi factorial nature of the causes (including psychosocial parameters), the methodology used to study SBS, and the present inadequate state of knowledge of this problem. Although there is a short Chapter on "Building Systems" (which may have been intended to address the SBS) it was rather superficial, incomplete, and did not address the above stated issues.

Although the authors state that EPA is adopting a "dual" approach to IAQ (cf. p.1-4), viz. sources and building types, the report neglects to discuss building types (the "Building System" chapter makes no mention of types). I don't believe the authors really mean EPA will address the IAQ problem by studying building types (although such a categorization is useful), but rather that studying individual sources is not sufficient but must be complimented with studies of the multi-factorial causes associated with buildings and building systems. They say something similar to this on p.1-4. However the report is heavily weighted towards individual sources. Thus, it does not in fact reflect a dual approach. Again this could be remedied by a thorough discussion on SBS and by improving the "Building Systems" Chapter.

In general the report is a useful start in assessing current IAQ information, but unless the weaknesses described above are addressed it will be of limited value, and in fact could be misleading enough to make intelligent choices for research priorities difficult.

Specific Comments:

p.1-7. Although "Estimation of health hazards from specific indoor situations or sources may be more useful than trying to derive risk estimates ..." (after all many inhabitants are not really interested in specific risk numbers). However risk estimates are still needed in order to establish research priorities for the Agency.

p.1-7. Dividing combustion products into combustion gases, combustion particles, and combustion organics could be confusing. For example, formaldehyde is a combustion gas, a noncombustion gas, a combustion organic, and a non-combustion organic. To demonstrate this possible confusion I note the awkward sentence on p. 2-123, "One noncombustion gas-phase organic compound is formaldehyde which is also a product of combustion". A better definition might be "Combustion products can be divided into inorganic gases, principally nitrogen dioxide, carbon monoxide and sulfur dioxide, particles, and organic compounds, including PAH and formaldehyde".

p. 1-7 Par.3, 1st sentence. Insert the article "as" before "an 8-hour day".

p. 1-8. The section on carbon monoxide should record that approximately 1,000 persons die accidentally each year in the United States of carbon monoxide poisoning, about 800 from motor vehicle exhaust and 200 from incomplete combustion of domestic fuels. This does not include about 300 who die in industrial accidents. And it should be noted that this death rate is not based on fragile epidemiological associations, but on actual mortality records. (It also does not include those who die of accidents caused by CO-induced mental impairment.)

p. 1-11. The first two sentences of the first paragraph are not complete.

p. 1-10. The sentence "Only some of these organics have been identified, fewer have been quantified" should be changed to read "Only some of these organic compounds have been identified, fewer compound's emissions have been quantified", since organic is an adjective not a noun.

p. 1-10. Should "One to 3 ng/m^3" be "One to 3 ng" or "should 20 to 50 ng" be "20 to 50 ng/m^3"?

p.1-10. The statement "It's primary source ... is ETS..." needs a reference since some believe that poorly adjusted unvented combustion appliances contribute to far larger concentrations than does ETS.

p. 1-11. Calling noncombustion gas-phase organics VOCs is indeed a misnomer. But scientists do not usually make this mistake. Why does this report imply that it is common? Organic compounds have been classified as VVOC--very volatile (or gaseous) organic compounds with boiling points from: 0 to 50-100 degrees C; VOC--volatile organic compounds with boiling points from 50-100 to 240-260 degrees C; SVOC--semi-volatile organic compounds with boiling points from 210-260 to 380-400 degrees C; and POM-- organic compounds associated with particulate matter with boiling points >380 degrees C. For the most part, these groups are operationally defined by the manner in which they are collected. The so-called misnomer is caused by the clumsy terminology coined by this report, noncombustion gas-phase organics.

p. 1-11. The Danish studies referred to did not demonstrate that 5 to 25 milliqrams per cubic meter caused synergistic behavioral changes. The work simply concluded that "Healthy persons with indoor climatic complaints react acutely to both 5 and 25 milligrams per cubic meter of a mixture of typical indoor climate pollutants." At no point did they claim that this demonstrated synergistic effects.

p. 1-11. According to Molhave, the particular organic compounds and the concentrations of these compounds are based upon residential indoor air not the air in office buildings.

p. 1-11. "However, no health effects data is available... should be "data are".

p. 1-11. Despite the statement that exposures to organic compounds cannot be estimated at this time, WHO believes that an estimate of exposure to many organic compounds is possible and has done so in a draft report that is currently being reviewed.

p. 1-12. "The extent of exposure (to formaldehyde) in environments other than mobile homes has not been estimated" is incorrect. SAI in a study funded by the Calif. Air Resources Board has measured the formaldehyde concentration distribution in typical California housinq (as reported in the 1983 National Consensus Workshop for Formaldehyde in Little Rock, AR), and LBL in a study funded by BPA measured the concentration distribution in 40 office buildings in the Pacific-Northwest (as reported at an APCA national meeting).

p. 1-12. Radon is also actively monitored.

p. 1-13. The statement "Since they are organic substances, primarily in the vapor phase" is incorrect and contradicts the statement that they are SVOC in the same sentence. SVOC have boiling points ranging from 210-260 to 380-400 degrees C. Compounds with such high boiling points will not exist primarily in the vapor phase.

p. 1-15. Table 1-1 indicates that there are no CO active samplers for use indoors. GE manufactured a small active sampler for use indoors. This is the sampler used for EPA's Denver and Washington studies. This sampler is described in detail on p. 1-19 of this report. Further, this table seems to be making a distinction between passive samplers used for area sampling and samplers used as personal exposure monitors (PEM). For the most part this is a distinction in use not in the actual monitor, in that a monitor suitable for area monitoring often oould be used as a PEM. e.g.. a Track-Etch radon detector could be worn as a PEM.

p. 2-1. The authors state "...individual pollutants from such a source are measured and correlated with source presence or use, but other emission components are not measured." What is meant by other emission components? If the authors mean not all pollutants from a source have their emissions quantified, they should say that.

p. 2-4. The authors state "...and usually the emission, of a very complex mixture of organic and inorganic gaseous and particulate pollutants. In addition, the complex mixture that results from incomplete combustion can contain a variety of other volatile and semivolatile, polar and nonpolar chemical products." The use of the word "other" notwithstanding, the second sentence merely repeats the message of the first.

p. 1-12. The authors should refrain from using such mass-media jargon as "formaldehyde is a suspected actor in the sick building syndrome." Further, why single out formaldehyde as one of the factors in SBS?

p. 1-18. There are typographical errors in the last three columns of the E.T.S. section of the Table.

p. 2-1. Again, one doesn't normally refer to noncombustion and combustion particles but rather to particles and combustion-generated particles. Likewise one does not normally refer to noncombustion gas-phase organic compounds but to organic compounds and combustion-generated organic compounds.

p. 2-2. The authors bring out the important difference between exposure, concentration and dose. However, they use two expressions for exposure, viz. "nominal exposure" and "exposure." They never state the difference between exposure and nominal exposure.

p. 2-4. The authors state the lower tail of distribution can identify especially sensitive populations." It is not clear how an exposure distribution will identify who is sensitive in the population.

p. 2-4. The authors state risk estimates for populations exposed to indoor air pollutants are therefore premature." Refer to an earlier general comment on this issue.

p. 2-41. The section on Sulfur Dioxide is structured differently than those on Carbon Monoxide and Nitrogen Dioxide, specifically exposure and conclusions are missing, as well as the opening paragraph describing the compound. Furthermore, the first paragraph on monitoring discusses particulate matter, not sulfur dioxide.

p. 2-6. Nitrogen dioxide and sulfur dioxide are indeed products of complete combustion, certainly not of incomplete combustion.

p. 2-8. I suspect that the statement that most American homes use natural gas and that most do not vent the combustion products outdoors is in error. It likely true for gas ranges and ovens but is not true for water heaters, wall space heaters and furnaces. A reference is needed.

p. 2-9. The GEOMET Technologies, Inc. reference that burner design does not influence emissions is out of date. Research by the Gas Research Institute has produced a burner design that appears to reduce NO_2 emissions. Research by LBL for the US CPSC showed substantial differences in NO_2 emissions for unvented gas-fired space heaters even after adjustment for heat output which was attributed to differences in burner design.

p. 2 9. Last paragraph: 500 and 600 hours should be 500 and 600 homes.

p. 2-14. Traynor conducted a study measuring the emissions of NO, NO_2, CO, and CO_2 from several wood stoves. This study should be referenced.

p. 2-16. "The absence of reliable emission factors from the indoor sources makes it impossible to establish a relative ranking between.." This statement is simply not true. The emission rates illustrated in Table 2-6 vary for well known reasons: 1) the rates listed are for appliances with different combustion rates, e.g., the emission rates for the gas space heaters were obtained from heaters whose inputs ranged from 12,000 BTU/H to 40,000 BTU/H, and 2) contrary to the statement on p. 2-9 burner design does affect emission rates. Moschandreas has conducted and reported upon an extensive study of the various test methods and showed that the various methods generally gave oomparable results within the experimental errors produced by state-of-the-art instrumentation.

p. 2-17. What are the authors referring to as unburned benzene hydrocarbons? What is a benzene hydrocarbon? How is it different from benzene? Do they mean aromatic hydrocarbons? Are they referring to PAH? If so, strictly speaking, they probably should not be referred to as unburned since they are formed in flames and are in a sense combustion generated.

p. 2-17. Emission rates from combustion appliances <u>are</u> well known with the exception of SVOC. It has not been demonstrated that these are produoed in sufficient quantity to warrant extensive study to obtain these rates.

p. 2-26. In contrast to what is implied, cigarettes are a minor source of NO_2. One could not measure the rise in NO_2 in a room where a cigarette is smoked (see for example, Good, Eviron. Int. <u>8</u>, 1982).

p. 2-29. Systems designed for monitoring NO_2 in ambient air have been employed to monitor it in indoor environments in many studies. Improvements would be very welcome but it is not true that the systems are too large and complex to be used indoors. It's been done frequently.

p. 2-30. It is unlikely that NO_2 is absorbed by materials: it is adsorbed. In addition, there are studies which have quantitated this effeot for various materials. These results and references should be added to this report.

p. 2-31. How do you "roughly assume"?

p. 2-41. The authors have offered no proof that, NO_2 is likely to have either an additive or synergistic effects with other

indoor pollutants." In fact, the statement contradicts the one on p.2-31 which states "Thus we have no significant knowledge of additivity, synergism, or antagonism associated with NO_2 in mixtures with other combustion products, much less with the full range of indoor air chemicals."

p. 2-110. The discussion regarding the variation of emission rates from adhesives is somewhat naive, indicates a lack of knowledge of the studies in the Table, and the authors implication that there is a right answer is incorrect. Certainly temperature is important. For "wet" building materials such as adhesives the age of the material is very important. The relative humidity may be important for certain products because of the specific chemistry involved, e.g., formaldehyde from urea-formaldehyde remains because of hydrolysis; product loading may also be important for products which contain the chemical as a bulk constituent, e.g.. again formaldehyde in urea-formaldehyde resins and p-dichlorobenzene in moth crystals; air exchange rate, per se, is probably not important but the local velocity of the air stream near the boundary layer may be very important. Unfortunately the report misses the major surprise of Table 2-23: the rates listed are amazingly similar when one considers that 1) the aqes of the adhesives range from 0.5 h to 14 days: 2) the chamber volumes ranged from 3.8 L to 1000 L; 3) air exchanqe rates varied from 0.04 h-1 to 14 h-1; and most importantly, 4) it is highly probable that none of the researchers were testing the same adhesive from the same manufacturer with the same formulation. Why would anyone expect to measure the same emission rate from different products? Presumably some of the adhesives even came from different continents. One of the major points of the study cited which examined 15 different adhesives (Girman et al., 1984b) was that there were large variations in organic emissions from different adhesives, even those with the same nominal application (and this from a study that used the same methodology in determining rates so that the comparison should be valid).

p. 2-42. The authors state that"...particulate matter consists of liquids, aerosols or solid particles ...". Aerosols are not a type of particulate matter. An aerosol is a gas system with solid and/or liquid particles dispersed in it.

p. 2-47. The reference to Sexton and Repetto (1982) concerning the mutagenic density for cooking stoves and cigarette smoke is incorrect. The correct reference is Sexton et al., 1984.

p. 2-50. The authors state that human exposures to inhalable particulate ... probably has increased due to concentrations of fine aerosols or ultra-fine particulates generated within homes and offices." What is the evidence for this increase?

p.2-61. Change PNA to PAH.

p.2-63. The authors state that "... nonpolar fraction...only accounts for about one-third of the mutagenicity...". Because one-third is larger than usually reported, a reference here is important.

p.2-64. The last sentence of 2.3.7 and the first of 2.3.7.1 are almost identical.

p.2-64, Sec. 2.3.7.1 In their article, Pandy, et.al. did not say the dwellings were "unventilated" but only "illventilated" cf. (p.414 of Vol. 4 of Stockholm conference).

p.2-122. A more recent paper on the "Bake-Out" procedure is: Girman, J., Alevantis, L., Kulasingham, G., Petreas, and Webber, L.(1987) "A Bake-Out of an Office Building" proceedings of the 4th International Conference on Indoor Air Quality and Climate, Berlin.

Table 2-39. A more recent paper which demonstrated irritant effects to be associated with HCHO exposure in a state-wide random survey of mobile homes is: Liu, Kai-Shen; Huang, Fan-Yen; Hayward, S.B., and Wesolowski, J.J. (1987). "Irritant Effects of Formaldehyde In Mobile Homes", proceedings of the 4th International Conference on Indoor Air Quality and Climate, Berlin.

p. 2-95. Top of page -It might be worth noting that the amphiboles are also more resistant to acid than is chrysotile. This is especially true of crocidolite.

p. 2-95. One of the more important uses of asbestos has been in spray-on fireproofing and acoustical insulation.

p. 2-96. Many of the studies mentioned in this report measured concentrations of airborne asbestos in ng/m^3. Such measurements involve the use of indirect preparation, including ashing and sonic dispersion. This means that the results are not interpretable in terms of fiber concentration or fiber size. In most of these studies this is not a serious flaw, as long as fairly high concentrations are detected. However, the Sebastien study on floor tile should have been repeated using direct methods. This is because it is not clear how much the fibers were bound in a vinyl matrix, which would have been oxidized and removed by ashing. Thus fibers might have been counted which may or may not have been biologically relevant.

p. 2-97. Top of page- Most fibers are not too short to be detected in the optical microscope. They are simply too thin.

p. 2-97. Bottom - Chrysotile identification by morphology is not enough. Electron diffraction is required for positive identification.

p. 2-99. The relationship 300 ng/m^3 = 10,000 fibers/m^3 seems rather high. A reference is needed. Our work would indicate that 10,000 fibers /m^3 usually equals approximately 0.1 to 1 ng/m^3.

p. 2-103. A discussion of asbestos in homes would be appropriate.

p. 2-130. Polonium 214 decays to lead-210 with a half-life of 164 microseconds, rather than 22 years. It is lead-210 that has a half- life of 22 years.

p. 2-131. The text states that radon decay products are very small particles which agglomerate rapidly and readily attach to surfaces. Of course atoms can be considered particles in the wave-particle quality sense. However, it would be more informative just to say that the decay product atoms are solids at room temperature, so that when they are produced by the decay of the radon gas atoms, they readily agglomerate or attach to surfaces.

p 2-131. Bottom of the page- The lower limit of detection for radon in air is listed as 500 pCi/m^3(0.5 pCi/1). Since the report lists levels measured in outdoor air which are lower than 500 pCi/m^3, this is clearly not a lower limit of detection for some methods. Even for methods typically used in indoor air, lower limits of detection are commonly achieved using longer integration times.

p. 2-132. Bottom of the page- "The radon is released from the water at elevated temperatures, and when the water is..." should read "Radon release from the water increases as the water temperature increases, or when the water is..."

p. 2-134. How could comparison to the National Ambient Air Quality Standard for particulate matter be illuminating in any way?

p. 2-137, 2-138. It does not make sense to state that the link between a given air concentration of radon and the consequent radiation dosage involves the ratio of indoor radon levels to outdoor levels.

p. 2-146, second to last sentence. "Typo on knowledge".

p. 2-146. This section should briefly discuss the measurement units that are often used, viz., cfm/m^3. The previous section should discuss typical values found, as well as the generally accepted "consensus" standard of about 1000 cfm/m^3.

p. 2-163. The authors state that "Biologically relevant exposures to electric and magnetic fields ... are widespread." They give no definition of "biologically relevant". If, as I suspect, they are referring to health endpoints studied in the

various experiments discussed subsequantly, then they should change the word "are" to "may" since, as the authors themselves state (p.2-167), "There are data consistent with a possible (my emphasis) connection between exposure....".

p.4-1. Odors is discussed in the welfare section. It would be interesting to state why here instead of in the health section, say under a comfort heading.

p.4-22. First paragraph, second sentence. Delete "in" ?

p.5-1, last sentence of introduction. Insert the word "to" before " a source...".

p.5-11. The authors state that "...the problems are caused by a mixture of pollutants and by the interaction of these mixtures with the building system." Although this may be true in many cases, there are others where the problem is caused by a single parameter. e.g. excess CO. Further,. the interaction can be with more than just the system, e.g. it can be with psychological, psychosocial factors, etc.

p.5-1. It is not clear what the difference is between two of the six categories, "building system source and sink effects" and "effects of sources and sinks". Further, an important research need is missing, viz. research in areas such as psychological, psychosocial, mass hysteria, etc. Occupants and their behavior can be considered part of the building "system". Although these are difficult research areas, the SBS problem will never be fully understood unless they are taken into account. The author's lack of discussion of these topics in this document is conspicuous.

Appendix E-References

This is a useful reference base. It would be much more useful if it could also be categorized according to subject matter. I would also recommend a clear statement on the first page indicating where abstracts and papers could be sent by authors in order to minimize emissions in subsequent updates. It also would be very useful if this data base could be put on floppies (in ASCII) and made available on request to authors and researchers in IAQ.

APPENDIX B

REPORT OF THE RADIATION ADVISORY COMMITTEE

TO THE

INDOOR AIR QUALITY AND TOTAL HUMAN EXPOSURE

COMMITTEE

RAC
Radiological Assessments Corporation

November 13, 1987

Dr. Morton Lippmann, Chairman
Indoor Air Quality/Total Human Exposure Subcommittee
Science Advisory Board
U.S. Environmental Protection Agency
Room 1145 W, Waterside Mall
401 M Street SW
Washington, D.C. 20460

Dear Dr. Lippmann:

The Radiation Advisory Committee has reviewed the "EPA Indoor Air Quality Implementation Plan-A Report to Congress Under Title IV of the Superfund Amendments and Reauthorization Act of 1986:Radon Gas and Indoor Air Quality Research." In order to keep in mind the objectives of the Report to Congress, I have restated Congressional expectations as they were presented to us earlier this summer.

> "...The Report is to describe the state of knowledge concerning risks to human health of indoor air pollutants; the locations and amounts of indoor air pollutants in structures through the country; existing standards for indoor air pollutants suggested by Federal and State governments or scientific organizations and the risk to health associated with such standards; research needs and the relative priority of these needs; and the effectiveness of possible government actions to mitigate health risks associated with indoor air quality problems."

The Committee kept this charge in mind as we performed our review. It is noted, however, that we focused on those sections dealing with radon (the main report and Appendix C). Our comments are summarized in the information that follows.

General Comments

In general, the plan is satisfactory and should meet the expectations of Congress. The summary should be carefully edited and Appendix C should be updated to include recent data that have been published on radon.

The Committee is concerned, however, with recent information regarding the status of the National Radon Survey, which is included as a part of the plan and which has been specifically mandated by Congress. It was pointed out to the Committee at its last meeting, that funding for the National Radon Survey has been eliminated in the budget plan for FY 1988. The Committee can understand that faced with limited funds and unlimited demand, it might be decided that this relatively expensive project should be deferred or even cancelled all together. We find this troublesome, however, since without this authoritative survey, it is going to be very difficult to decide how to attack the indoor radon problem. It is certainly recognized that risk from radon in indoor air ranks highly among total airborne constituents known to be present in most buildings.

As one of its responsibilities recently, the Radiation Advisory Committee established a Subcommittee to review Agency plans for the National Radon survey. Consequently, the Committee made recommendations for what is considered a scientifically satisfactory study for the frequency distribution of radon exposures nationwide. The study might not answer all questions raised about factors influencing the radon levels, since it was realized that some of these answers would require a much larger study. Nevertheless, the National Survey would answer key questions related to radon in indoor air and assist greatly in putting exposure to radon and progeny in better perspective.

The Committee believes that it is essential to obtain a reasonable fix on the magnitude of the indoor air radon problem. This step can best be taken with the proposed National Survey on radon. It is therefore strongly recommended that this survey be supported and carried out as soon as possible.

Specific Comments on the Report to Congress

Summary

Page 1

The summary deals with generalities and lacks specific tangibles. The Committee believes that Congress will find it difficult to understand what is being proposed as a plan based on the summary alone. Effective summaries are difficult to write, of course, but this one could have been much more specific about the general types of pollutants to be looked and how the relative importance of each will be addressed. As it is currently written, the summary does not do justice to the rest of the document.

As a minor point, HUD is not mentioned here. It's role is given on page 21 and the planned coordination with HUD throughout seems much less than we would have expected, given that HUD has been involved in substantial research in this area and presumably has a continuing interest, especially, as specifications for new houses are involved.

Pages 7-10, Activities and Accomplishments to Date

This section contains a lot of specifics and is generally good and informative. However, there is nothing here at all about progress that EPA has already made on radon. More information should be included here on what has been accomplished to date.

Pages 10-17, Near Term Implementation Plan

This section is also good where it is specific, however, much of the material contains generalities. Again there is nothing presented on radon and a cross reference to Appendix C as a minimum would be helpful. Note that in the table on page 24 under radon in the right hand column on health effects, the end product should not be "cancer" which implies cancer in general, but "lung cancer" since this is the only type of cancer which radon induces.

Appendix C
Since pages 1-11 are missing, the reader might wonder why these pages were omitted. As a minimum, some statement about their content and why they were not included should be added.

page 12, lines 1-4
It is true that radon comes from radium but the radium comes from uranium, and it is the distribution of uranium in soil that begins the decay chain. We recommend adding to the first sentence"...and is itself a decay product of uranium."

page 14, Implementation Plan
We recommend separating radon exposure and health risk since they are quite distinct and health risk deserves its own bullet.

page 17, (d)
This section points to a highly desirable need to ensure sound measurement methods. However, it also brings up the question of how all the measurements made by commercial firms could be utilized. For example, for epidemiological purposes, for contributing to our knowledge of a national average background level, etc. Perhaps such firms could be required to publish their results or submit them to EPA in a form that would make them useful.

page 17, (e)
Health risks should have its own section and the information could be expanded. Reviewing the miner studies is still an important thing to do and information on them keeps accruing. This fact is somewhat buried in the last paragraph.

page 18, paragraph 1
Isn't NCI (Boice) also conducting or collaborating in some studies in New Jersey, Stockholm, and China?

page 18, paragraph 2
The BEIR IV Report being referred to as published in 1987 has not yet been released.

page 19, paragraph 1
Among these four mitigation techniques there is no discussion of number two, ventilation, throughout pages 19-21 even though it is noted that simple basement exhaust fans are very effective in some circumstances. In general, it appears that this section could be expanded based on the recent work by OEET.

page 20
It seems that greater involvement with HUD could have been expected in (c) and (d).

page 24, Public Information
EPA deserves credit for getting something done here. The brochures produced by the Agency are very good.

page 25, line 1
"A copy of DOE's Radon Research Program Plan is attached as Appendix E." The plan is not attached. Appendix E is a bibliography.

We hope these comments will be helpful in your review. Please contact me if we can be of further assistance.

Sincerely,

John E. Till, Ph.D.
Acting Chairman

copy to: Members, Radiation Advisory Committee