BOARD OF SCIENTIFIC COUNSELORS (BOSC)
OFFICE OF RESEARCH AND DEVELOPMENT (ORD)
UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY (EPA)

PROGRAM REVIEW OF THE
NATIONAL RISK MANAGEMENT RESEARCH
LABORATORY (NRMRL)

Final Report of the Ad Hoc Subcommittee
on the Review of NRMRL

April 30, 1998

NOTICE

This report has been written as part of the activities of the Board of Scientific Counselors (BOSC), a public advisory group that provides objective and independent counsel to the Assistant Administrator for the Office of Research and Development (ORD) of the Environmental Protection Agency (EPA). The Board is structured to provide a balanced expert assessment of the management and operation of ORD's research programs and its utilization of peer review. 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 EPA or other agencies in the federal government. Mention of trade names or commercial products does not constitute a recommendation for use.

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PREFACE

The Board of Scientific Counselors (BOSC) provides objective and independent counsel to the Assistant Administrator of the Office of Research and Development (AA/ORD) on the management and operation of ORD's research programs. The primary functions of BOSC are to: (1) evaluate science and engineering research programs, laboratories, and research-management practices of ORD and recommend actions to improve their quality and/or strengthen their relevance to the mission of the EPA; and (2) evaluate and provide advice concerning the use of peer review within ORD to sustain and enhance the quality of science in EPA.

In fall 1996, Dr. Robert J. Huggett, AA/ORD, requested that BOSC conduct peer reviews of the ORD Laboratories and Centers. Accordingly, BOSC undertook the task of conducting programmatic, as opposed to scientific or technology, reviews of the Laboratories and Centers and proceeded to establish policies and procedures for conducting such reviews. The scheduled reviews occurred as follows:

- National Exposure Research Laboratory, July 21-22, 1997, at Research Triangle Park, NC
- National Health and Environmental Effects Research Laboratory, August 4-5, 1997, at Research Triangle Park, NC
- National Risk Management Research Laboratory, August 18-19, 1997, at Cincinnati, OH
- National Center for Environmental Assessment, September 8-9, 1997, at Washington, DC
- National Center for Environmental Research and Quality Assurance, October 20-21, 1997, at Washington, DC

As constructed, the Laboratory and Center reviews are expected to lead to a better understanding of the strategies employed by the respective Directors in accomplishing their missions, and to a better understanding as to how these strategies are implemented. BOSC also expects to develop a clearer perspective on how effective these strategies are in causing the operation of the Laboratories and Centers to come into alignment with the strategic plan of the ORD.

Each Laboratory and Center review consisted of two parts. The first part was a written self-study submitted to the review committee in advance of the date of its review, and the second part was a 2-day site visit conducted by the review committee. In the self-study, Directors were asked to prepare responses to eight questions aimed at a programmatic assessment of the organization. During the first day of the site visit, the Director made a brief presentation about the organization and was then asked to respond to questions from the review committee about the self-study document. Later, case studies were presented that reflected how the organization successfully addressed a specific issue faced by the Agency. The first day concluded with breakout sessions attended by staff scientists and other professionals. On the second day, the committee drafted a report that contained its findings and recommendations. At the end of the day, an exit interview was conducted with the Director.

All review teams were organized as *Ad Hoc* Subcommittees of the Board of Scientific Counselors and were headed by a chair and vice chair, both members of BOSC. Additional members of the Subcommittee were selected on the basis of an appropriate technical discipline as well as having broad experience in science and research management, planning, and communication. The Chair of BOSC attended all reviews as an ex-officio member.

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1.0 EXECUTIVE SUMMARY

A Review Panel (hereafter referred to as the Subcommittee) of the Board of Scientific Counselors (BOSC) met on August 18 and 19, 1997, at the National Risk Management Research Laboratory (NRMRL) in Cincinnati, Ohio, to review a Self-Study Report prepared by NRMRL. The Self-Study Report was prepared in response to a series of questions posed by the BOSC to assess the research management practices within each of the Laboratories and Centers of the Environmental Protection Agency's (EPA) Office of Research and Development (ORD). The Subcommittee was charged with critically reviewing the NRMRL Self-Study Report and recommending actions that could be taken to enhance NRMRL's effectiveness in accomplishing its mission. The Subcommittee review was based upon the NRMRL Self-Study Report as well as information obtained from NRMRL staff during the August site visit in Cincinnati (general presentations and discussions, case study presentations, and breakout sessions with staff).

It was evident to the Subcommittee that the Self-Study Report was carefully prepared, and it reflected the serious consideration NRMRL staff gave to the questions posed by the BOSC. The Subcommittee was impressed by the open and frank tone of the Self-Study Report and candid nature of discussions that occurred during the site visit. It was apparent to the Subcommittee that the major strength of NRMRL lies in its highly talented, dedicated, and motivated scientific and engineering staff. The junior and mid-level staff have a great deal of respect and confidence in both the technical and managerial skills of the senior NRMRL staff. Over the years, NRMRL has enjoyed an excellent national and international reputation for applying sound and innovative engineering principles to identifying and controlling air and water pollutant emissions from a variety of sources. Organizational and mission changes imposed upon NRMRL over the past 3 years by ORD, however, pose a considerable challenge for NRMRL in the years ahead. The major challenges to NRMRL are a result of a change in its mission, a shift away from funding of extramural research to stronger in-house efforts, and decreasing resources. These issues were the common threads that ran through NRMRL's response to each of the questions posed by the BOSC. The Subcommittee's major conclusions and recommendations relate to these challenges.

Under the new risk assessment/risk management paradigm adopted by ORD, NRMRL's mission has changed from a focused scientific/engineering mission to a much broader risk management mission. If the risk management paradigm is to be implemented, the resultant shift in NRMRL's mission will require a fundamental transformation in the scientific and technical expertise at NRMRL and a potential reorganization of its management structure. Expertise will have to be acquired in a variety of disciplines (e.g., economics, social and behavioral sciences, political science, etc.), which NRMRL currently does not have or has in an insufficient quantity. The Subcommittee recommends that a very specific mission statement and accompanying strategic plan be developed for NRMRL. The strategic plan needs to provide a clear blueprint and timetable for acquiring the needed resources (personnel and infrastructure) necessary for NRMRL to make the transformation to a more broadly based risk management research laboratory. If the transformation is to be successful, ORD must commit to providing the needed resources. The needed resources are currently not being provided. The Subcommittee also recommends that the traditional engineering strength of NRMRL in areas of treatment/management of water and air pollutants not be diminished in the effort to "retool" NRMRL into a broadly based risk management laboratory.

Prior to 1995, NRMRL's research effort was highly leveraged with extramural funds, with as much as 60 percent of its budget devoted to outside contracted research. Managing the extramural research was a major focus for the scientific and engineering staff and represented the primary opportunities for professional advancement. Since 1995, there has been a pronounced shift away from outside contracted research toward in-house research. In addition, the new Science to Achieve Results (STAR) program, administered by ORD, is perceived by NRMRL staff as having drained resources from NRMRL. This shift is likely to continue to have a substantial impact on NRMRL. The Subcommittee recommends that NRMRL take a number of steps that would help ensure an efficient and smooth transformation to enhance capabilities for in-house research. These steps include the following:

- Identification of the needed skill mix of professional and support personnel (i.e., laboratory technicians) and establishment of a timetable for acquiring them

- Improvements in infrastructure (i.e., laboratory space, analytical and computer equipment, etc.) necessary to support an increased in-house research effort

- Development of an objective measures system that is clearly weighted toward promoting good in-house science

- Development of an objective rewards system (e.g., promotion system, sabbaticals, research space, research equipment, travel money, additional technical support, etc.) that is well understood by the staff, is fairly applied, and enhances and rewards good in-house science

- Establishing an aggressive program for retraining staff from managers of externally funded research to productive contributors to the in-house scientific effort

- Ensuring that the large number of research coordinating committees are effective

- Instituting a mechanism for NRMRL scientists/engineers to interact with STAR program grantees.

The Subcommittee encourages ORD to provide the resources necessary for NRMRL to make the successful transformation to an in-house based research laboratory.

Finally, NRMRL's Self-Study Report identified a series of actions that could be taken by ORD/EPA that would enable NRMRL to meet the strategic challenges it faces. The Subcommittee fully agrees with and supports the recommended specific actions. These actions (i.e., stability and predictability in research priorities and resources, administrative streamlining, integration of science across EPA, and clarification of risk-based priority setting) seem not only reasonable but also necessary. The Subcommittee, however, concludes that these actions by ORD/EPA may not be enough to ensure the success of NRMRL in its new risk management research mission. A more focused mission with additional resources (personnel, improved infrastructure, etc.) consistent with that mission are required.

2.0 INTRODUCTION

The Board of Scientific Counselors (BOSC) of the U.S. Environmental Protection Agency's (EPA) Office of Research and Development (ORD) is charged, in part, with evaluating the research-management practices of ORD and recommending actions to improve their quality and relevance to the mission of EPA. As an initial step in that charge BOSC conducts peer reviews of the Laboratories and Centers in ORD. In accordance with that charge, a Research Plan Review Panel (hereafter referred to as The Subcommittee) of BOSC was formed to review the research-management practices of the National Risk Management Research Laboratory (NRMRL). A list of the members of the Subcommittee is presented in the Preface.

In May 1997, the BOSC sent a letter, under the signature of the BOSC Chair (Dr. Costel Denson), to the director of NRMRL (Dr. Timothy Oppelt) requesting the Laboratory to prepare a written Self-Study Report to be submitted to the Subcommittee. Dr. Denson's letter (see Section 8.0, Appendix A) requested that the Self-Study Report be prepared in two parts. In the first part, NRMRL was asked to address eight specific issues related to the development and implementation of the Laboratory's mission within the overall ORD mission. In the second part of the Self-Study Report, NRMRL was given the opportunity to identify Laboratory needs and what assistance ORD/EPA may provide NRMRL in addressing its mission. After receipt of the Self-Study Report (see Appendix B), the Subcommittee conducted a site visit at the NRMRL Cincinnati office.

The site visit was conducted on August 18 and 19, 1997. The site visit provided the Subcommittee the opportunity to gather additional information and delve in greater detail into issues raised in the Self-Study Report. The agenda followed during the site visit is presented in Appendix C. As part of the site visit, NRMRL was asked to prepare presentations on two case studies and organize breakout sessions. The case studies on Particle Matter and Drinking Water Disinfection were intended to demonstrate NRMRL's role in the development and implementation of research programs directed at addressing two of the six high-priority research areas identified by ORD in its Strategic Plan. The breakout sessions were designed to explore the role of NRMRL staff at every level (administrators, research staff and technical staff) in setting research priorities and planning and implementing scientific and management strategies to address those priorities.

This report presents the results of the Subcommittee's review of NRMRL. The report is organized along the lines of the Self-Study Report, with additional sections devoted to the case studies and breakout sessions conducted during the site visit. Each section provides an overall summary of NRMRL's current efforts in that area and the strengths and weaknesses identified by the Subcommittee. The report concludes with two sections devoted to Subcommittee findings and recommendations for enhancing NRMRL's ability to realize its research mission. Because this report is in large part a commentary on the NRMRL Self-Study Report, it should be read with frequent reference to that document.

3.0 LABORATORY REVIEW

3.1 Alignment of Priorities and Directions With the ORD Strategic Plan

Under ORD's Strategic Plan, NRMRL is responsible for development of the scientific basis for environmental risk management encompassing both human and ecological health. The broad research responsibilities for NRMRL are outlined under the risk management paradigm contained in the ORD Strategic Plan and shown in Figure 1 (see Section 8.0, Appendix E). These responsibilities involve a wide range of scientific and technical activities, covering a diverse array of skill areas (e.g., engineering, economics, public health, ecosystem modeling, etc.). The general research responsibility of NRMRL is to provide technical data to characterize pollutant sources and to help identify and implement efficient and cost-effective solutions to environmental problems that are high risk, high cost, or lack effective management alternatives.

In developing EPA's risk-based research agenda, the ORD Strategic Plan puts forth a vision statement and four mission statements consistent with that vision. The ORD Strategic Plan also identified six long-term goals designed to achieve those missions. In addition, the ORD Strategic Plan listed several objectives developed to meet the research goals. The NRMRL Self-Study Report has identified three of those goals as guiding NRMRL's research programs. Those goals are: (1) Goal Three—to provide common sense, cost-effective approaches for preventing and managing risks; (2) Goal Five—to exchange reliable scientific, engineering, and risk assessment and risk management information among private and public stakeholders; and (3) Goal Six—to provide leadership and encourage others to participate in identifying emerging environmental issues, characterizing the risks associated with these issues, and developing ways of preventing or reducing these risks. In addition to focusing on these three ORD stated goals, NRMRL has adopted several objectives identified in the ORD Strategic Plan as necessary to work toward if the goals are to be met.

In setting research priorities in areas other than those mandated by statutory requirements or court orders, ORD has established criteria to evaluate and rank potential research topics within major subject areas, including human and ecological health, methods/models, and risk management. NRMRL has developed the component of the ORD criteria dealing with risk management. The risk management criteria consist of the following four components:

1. Has the problem's source(s) been sufficiently characterized to develop risk management options?

2. Do risk management options (i.e., political, legal, socioeconomic, or technical) exist and are they cost-effective, acceptable, implementable, and reliable?

3. Could new or improved technical solutions prevent or mitigate the risk efficiently, cost-effectively, and in a manner acceptable to stakeholders?

4. Are other organizations (public and private) currently investigating/developing these solutions or interested in working in partnership with ORD on these solutions?

NRMRL's research effort addresses five of the six high-priority EPA research topic areas identified in the ORD Strategic Plan and several research areas related to the priority topics. NRMRL is a major participant in developing research strategies to address those six priorities, and has the lead role in the development of three research strategies [Environmental Technology Verification (ETV), Pollution Prevention, and Waste].

NRMRL conducts research programs in six fundamental categories within the risk management paradigm (i.e., source or problem characterization, prevention methods development, control methods development, remediation or restoration methods development, performance and cost verification, and technology transfer). These programs address research topics mandated by statutory requirements or court orders as well as the six high-priority topic areas identified in the ORD Strategic Plan (i.e., safe drinking water, high-priority air pollutants, emerging environmental issues, ecosystem risk assessment, health risk assessment, and pollution prevention and new technologies for environmental protection). The level of commitment devoted to each research topic area across each of NRMRL's fundamental categories (see Table 1 of NRMRL's Self-Study Report) can vary considerably in time.

Critique

NRMRL has been highly responsive to ORD in its attempts to reorient its research planning to conform with the ORD Strategic Plan. Under ORD's new risk assessment/management based planning process, NRMRL plays a central role as the Laboratory responsible for providing risk management scientific and technical support. The goals, risk management criteria, research priorities, research objectives, and research strategies identified in the NRMRL Self-Study Report appear to be consistent with its new risk management research role. The Self-Study Report does an excellent job of identifying the fundamental categories of risk management research conducted by NRMRL and the relative priorities assigned within each category across a wide range of research topics.

The Subcommittee noted several concerns regarding NRMRL's efforts to align its research priorities with those articulated in the ORD Strategic Plan. Specifically:

1. Adoption of the risk management paradigm poses a considerable challenge for NRMRL. This Laboratory has enjoyed an excellent reputation for applying sound and innovative engineering approaches to identifying and controlling air and water pollutant emissions from a variety of sources. If the risk management paradigm proposed in Figure 1 (see Section 8.0, Appendix E), is to be adopted, it will require a fundamental shift in the scientific and technical expertise at NRMRL as well as a potential reorganization of its management structure. Expertise will have to be acquired in a variety of disciplines (e.g., economics, management science, social and behavioral sciences, etc.) that are not currently available at NRMRL. The Subcommittee is concerned that the traditional engineering strength of NRMRL will be diminished, and wonders if this is EPA's and ORD's intent. Further, the Subcommittee is concerned that the resources needed to "retool" NRMRL with the staff and infrastructure necessary to allow it to function as a risk management research facility will not be provided.

2. The ORD Strategic Plan outlines a process by which it arrives at its risk-based research agenda (i.e., vision statement, mission statement, etc.). NRMRL would benefit from undertaking a similar process. NRMRL, for example, does not have a mission statement. The development of an NRMRL strategic plan would be helpful in developing a blue print for the Laboratory in setting and achieving research goals in harmony with the ORD Strategic Plan and consistent with the resources available.

3. Research priorities at NRMRL are determined by statutory requirements or court orders as well as by the ORD Strategic Plan. Table 1 in the NRMRL Self-Study Report provides a useful (but subjective) evaluation of the level of research effort devoted to various research topics that relate to one or more of the six fundamental categories of risk management. However, it is not clear how the research priorities are set, how much flexibility NRMRL has in setting priorities, how the available resources are divided among the topics, how the research emphasis for 1996 to1999 was determined, or how the topic areas relate to priority focuses (e.g., court orders, ORD Strategic Plan, etc.).

4. NRMRL identified six fundamental categories of risk management research that it performs. The categories are somewhat vague. The scope of each category is not clear (engineering, control cost effectiveness assessment, control options comparisons, etc.). Also, the Self-Study Report fails to explain how each category is structured to meet NRMRL's new responsibilities under the risk management paradigm.

5. It is not clear from the Self-Study Report how the risk management paradigm adopted by NRMRL is being applied or would be applied to the challenge of remediating ecological hazards.

3.2 Laboratory Strategic Initiatives

Strategic directions for NRMRL have been established in the context of a major amalgamation of Laboratory elements and significant decreases in overall funding as well as substantial changes in funding allocations among EPA staff, contractors, and extramural research. The adoption of the risk assessment/management paradigm also is a major change in direction for the organization.

NRMRL consists of eight geographically separated research Laboratories with the central administration function located at the Andrew W. Breidenbach Environmental Research Center in Cincinnati, Ohio. The NRMRL research structure is comprised of six divisions organized along the environmental compartments or media where environmental problems occur. Four of the divisions conduct research that is likely to be focused largely in single compartments (i.e., water resources, air resources, land resources, and surfaces). The two remaining divisions (sustainable technology and technology transfer and support) are cross-media in their research focus, and were formed to integrate the science and information of the other four divisions and to conduct cross-media research in such areas as pollution prevention and cost analysis.

In-house research, enhanced science quality, and improving science management have been identified by NRMRL as its three strategic initiatives. Prior to 1995, NRMRL's research efforts were strongly oriented to outside contracted research, with as much as 60 percent of its budget devoted to extramural funds for this purpose. In-house research was minimal. Managing the

extramural research was a major focus for the scientific and technical staff at NRMRL and represented the primary opportunities for professional advancement of the staff. Since 1995, there has been a pronounced shift away from outside contracted research and toward in-house research. This shift poses a considerable challenge to NRMRL. Building a competent scientific and technical staff and research infrastructure to achieve a viable in-house research effort will be difficult. The Self-Study Report outlines a range of measures to be taken by NRMRL to address this strategic initiative. Proposed measures designed to strengthen in-house programs include: using more post-doctoral researchers, focusing on fewer research areas, developing research teams, and using measures of success in performance evaluations. The overall objective of this shift is to return intellectual leadership to EPA researchers, develop their talents, and obtain greater recognition from the scientific community.

NRMRL proposes to measure the quality of science by external peer review, data quality review, and publications in scientific and engineering journals. A comprehensive peer review program has been initiated to ensure critical evaluations of research strategies and plans, project level plans, and research projects. An aggressive data quality assurance and control plan has been implemented; eight full-time, in-house staff have been assigned to this task. Scientific and engineering staff are encouraged to publish their work in peer-reviewed journals.

Scientific management is being improved by developing procedures and policies to be used across all eight divisions of NRMRL. Adoption of an ORD Management Information System has provided better control over expenditures and allowed streamlining of some management functions. Guidelines have been developed for the formation and use of cross-organizational research teams, and all NRMRL staff are receiving training on working in teams.

Critique

NRMRL has made a concerted effort to develop and implement a Laboratory reorganization that will effectively adjust to the new emphasis on in-house research and expand from an engineering research mission to a much broader risk management research function. This reorganization was a major undertaking. The NRMRL initiatives seem to have been carefully chosen to develop the mission of the reorganized Laboratory in a time of diminishing resources. The emphasis placed on shifting resources, increased scrutiny of research quality, and improved management should lead to a more effective system of selecting and prioritizing research topics as well as higher quality research products.

The Subcommittee noted a number of serious issues that are related to the NRMRL research structure and the strategic initiatives presented in the Self-Study Report. These issues are primarily related to a lack of specifics in the Self-Study Report about the relations between resources and initiatives. NRMRL should strive to provide measures, as well as examples, of how resources are managed in response to strategic direction. Specifically:

1. It is not clear what specific changes have been made to ensure an integration and balance of resources in merging ecological health and human health-related risk management research.

2. Although the management and strategic initiatives appear appropriate, no information was presented to indicate how effective these efforts (e.g., use of postdoctoral researchers,

developing research teams, adoption of an ORD Management Information System, etc.) have been in improving the Laboratory's ability to address its objectives or to achieve the stated strategic initiatives. In addition, no metric was proposed to monitor short- or long-term progress in meeting stated objectives under the new organizational structure.

3. The shift from extramural to in-house research has had, and will continue to have, a profound impact on the mix of in-house personnel, setting of research priorities, selection of research topics, and level of project funding. The NRMRL Self-Study Report did not clearly define the nature and extent of the impact of this shift nor how it will impact the type and quantity of resources needed over the next several years.

4. The current mix of managerial personnel, including those who manage extramural research projects as well as in-house scientists and engineers actually conducting research, was not well described. Information on how this mix will change with an increased emphasis on in-house research was not provided. What mix is considered desirable?

5. The change of in-house scientific staff from managers of extramurally funded research to principal investigators on in-house research presents a considerable challenge to NRMRL. The Self-Study Report did not address the likely impact of this retraining effort on NRMRL's ability to achieve the stated research objectives. Greater consideration should be given to defining the nature and extent of the problem, the development and implementation of well-specified retraining programs, introduction of a tracking system to monitor progress, and institution of an objective reward system. Measures similar to these will be necessary for an effective and efficient transformation.

6. It is not clear how the cross-media research teams function in terms of establishing research agendas and setting priorities. The authority for resource allocation also is unclear.

3.3 Integration Across and Within Divisions and Within ORD

Integration of work across Centers and Laboratories has been a major focus of ORD. Integration of research done by NRMRL with other ORD Laboratories is achieved in part through the operation of several senior executive-level councils (i.e., Executive Council, Management Council, and Science Council). In addition, Research Coordination Teams, comprised of mid-level administrators from each ORD Laboratory and Center, have a primary responsibility for planning integrated research programs on priority issues. NRMRL staff has contributed to 9 of the 11 ORD-wide research plans that have or are being developed, suggesting that NRMRL is actively involved in ORD's overall effort for the integration of research across all ORD Laboratories.

Integration of the implementation of research plans within NRMRL is fostered through the formation of research teams involving as few as two to four members within a branch to 20 or more individuals drawn from across several divisions. NRMRL currently has a total of 54 teams, including 17 with all members from a single branch, 21 with staff from several branches within a single division, 11 with members from more than one NRMRL division, and 5 with staff from NRMRL and several other ORD Laboratories. NRMRL staff also has participated in several cross-Agency planning efforts with the U.S. Army Corps of Engineers (USACE), Department of Energy (DOE), and Department of Defense (DOD).

Integration in technology transfer and research communication efforts also is described in NRMRL's Self-Study Report. Specific mechanisms to foster such integration are not described, but some examples were provided. These examples demonstrate the integrating activities in the area of technology transfer and research communication. In particular, the document states that NRMRL is taking a leadership role within ORD in identifying topics for ORD-wide "state-of-the-science" workshops and reviews. Finally, the Laboratory acknowledges the importance of Internet communication vehicles in enhancing internal staff interactions within ORD and with non-EPA parties. Development of home pages to summarize research findings, share research plans, and distribute reports and software are examples of NRMRL's activities in this regard. The Self-Study Report also states that NRMRL is taking the lead within ORD in facilitating Internet-based chat rooms for discussion of research plans, emerging issues, and potential research initiatives.

Critique

A concerted effort is being made by NRMRL to plan research in an integrated manner and to implement plans across ORD's Laboratories and its six divisions. In theory, this effort should lead to a targeted, prioritized, and integrated research program in NRMRL that is more effective, better coordinated, and more cost efficient. NRMRL's efforts to participate in cross-Agency research planning groups may help provide a method of leveraging its limited resources. Efforts to use the Internet to enhance communication with EPA and non-EPA institutions and individuals on research needs and results of research projects are highly desirable.

The Subcommittee has a number of concerns related to NRMRL's efforts to integrate work across and within divisions in NRMRL and other parts of ORD. Specifically:

1. The overall effort to integrate the research planning program appears to be a hierarchical, top-down approach. There appears to be little evidence that "bench-top" scientists or principal investigators are involved in the planning process. It is reasonable that the overall strategic planning in an agency be done by senior level personnel, but it is important to involve active researchers at NRMRL in the process to give them a sense of involvement and ownership. Breakout discussions with NRMRL staff at all levels, conducted during the site visit, revealed a strong sense of disconnection between those scientists and engineers conducting the research and the process by which research goals are established and implemented. A concerted effort is needed to include those actually responsible for conducting the research in the research planning and coordination process.

2. Although there are a number of efforts, through various committees, to integrate research planning across ORD Laboratories as well as within and among the NRMRL divisions, no information was presented on the level of effort expended, nor was there any measure of the effectiveness of the integrating effort. Are the number of research teams sufficient to achieve the desired integration and interactions? Several basic questions should be examined critically by the Laboratory administration in evaluating the success of research integration, including: How many of the scientists/engineers who are active in research at NRMRL are directly involved in the 54 research teams? How many of these active scientists/engineers are involved in more than one team? What is the distribution of time for these active scientists/engineers between planning team activities and actual research? How do these teams actually impact the conduct of a research project (i.e., what mechanisms are used by the teams to foster integration

3. over and above that which would be achieved by single investigators interacting with each other as normal inquisitive, active scientists)?

4. The pronounced shift toward risk management research at NRMRL and toward a more robust in-house research program presents a number of issues/opportunities (e.g., expansion of ongoing research, new lines of research involving additional research disciplines, greater emphasis on collaborative work, etc.). It is not clear which, if any, of the integrating efforts undertaken by NRMRL or ORD are addressing these issues.

5. Although NRMRL appears to be quite active in integrating efforts to foster technology transfer and research communication (e.g., Web sites, science workshops, etc.), no information was presented to judge the extent or effectiveness of this effort. It is in NRMRL's self interest to document, with appropriate statistics, the effectiveness of this important effort.

3.4 Measures of Performance and Awards

NRMRL's scientific productivity and effectiveness in support of EPA's mission are affected by requests for technical support from the clients it serves as well as by the recent shift from extramural to in-house research. Conflicts in research priorities set by ORD and NRMRL and requests for technical assistance from EPA's Regional and Program Offices impact the type and quantity of research conducted by NRMRL. The transition period accompanying the shift from extramurally funded research to in-house research is expected to result (in the short term) in a highly variable level of technical and scientific support of EPA's mission. In the long-run, the transition is expected to result in a highly productive, more skilled research staff with expertise in a wider range of disciplines related to risk management. The Self-Study Report, quite correctly, notes that "the challenge for NRMRL is to develop measures that reflect an appropriate balance among competing priorities, develop and enhance technical careers, and use available reward systems to promote productivity and our mission's relevance."

The Self-Study Report presented a detailed description of the basis for NRMRL-wide measures of success that are used to focus divisions, branch, team, and individuals. The success measures are directly related to program, organizational, and administrative goals. The NRMRL measures attempt to quantify the impact of NRMRL's work on the practice of risk management. The Self-Study Report acknowledged that no statistics have yet been compiled for the measures adopted for several reasons (budget impasses, Laboratory reorganization, etc.); however, some data on work products (e.g., peer-reviewed journal articles, patents, etc.) produced in FY 1996 were provided.

NRMRL uses the well-established awards system of EPA and ORD (i.e., scientific recognition, excellence in management, etc.) to further its strategic goals and to correlate them to its measures of success. During FY 1995 and FY 1996, NRMRL was awarded 3 gold, 0 silver, and 22 bronze medals. NRMRL also uses the government-wide and EPA/ORD procedures for staff development and advancement.

Critique

NRMRL has a difficult task of prioritizing and fulfilling requests for technical support and research within EPA and ORD while it is in the middle of a shift from extramurally funded research

to in-house research. NRMRL appears to have done a good job of meeting this challenge under what can only be described as very difficult circumstances. Effective performance standards and a system to measure success within the framework of EPA/ORD/NRMRL goals and ORD's Strategic Plan are needed, but difficult to develop and institute. NRMRL has made a conscientious effort to formulate such a measure of success (Appendix V of the Self-Study Report). NRMRL's efforts to track its progress toward quantifying the impact of the Laboratory's work on the practice of risk management is particularly laudable. However, no statistics on the results of the application of the measures system were available because the reorganization efforts at NRMRL over the past few years have prevented the application of the system.

Numbers of work products, journal articles, patents held, and awards won over the last few years are currently the only reasonable measures of success and do provide an approach for furthering NRMRL's strategic goals. A better awards system for scientists and managers within NRMRL is important in establishing high-quality work, high productivity, and good morale among all staff. NRMRL management correctly appears to place a high level of importance on award systems. The NRMRL Self-Study Report noted that the success of its staff in the career development and promotion procedures is an additional measure of success in meeting their strategic goals. NRMRL recognizes the importance of career development and promotion in attracting and retaining the best scientists, engineers, and managers and makes a good faith effort to provide advancement opportunities. Many of these efforts have been handicapped by ORD hiring and promotion freezes and the difficulty in advancing scientific/technical staff to Senior Executive Service level. These measures of success, however, are very broad in nature and are applied throughout EPA and ORD, and thus not specific to NRMRL. They can only be used as an indirect measure for assessing NRMRL's success in meeting its risk management goals.

The Subcommittee noted a number of concerns related to the NRMRL measures for assessing scientific productivity and support of EPA's mission presented in the Self-Study Report. Specifically:

1. It is not clear how NRMRL proposes to translate its measures of success in Appendix V into an evaluation system that is practical and can be easily understood by the staff. Although the overall measures of success seem appropriate (i.e., programmatic goals, organizational goals, and administrative goals), there are 13 subgoals with 41 measures of success. Although NRMRL has not had the opportunity to gain experience with the measurement system, it would appear to be of only limited use in its current form. Many of the measures of success appear to be subjective and as such are subject to bias. NRMRL needs to work toward a simpler, more objective system that is easily understandable by its staff.

2. The measures system seems much more weighted toward measures of success in the areas of management than in directly promoting good in-house science. Given the shift in emphasis from managing extramural science to developing quality in-house science capabilities, it would seem desirable to have a specific in-house science goal with clear, objective measures of success.

3. The trend data on product type by NRMRL divisions presented in the Self-Study Report would be more informative if they were generated as a function of the number of scientific or engineering staff dedicated to the work or dollars spent. It is difficult to assess the productivity

data among or between NRMRL divisions or to compare the data to other ORD Laboratories without a denominator.

4. The awards system does not make a clear distinction between scientists, engineers, and managers. Given the increased emphasis on improving the in-house science at NRMRL and within ORD in general, there should be clearly separate awards systems for scientists/engineers and managers.

5. Improving in-house research, in part, requires a highly trained and motivated technical support staff. An awards system should be set up to recognize and reward the contributions of the technical support staff.

6. Awards systems specific to ORD or NRMRL should be established to improve the quality and productivity in science and engineering within these organizations. Rewards other than monetary awards should be considered (e.g., sabbaticals, research space, research equipment, additional technical support staff, travel money, etc.). Based on discussions with staff in the breakout sessions, the medals are not widely appreciated as important measures of achievement.
7. As noted above, the promotion process is important in recruiting and retaining the best scientists/engineers and managers. This process should be critically evaluated to ensure that it is truly peer reviewed in nature, and that the criteria for promotion are well understood by the staff and perceived to be applied fairly. Particular attention must be paid to ensure that scientists/engineers have as much opportunity for upward mobility as program managers, especially under the new system.

8. Consideration should be given to the development of an incentive program(s) to enhance staff scientific skills (e.g., offering in-house refresher courses, encouraging enrollment in advanced degree programs or graduate courses, etc.). Such programs are important in staff career development.

3.5 Organizational Performance Compared With Others

NRMRL's Self-Study Report indicates that the Laboratory has not conducted a quantitative assessment of its performance against organizations with similar objectives. Also, NRMRL does not yet have a formal benchmarking process in place to identify organizations or institutions whose performance or processes NRMRL should aspire to match or exceed. However, the report does acknowledge that such efforts are possible and would be beneficial. Some qualitative benchmarking efforts were made during the ORD reorganization in 1994-1995, during which ORD staff (it is not indicated whether this included staff from NRMRL) visited several private organizations and one federal research and development (R&D) facility to gain perspective on their missions, organization, and research process. No performance-effectiveness information was gathered in this effort.

NRMRL has developed some measures of success that it intends to apply to itself in ongoing self evaluations, and the Self-Study Report indicates that these measures could be used to compare the Laboratory's performance with "peer" institutions. These measures are mentioned in Section 4 of the report and listed in the Appendices. The report describes "benchmarking" as a management concept whereby an organization learns from others, in part by seeking the "best-in-class"

organization, adopting its processes and operations, and comparing one's own output effectiveness to that of the benchmark organization. A table is provided of organizations that NRMRL believes may be appropriate benchmark organizations for NRMRL's five primary missions: (1) research, (2) technology development, (3) technology demonstration/verification, (4) regulatory/mission support, and (5) technical assistance/technology transfer. Examples of success measures that would be compared also are included in the table.

Critique

It is difficult to provide detailed commentary on this topic given the preliminary status of the Laboratory's efforts in implementing benchmarking and performance comparisons. The report is positive in acknowledging the desirability of conducting such comparisons. Given the level of flux and uncertainties that the Laboratory has experienced during its relatively short existence and the pressing needs to pull the operation together from rather disparate operations, the relative lack of progress in implementing benchmarking is understandable. The Subcommittee, however, noted the following points:

1. NRMRL should collect internal performance measures that can be used in comparisons with other agencies and organizations; performance measures that no other organization collects should be avoided.

2. NRMRL should select appropriate benchmark organizations for its five missions as soon as possible, and should contact these organizations to learn not only how they conduct their operations, but also how they evaluate their own success (so that NRMRL can start collecting comparable data). Given the amount of effort that benchmarking could require if applied across all five missions of the Laboratory, it perhaps would be best to initiate this program as a pilot study on one or few of the missions.

3. In Table 4 of the Self-Study Report, several customer groups are identified, but some items listed as measures of success are really just activities that relate to the customer.

4. The benchmark organizations proposed for the research mission are all universities. These would not seem appropriate benchmark institutions for NRMRL to use because the way in which universities operate is fundamentally different from the way government agencies must and should operate. It would be better to select benchmark research organizations from the government sector such as NIH laboratories, the research laboratories of the U.S. Geological Survey (USGS) Water Resources Division, USACE Waterways Experiment Station, or perhaps some of DOE's National Laboratories (Argonne, Oak Ridge). Similarly, it is doubtful that a private and highly dispersed consulting firm (e.g., CDM) would be an appropriate benchmark organization for technical assistance and technology transfer. Some components of the USACE, the state cooperative program of the USGS, or some consumer-oriented programs in the U.S. Department of Agriculture (USDA) may be more appropriate. NRMRL also might consider looking to non-U.S. government organizations as possible models.

5. Not all the measures of success listed in the Self-Study Report seem to be well developed. Many of them are not quantitative, and many seem simply to be descriptions of the goals rather than actual performance measures. A single example will suffice. Under administrative goals,

Goal 3 is to plan and implement appropriate consolidated and efficient extramural funding instruments. The listed measures of success are merely further descriptions of this goal rather than specific metrics of the Laboratory's success in achieving the goal.

6. NRMRL should consider developing a system to gather information on the satisfaction level of its customers with the Laboratory's performance.

3.6 Interactions With the Outside Scientific Community

Interactions of NRMRL's scientific and engineering staff with the outside scientific community are important from several points of view (e.g., leveraging research dollars, minimizing duplication of research effort, producing more focused and useful research, application of results, staff scientific development, visibility of programs, etc.). These interactions take the form of NRMRL staff involvement in and interactions with professional organizations, other federal organizations, the international community, and the academic community as well as participation in government-private sector partnerships. In some cases, these interactions are constrained by the potential or actual policy initiatives of EPA.

NRMRL staff are active in 34 professional organizations that focus on a wide range of risk management topics. These organizations are discipline-based, subject matter-based, and general science-based. NRMRL staff serve these organizations in a variety of functions (i.e., subcommittee chairs, boards of directors, organizing technical sessions, etc.). Interaction of NRMRL staff with other federal agencies is achieved through Interagency Agreements, Memoranda of Understanding, and *ad hoc* interactions for specific research projects. Interactions with the international scientific community are not formalized but tend to occur as opportunities arise or as requested as part of an EPA activity. Under a number of formal agreements (i.e., Cooperative Research and Development Agreements), NRMRL is able to enter into agreements with private laboratories. These agreements allow industrial firms to sponsor research at NRMRL; the Laboratory can license specific technologies developed by NRMRL staff and joint research on remediation technologies can be undertaken by NRMRL staff and private sector scientists. NRMRL currently has 21 active agreements with the private sector, which involves 115 entities having a total value of $24.5 million.

NRMRL interacts with the academic community on several levels. NRMRL scientific and engineering staff serve in advisory roles for University Centers, thesis and dissertation committees for graduate students, and external teams reviewing academic departments or programs. Possibly the strongest link with the academic community is through Cooperative Agreements. Despite the decrease in extramural research funding, NRMRL still has 111 active Cooperative Agreements with 75 academic institutions. The current number of Cooperative Agreements is about one-third of the number funded during FY 1995. It is not clear what level of support this program will receive in the future.

The recently instituted STAR program may provide an opportunity for NRMRL to further interactions with the academic community. At the present time, NRMRL and other ORD Laboratories believe they are prohibited from interacting with those funded under the STAR program. When the "rules of engagement" are established, NRMRL expects the STAR program will increase interactions and cooperation with the academic community.

Critique

NRMRL continues to recognize the value of strong interactions with the scientific community outside EPA. NRMRL has made substantial and successful efforts to forge strong ties to professional organizations, the broader federal community, international community, private sector, and academic communities. These efforts not only improve the knowledge base of the in-house staff, but also have been important in focusing research efforts, leveraging limited research funds, and developing and demonstrating remediation technologies.

The Subcommittee identified several concerns related to NRMRL's interactions with external scientists, including:

1. Several questions related to outside interactions were not addressed in the Self-Study Report. It is not clear how many NRMRL scientists or engineers are engaged in the interactions described or the amount of time they spend on various tasks. Is the staff rewarded for their outside efforts in the promotion system? The usefulness of these efforts in advancing the mission and strategic goals of NRMRL and the amount of the Laboratory's resources devoted to these efforts are not well documented.

2. The development of a program of exchanges of scientists between NRMRL and universities, other federal agencies, and the private sector should be explored. Such a program would have a number of potential benefits for NRMRL such as enhanced training of in-house scientists and more effective transfer of risk management technology.

3. The STAR program offers the potential to enhance the interactions between NRMRL and universities. ORD needs to develop the guidelines that will encourage such interactions without compromising the independence of the STAR program grantees. These interactions might be enhanced through seminar series and workshops as well as further opening of EPA Laboratories to master's and doctoral students.

3.7 Unique Capabilities and Their Uses

The Self-Study Report describes and emphasizes the development of generic core competencies in six areas as unique and valuable capabilities. These core areas are described as: source/problem characterization; pollution prevention methods; control methods; remediation/restoration methods; performance and cost verification; and technology transfer. These same areas are identified as fundamental categories of risk management research in Section 1 of the Self-Study Report. It is stated that some of the competencies are stronger than others, given the historical development of NRMRL and the continuing evolution of its research role. The Self-Study Report notes, for example, that NRMRL's competency in remediation of contaminant sites is stronger than its competency in restoring ecosystems. The core competencies are designed to be generic and include both existing expertise as well as expertise that will need to be better developed to meet perceived future needs as NRMRL prepares to provide an expanded risk management research service capable of responding to changing risks and priorities.

Critique

Overall, NRMRL has some strength in many of the generic core competencies identified in the Self-Study Report. It has particular engineering expertise with respect to air, water, and subsurface environmental problems. NRMRL's work in source emission characterization is, for example, well known. The Subcommittee agrees that many of the core competencies identified are unique and of great value to NRMRL, ORD, and all of EPA. The generic structure in which they are presented should allow for future expansion within NRMRL's risk management research function.

The Subcommittee noted a number of concerns related to the development and utilization of the unique capabilities identified by NRMRL in its Self-Study Report:

1. The organization, management, and deployment of the core competencies need to be carefully developed by NRMRL management. The core competencies are purposefully generic, and the approach to using the core competencies in specific problems is not spelled out. It was not at all clear, for example, in the two case studies presented during the site visit (i.e., particulate matter and drinking water disinfection and by-products), how the six NRMRL core competencies are applied.

2. There appear to be substantial challenges in working within the divisional structure of NRMRL in highlighting the core competency areas, which are inherently cross-divisional in nature. To the extent that the core areas can be developed as cross-divisional, Laboratory-wide expertise, they will be stronger than those based on reliance on the expertise contained within each division. This should be a goal for NRMRL.

3. Neither the Self-Study Report nor the presentations made at the site visit made a clear case for how the core competencies are used, or could be used, effectively in addressing either human health or ecologic health risk management issues. A conscious strategy on how to bring the resources to bear on risk management problem areas needs to be developed and piloted. NRMRL, in assuming its new risk management responsibilities (see Figure 1 in Section 8.0, Appendix E), needs to consider the nature and mix of competencies it will need to be effective in its new functions. It is not clear that the current identified competencies are adequate to fulfill its new responsibilities.

4. With respect to specific areas, the long-standing competency of NRMRL in wastewater technology is not being used effectively at present, although it certainly ranks high among the Laboratory's unique strengths. The competency in ecosystem restoration, on the other hand, is at best premature—a hope for the future rather than a reality.

3.8 Appropriate Mix of Workforce, Facilities, and Infrastructure

The ORD reorganization and NRMRL's new role as a risk management laboratory have resulted in a substantial expansion of NRMRL's scope of work. NRMRL's new risk management mission requires it to address research and service issues well beyond its historic focus on engineering and technology. The risk assessment/management paradigm (see Figure 3 in the Self-Study Report) suggests that NRMRL will have to considerably broaden its scientific expertise in a number of disciplines in which it currently has little or no resources. Compounding the problem is

a shift at NRMRL from meeting short-term, highly variable technical support/assistance needs of EPA programs to a longer term, risk-based set of priorities. NRMRL's response to this question lays out the strategic dilemma in which the Laboratory finds itself—ORD has greatly expanded its mission, both in terms of focus and timeframe (increased emphasis on long-term priorities), and at the same time reduced its resources. NRMRL has 70 fewer staff and 60 percent fewer extramural resources now than it did in FY 1995 before the ORD reorganization. Meeting the goals under its new risk management mission presents a considerable challenge to NRMRL.

The Self-Study Report indicates that NRMRL has sufficient facilities and equipment to support in-house research in its traditional areas of expertise specified under its former mission. Anticipated increases in the in-house research in these traditional areas of research will require additional space and equipment. The most significant factor impacting NRMRL's ability to carry out its new risk management mission is personnel, both in terms of numbers and skill mix. NRMRL has lost staff in its traditional strength areas, has largely lost its ability to conduct targeted research in its priority areas through extramural cooperative agreements and onsite contractors, and has now acquired a whole new set of research responsibilities.

Expertise will have to be acquired in specialty areas new to NRMRL (e.g., microbiology, endocrinology, ecology, economics, sociology, systems analysis, risk communication, policy and land use, etc.), and an infrastructure will have to be developed to support an anticipated increase in-house research (i.e., technical support staff, laboratory and computer facilities, etc.). NRMRL is in the process of completing a strategic staffing plan that presumably will address its staffing needs.

Critique

The primary strength of NRMRL's response is its candid nature. Management's response clearly highlights the considerable problems NRMRL faces in meeting its goals under its new risk management mission. The response puts the best possible face on a very difficult situation by referring to it as "a considerable opportunity to adjust its personnel skill mix."

If NRMRL's mission is to be completely defined in terms of risk-based prioritization, then there are a number of important issues that have to be addressed. The Subcommittee noted several of these issues, including:

1. There is serious concern that NRMRL will not receive the minimal resources needed to fulfill the strategic goals under its new risk management mission.

2. The task facing NRMRL in finding the necessary financial and human resources to meet its new strategic goals is daunting. NRMRL should prepare a detailed plan for identifying and acquiring the resources necessary to achieving the strategic goals under its new risk management mission. This plan should include: (a) a description of the skill mix of current employees; (b) an identification and prioritization of the number and skill mix of professional personnel needed and a timeframe for acquiring them; (c) a specific process by which current staff who have been managing externally funded research will be retrained to become productive contributors to in-house efforts; (d) identification of the type of support personnel needed (i.e., laboratory technicians); and (e) a critical evaluation of the infrastructure needs (i.e., laboratory space, equipment, etc.).

3. ORD must recognize that, if it expects NRMRL to meet the strategic goals under its new assigned mission, it must supply the resources necessary to implement the plan developed under Issue 2. If the necessary resources are not provided, the strategic goals and mission for NRMRL should be reformulated to bring their goals in line with NRMRL's existing staff and physical environment.

4. NRMRL has acquired a national and international reputation in several of its traditional engineering/technical/scientific areas of research. Because the staff are fundamentally going to remain in place as the transition occurs, it makes sense that it reorganize these traditional strengths and attempt to preserve those historical skill areas.

4.0 LABORATORY NEEDS TO ACCOMPLISH ITS MISSION

It is clear that NRMRL is faced with a considerable challenge. The Laboratory has seen a shift in its historical role of managing externally funded research to now conducting an in-house research program. At the same time, staffing levels have been decreased, expectations for research support and technical assistance from other branches of EPA are increasing, and its strategic goals have been considerably broadened under the new risk assessment/management paradigm. In addition, the skill mix and training of the professional staff are not consistent with the new set of research priorities and responsibilities, and the infrastructure to support the program is simply inadequate.

The Self-Study Report identified a number of actions that could be taken by EPA and ORD, which would enable NRMRL to meet the strategic challenges it faces. The following specific actions were identified:

1. Promote reasonable stability/predictability in research priorities and resources.

2. Continue administrative streamlining/flexibility.

3. Promote an integration of science activities across EPA.

4. Clarify risk-based priority setting.

Although these actions are rather broad and need to be made more specific, the Subcommittee endorses NRMRL's recommendations to ORD and EPA management. All seem not only reasonable but also necessary if NRMRL is to become effective in its new role as a risk management research laboratory.

The Subcommittee, however, believes that these actions may not be enough to ensure the success of NRMRL in its new research/technical support role. EPA and ORD will need to provide the resources (i.e., personnel and infrastructure) necessary for NRMRL to be effective in meeting its strategic goals under its new risk management mission or, alternatively, give serious consideration to reformulation of NRMRL's mission to one more consistent with its resources and capabilities. NRMRL needs to develop the detailed implementation plan called for under Section 3.8 of this Subcommittee report, and ORD and EPA need to provide the resources necessary to implement that plan.

5.0 BREAKOUT SESSIONS

The breakout sessions were designed to explore the role of NRMRL staff at every level in setting research priorities and planning and implementing scientific and management strategies to address those priorities. Three breakout sessions were conducted that lasted approximately 2 hours. Each group was comprised of two Subcommittee members and up to 10 NRMRL staff members. The NRMRL participants represented a broad cross-section of personnel with wide-ranging responsi-bilities and disciplines (Division Directors, Assistant Laboratory Directors, Branch Chiefs, scientists, engineers, economists, technicians, etc.). Several views, covering a wide range of topics, were voiced by the NRMRL participants in the discussion groups.

The NRMRL staff indicated that they are happy with their jobs and feel their work makes a difference in reducing human and ecosystem exposures to environmental contaminants. They pointed out that the NRMRL has effective and knowledgeable leaders with vision, and they have the respect and confidence of NRMRL staff at all levels. In the course of the discussion, a number of recommendations emerged that the staff would like to have considered, including:

1. A review of the risk-based, priority-setting process to ensure that the highest research priorities are being identified.

2. Attempt to bring more stability to research projects by establishing long-term goals that are not impacted by constantly shifting short-term goals.

3. Ensure that the traditional engineering strengths of NRMRL are not compromised in the course of the shift of NRMRL to the risk management paradigm.

4. A process should be developed to strengthen the lines of communication between those developing research plans and the scientists/engineers conducting the research.

5. Procedures should be developed that provide opportunities for NRMRL staff to interact with STAR grantees.

6. Modifications to the internal grants program are needed to ensure that the awardees are provided with the necessary resources to conduct their research in-house.

7. A substantial skill enhancement program should be undertaken and the number of FTEs needs to be increased if NRMRL is going to be successful in converting to the risk management paradigm.

8. A new incentive program needs to be developed that actually rewards scientific/engineering research productivity.

6.0 CONCLUSIONS

1. The current ORD mission statement specifies responsibilities for NRMRL that are too broad in relation to the currently available resources and staff.

2. Although NRMRL has developed a set of goals for the Laboratory, it has not developed a mission statement and strategic plan that clearly defines its research direction.

3. There is a lack of coordination and integration among the various ORD research Laboratories on priority research items, and there is a lack of outside peer review of the ultimate agenda within each Laboratory.

4. Although perhaps the most reasonable of its charges, the Laboratory has not yet developed identifiable organizational priorities for addressing ORD goal #3 (providing common sense, cost-effective approaches for preventing and managing risks).

5. NRMRL management fully understands and is making a considerable effort to align the Laboratory's goals and activities with those described in the ORD's 1997 Strategic Plan.

6. NRMRL is making considerable progress in achieving the transition from an extramural centered laboratory to an intramural research laboratory, despite inadequate scientific/engineering personnel and budget.

7. The NRMRL has not developed a mechanism for selecting a reasonable number of high-priority research topics that are consistent with its charge (compared with other laboratories) and their current staffing.

8. There is no evidence that a mechanism is in place to monitor the amount of time invested into various activities such as administrative vs. research activities on specific projects.

9. There appears to be a "lack of correlation" between the Assistant Laboratory Directors planning and focus, and the work that actually occurs during the implementation process.

10. The engineering, scientific, and technical support staff at NRMRL are a talented, motivated and dedicated workforce, who have a high level of respect for and confidence in its senior management.

11. No detailed human resource plan has been developed to meet the greatly expanded mission of NRMRL.

12. The unique talents and capabilities within NRMRL appear not to have been understood by ORD when it developed its strategic plan. ORD management has not effectively evaluated how NRMRL can support the new ORD risk assessment/management mission in light of NRMRL's current personnel skill mix and resource constraints.

13. Because of the age structure of the scientific staff and the overall reduction in staff in recent years, the distribution of staff between those dedicated to planning, reporting, and administra-

tive activities and those devoted to conducting research seems not to be consistent with an organization dedicated to producing the highest caliber research. In short, there appears to be an abundance of seasoned project managers, but a shortage of persons who have "hands-on" experience, or a desire, to conduct research consistent with NRMRL's new risk management mission.

14. The Laboratory has not yet identified the need for developing the skills necessary to conduct decision science analysis (cost-benefit analysis, cost-effectiveness analyses, etc.) and to meet the much broader strategic goals set by ORD.

15. NRMRL has not adequately taken advantage of opportunities to encourage the current Laboratory staff to embrace their new role as participants in improving the risk management process/paradigm.

16. Laboratory personnel whose skills do not match those required to conduct in-house research are not receiving the formal or informal retraining necessary to provide them with the skills needed to prepare them for their new role in conducting innovative research on cost-benefit research studies, and for developing cost-effective risk management techniques.

17. The EPA has taken little advantage of the geographical proximity of the NRMRL and RTP Laboratories to major universities to access potential mentors for new postdoctoral fellows or to recruit recent graduates.

18. NRMRL's infrastructure, including laboratory space, technician support, and library resources, do not appear adequate to permit NRMRL principal investigators to compete successfully for internal or external research grants.

7.0 RECOMMENDATIONS

1. A mission statement and strategic plan should be developed that provides specific guidance for NRMRL and clearly delineates NRMRL's role within the new ORD structure.

2. More extensive external review is needed to ensure that NRMRL's research agenda is consistent with and coordinated with the overall ORD research agenda and those research activities of other ORD Laboratories.

3. Conduct a study to evaluate the current roles and responsibilities of the Associate and Assistant Laboratory Directors to identify ways to ensure that they are a productive part of the overall strategic plan rather than having their activities primarily devoted to the coordination, planning, and establishing the general direction of research.

4. Redesign the planning process to ensure greater involvement of division personnel, particularly those responsible for conducting the research.

5. Evaluate the effectiveness of the internal committee structure within NRMRL and eliminate unnecessary or redundant committees. Set goals to reduce the amount of professional staff time allocated to "overhead" activities.

6. Explore the development of an information system that permits tracking of effort and resource allocation with respect to all five NRMRL mission areas. Specifically, level of effort, equipment usage, and time to closure should be attributable to specific projects. Explore the use of private sector models to track progress in achieving the goals specified in the human resource plan.

7. A 5-year plan for human resource development should be generated for NRMRL. This plan should take into account research priorities, shifting internal resources, the paradigm shift from predominantly external contract research management to predominantly internal research, and the age/skill set distribution in NRMRL. This plan should contain an ongoing, yearly systematic review to track progress in achieving the goals specified in the human resource plan.

8. The Director of NRMRL should convey a clear message to the staff regarding the two paths that professional staff can pursue under the new ORD agenda and strategic plan (administrative/management or research). Based on the Subcommittee's understanding of NRMRL's mission, the majority of staff will be encouraged to pursue original research in science/engineering and decision analyses (cost-benefit analyses, uncertainty analysis, etc.) that characterize the impact of new regulatory initiatives or classic engineering control technologies.

9. Develop a detailed career enhancement plan to be made available for members of the professional staff that would incorporate a formal mentoring and skills enhancement program.

10. Develop an effective rewards program that encourages a desire to conduct research consistent with the ORD/NRMRL's mission, strategic plan, and research agenda. Rewards that should be given consideration include support for enhancing Laboratory capabilities (analytical

equipment, computers, etc.), increased technical support (i.e., technicians), increased access to postdoctoral researchers, travel to scientific meetings, sabbaticals, and other similar incentives.

11. The internal grants program should ensure that the awardees have adequate facilities, equipment, technical staff, and administrative support necessary to conduct the research in-house. As NRMRL staff increasingly engage in in-house research every effort has been made to ensure that their administrative responsibilities decrease.

8.0 APPENDICES

A. Letters From Board of Scientific Counselors Chair

B. Self-Study Report

Oppelt, E. Timothy, National Risk Management Research Laboratory
August 18-19, 1997

C. Meeting Agenda

U.S. Environmental Protection Agency
Office of Research and Development
Board of Scientific Counselors (BOSC)

REVIEW OF NATIONAL RISK MANAGEMENT RESEARCH LABORATORY (NRMRL)
Andrew W. Breidenbach Environmental Research Center
Room 120
26 West Martin Luther King Drive
Cincinnati, OH 45268

August 18-19, 1997

PROPOSED SITE VISIT AGENDA

Monday, August 18, 1997

8:00 a.m. - 8:15 a.m.	Welcome and Introductions	Laboratory Director
8:15 a.m. - 9:00 a.m.	Overview of NRMRL	Laboratory Director
9:00 a.m. - 9:45 a.m.	Discussion of NRMRL Self-Study	Review Team/ Laboratory Director
9:45 a.m. - 10:00 a.m.	**BREAK**	
10:00 a.m. - 12:00 noon	Discussion of NRMRL Self-Study	Review Team/ Laboratory Director
12:00 noon - 1:00 p.m.	**LUNCH**	
1:00 p.m. - 1:45 p.m.	Presentation of Case Study Particulate Matter	Laboratory Staff
1:45 p.m. - 2:30 p.m.	Presentation of Case Study Drinking Water Disinfection And By-Products	Laboratory Staff
2:30 p.m. - 2:45 p.m.	Public Comment	
2:45 p.m. - 3:00 p.m.	**BREAK**	
3:00 p.m. - 5:00 p.m.	Breakout Sessions	Review Team/ Laboratory Management
5:00 p.m.	Adjourn	

Tuesday, August 19, 1997

7:30 a.m. - 9:00 a.m.	Discussion and Writing Session	Review Team
9:00 a.m. - 10:00 a.m.	Meet With NRMRL Director for Additional Information (IF NEEDED)	Review Team
10:00 a.m. - 12:00 noon	Writing Session	Review Team
12:00 noon - 1:00 p.m.	**LUNCH**	
1:00 p.m. - 2:00 p.m.	Debriefing	Review Team/ Laboratory Management
2:00 p.m.	Adjourn	

D. Case Studies

NRMRL was asked to prepare two case studies for presentation during the site visit of the Subcommittee. The case studies were intended to demonstrate NRMRL's role in the development and implementation of research programs directed at addressing two of the six high-priority research areas identified by ORD in its Strategic Plan. Case studies on particulate matter and drinking water disinfection and by-products were presented and discussed. A summary of the Subcommittee findings follows.

Particulate Matter Case Study

High-priority air pollutants with an emphasis on particulate matter (PM) is one of the six high-priority research areas specified in ORD's Strategic Plan. A comprehensive review of the current status of the PM program within ORD, with emphasis on the role of NRMRL was presented during the site visit. This presentation summarized the key PM issues, the major uncertainties regarding regulation of PM, the history of NRMRL in addressing PM issues, the current strategic approach of NRMRL to ensure consistency of PM research with ORD's Strategic Plan, and the current role of NRMRL in the PM program.

This case study clearly illustrates many of the challenges facing NRMRL and ORD in the development and implementation of ORD's Strategic Plan. These challenges include: (1) establishing priorities among research projects in support of the objectives of the strategic plan, (2) integration of research efforts across divisions, (3) measuring success, (4) effectively interacting with the external scientific community and other stakeholders, and (5) maximizing the use of unique core competencies within the Laboratories.

The recent update of ORD's Strategic Plan (ORD, 1997) summarized the key elements in the PM program with respect to health effects, exposure, risk assessment, and risk management. As noted in the presentation, the primary research emphasis in the next 3-4 years will be strengthening the scientific basis for the potential regulatory control strategies for PM. This will require integration of research activities across the various Laboratories tasked with conducting portions of the research program. In the case of the PM program, funding for PM research is provided to NERL, NHEERL, NRMRL, NCEA, and NCERQA. Prioritization of research projects, and the allocation of funds is a key programmatic issue, which was not specifically addressed during the case study presentation.

NRMRL has clearly played a significant role during the past 30 years in conducting R&D for PM control, PM precursor control, and PM source characterization for several industrial categories. However, the PM branch of NRMRL was disbanded in 1987. Since 1994, NRMRL has renewed PM research and has actively participated in the development of the PM research program currently being implemented within the Laboratories. The case study illustrated how the different Laboratories collaborated in development of the new PM research plan, and summarized the results to date of several research projects. The PM research program appears to have made substantial progress towards the goal of developing the necessary scientific and technical bases for developing PM management strategies. It is too early in the process, however, to evaluate the success of the program.

From a programmatic perspective, which is the primary focus of our review, the PM program appears to be a good example of how the Laboratories can effectively collaborate on the development and implementation of an effective research program in an area deemed to be a high-priority research area by ORD. Whether the current PM program is likely to meet the challenges noted above successfully could not be determined based on the case study presentation. However, the case study clearly showed that NRMRL has made substantial progress in developing linkages between Laboratories. NRMRL's core competencies for PM control technologies are an important part of the PM research program, but their effective integration into the current program was not clearly identified. Results of the program presented in the case study stressed source characterization. We presume that subsequent R&D projects will focus greater efforts on control technologies once the PM source characterization studies have been completed. NRMRL's future role in the PM R&D program should thus increase in priority, which presumably would be reflected in a shift of research dollars in FY 1999 and FY 2000.

Microbial and Disinfection By-Products Research Program

Safe drinking water with a near-term emphasis on microbial pathogens, disinfection by-products (DBP), and arsenic is also one of the six high-priority research programs identified in ORD's Strategic Plan. NRMRL is the lead Laboratory directing ORD's R&D efforts to address this high-priority research program. NRMRL presented a case study on the current status of its regulatory and research activities in addressing the microbial/DBP research priority. This case study also illustrated many of the programmatic challenges facing NRMRL. The presentation consisted of an overview of the history of federal regulatory actions to protect the safety of drinking water in the United States, the historical evolution of federal R&D activities, including the creation of the original drinking water research programs within EPA, and the historical and current organizational development of R&D activities within EPA.

NRMRL and the other Laboratories have clearly responded to ORD's recent strategic initiatives in drinking water research. A new research plan has been developed and approved by EPA's SAB, which presents the specific research projects to be undertaken to address uncertainties in health effects, exposure, risk assessment, and risk management in support of EPA's regulatory initiatives to provide safe drinking water. Funding resources for drinking water research were dramatically increased in 1997, after nearly 20 years of stable or decreasing funding. NRMRL intends to continue its historical role to address primarily risk management issues for determining the appropriate balance between maintaining or improving microbial drinking water quality while decreasing the quantity of DBPs formed by disinfection. NRMRL's core competencies in control technologies, analytical methods, and water quality will play a key role in the implementation of this research program.

Programmatic challenges highlighted by this case study include: (1) difficulties in maintaining high-quality research projects over the years in the context of decreasing budgets and fragmentation of research projects within the Laboratories; (2) continuing difficulties in developing or maintaining linkages between ORD Laboratories and integrating research efforts across division/Laboratory boundaries; (3) a lack of clear measures of success for program evaluation; and (4) continued difficulties in coordination of research projects with other government organizations, the STAR program, and external research organizations such as the American Water Works Research Foundation and the National Water Research Institute.

E. Figure 1: Identification of Future Problem, Initiating Event, or Public Policy Mandate

F. NRMRL Organization Chart