

July 14, 2005

Mr. E. Timothy Oppelt  
Acting Assistant Administrator  
Office of Research and Development  
U.S. Environmental Protection Agency  
Washington, DC 20460

Dr. William Farland  
Acting Assistant Administrator  
for Science  
Office of Research and Development  
U.S. Environmental Protection Agency  
Washington, DC 20460

Re: BOSC Review of the Mercury Multi-Year Plan

Dear Mr. Oppelt and Dr. Farland:

As a part of its commitment to provide advice to EPA's Office of Research and Development (ORD) on its research programs and following a request from ORD, the Board of Scientific Counselors (BOSC) agreed to review the Mercury Multi-Year Plan (MYP) and the planning process with respect to what changes should be made to ensure that:

1. The proposed scope of the work is consistent with: (a) ORD's subject area Research Strategy, (b) the current state-of-the-science, and (c) research by others.
2. The science questions address the most important scientific gaps and uncertainties in the subject area.
3. The long-term goals (LTGs) are relevant to the science needs of the Agency, and the MYP situates the annual research products (Annual Performance Goals [APGs], Annual Performance Measures [APMs]) on a clear path to accomplishing each of the LTGs (and APMs contribute to APGs).
4. Research products and emphases over the next 5 to 7 years are sequenced appropriately to accomplish goals and meet program and regional needs.
5. The MYP is flexible enough to adapt to future science and policy changes.
6. The MYP articulates a strategy that facilitates effective communication and utilization of research products (with domestic and international parties).
7. There is a clear path for assessing/evaluating the MYP and progress toward its goals.

For the purpose of this review, BOSC formed a subcommittee, chaired by Herb Windom from Skidaway Institute of Oceanography. Other members included Rui Afonso, Energy and Environmental Strategies; Cindy Gilmour, Smithsonian Environmental Research Center; Rogene Henderson, Lovelace Respiratory Research Institute; James Johnson, Howard University; George Lambert, University of Medicine and Dentistry of New Jersey; Michael Waalkes, National Cancer Institute.

The BOSC Mercury Subcommittee reviewed the most recent Mercury MYP (May 2003) and heard presentations by and had discussions with a number of ORD staff. Though the subcommittee was not charged specifically with assessing the quality of

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ORD's mercury research program, it is apparent that ORD has accomplished much with the available resources and is poised to contribute significantly more to the better understanding of the global mercury problem, especially with regards to transport and fate.

Based on the results of this review, the subcommittee prepared this Letter Report, which presents the subcommittee's five overriding recommendations, followed by specific comments and recommendations that address the specific charge questions listed above.

#### Overriding Recommendations

1. Because mercury is important to many agencies, the subcommittee members believe that the Mercury MYP planning process would benefit greatly from an interagency council to institutionalize and harmonize collaboration across federal agencies and to provide for proactive leveraging of resources. Such coordination is necessary to assure that all aspects of the mercury problem are being addressed and is particularly important in assessing the adequacy of ORD's funding for research on its part of the problem as compared with the parts addressed by other agencies. Regardless, the subcommittee considers the present level of funding provided to the ORD for research on mercury to be limited considering the regulatory needs of the Agency to address the effects of mercury on the human condition and ecosystems.
2. Prioritizing and sequencing of APMs need to be discussed more fully in the Mercury MYP. Some APMs must be completed before others can be accomplished, but some are probably more flexible regarding when they are accomplished. Prioritization often is a "moving target." For example, a program need may require that resources be shifted from research aimed at one APM to another one. Flexibility is required to accommodate such shifts, but for the purpose of communicating the Mercury MYP, the criteria for sequencing and for shifting priorities should be stated and reflected in an annual update of the plan as recommended below (see response to Charge Question 4).
3. The value of the Mercury MYP as a "living" document would be enhanced if it were updated annually. A rewrite of the text would not be required; rather, the appendices could be used to provide an indication of progress on the APMs. For example, if an APM was proposed to be completed during a given year and for some reason it was not, the explanation for why the APM was not completed could be annotated in a footnote that might relate to the criteria for prioritizing/sequencing as recommended above.
4. The Mercury MYP is a communication document as well as a planning document. Communication should be made a major part of the plan if the program is to be successful. This is discussed in more detail below but the subcommittee recommends strongly that the Mercury MYP articulate a detailed plan for communications with domestic and international parties. These parties include EPA outside of ORD, other federal agencies, states, tribes, the general public, industry, extramural research groups, and governments of other countries. It should recognize that communication is a two-way process and feedback from partners is crucial to success.
5. It would be helpful if the Mercury MYP provided an assessment of outcomes related to the various APGs and APMs since the previous plan. This would help to track progress and to translate just how the results are being used. More discussion supporting this and the other overarching recommendations is provided below.

## Responses to the Charge Questions

1. **What changes should be made to ensure that the proposed scope of the work is consistent with: (a) ORD's subject area Research Strategy, (b) the current state-of-the-science, and (c) research by others?**

*Comments:* The Mercury MYP, as laid out in 2003, is comprehensive and well thought out. It focuses on the most critical information needs in mercury fate and transport (including risk assessment), and on reduction of mercury emissions from a variety of sources, most importantly coal-fired utility boilers. The MYP is based on EPA's Mercury Research Strategy of 2000. The six key scientific questions listed in that document are listed on page 8 of the MYP. These questions were extensively peer reviewed in 1999, and remain the key information needs. According to the Mercury Research Strategy the overarching goal of EPA's mercury research program is "to provide information and data that reduce scientific uncertainties limiting the Agency's ability to assess and manage mercury and methyl mercury risks." This is a goal worth keeping and highlighting in the MYP.

The commitment of approximately \$5.5 million and 8 full-time equivalents (FTEs) per year does not allow for a full research plan to be pursued in all six areas of research that were identified in the Mercury Research Strategy and are critical to meeting the overarching goal of the program. The limited funds restrict the Mercury Program to examining only one or two of the critical areas of needed research in any given year. Notable for its absence is any research on the effects of mercury on either human health or on ecosystems (Science Question #5).

The research that is underway by the Agency is state-of-the-art in the topics that are being addressed. EPA is aware of the research going on in other federal and local government agencies, universities, and the private sector. The limited research program requires that the Agency leverage funding by collaborating with other entities and stakeholders to acquire needed data sets.

The Agency is working with international governments to gather important data sets to maximize its research productivity. In addition, EPA realizes that the United States is one of many countries in the world that is adding to the global load of mercury. If progress in reducing global load of mercury is to be made, it will require an international effort in research and development and technology transfer. EPA is actively trying to reach out to the other countries of the world to work with them to address the mercury issues.

In summary, mercury has been identified by the EPA as one of the 15 leading environmental chemicals of most concern. The proposed scope of the work in the MYP is consistent and well thought out. EPA is maximizing the research productivity in all ways possible; however, the subcommittee considers the amount of funds provided to the Agency for mercury research to be limited considering the regulatory needs to address the effects of mercury on the human condition and ecosystems.

*Recommendation:* None

2. **What changes should be made to ensure that the science questions address the most important scientific gaps and uncertainties in the subject area?**

*Comments:* EPA has significant research needs in order to adequately support pending regulatory commitments for mercury. The most critical immediate need is research to reduce uncertainty in the cost/benefit assessment of proposed rules like the Clean Air Mercury Rule (CAMR) and the Clean Air Interstate Rule (CAIR). Significant new research and assessments also will be needed to adequately monitor the effectiveness of regulations once they are in place.

The Mercury MYP lays out two LTGs, which cover the six scientific questions. The two broad and all encompassing LTGs and the associated APGs generally address the most important scientific gaps and uncertainties, and are on-target to meet EPA's needs. A comparison of the MYP with EPA's Mercury Research Strategy of September 2000, and with a recent summary of EPA's needs in support of the proposed CAMR (*Federal Register* 69:230 December 1, 2004, Notice of Data Availability), however, highlight the large gaps between the research listed in the MYP (and the level of recent and ongoing EPA research) and EPA's research needs.

The current MYP, dated May 2003, is out of date in a number of ways. Most importantly, the APGs and APMs in the MYP are 2 years out of date, making it difficult for a reader to assess what research EPA has already accomplished and what research remains to be accomplished. The current MYP does not fully reflect the current mercury research efforts within EPA or outside of the Agency. The MYP should be updated annually, documenting progress, outcomes, and any necessary revisions. This is discussed in more detail in the following sections.

**Recommendation:** The current MYP was written in 2003 and does not reflect the updated current progress or the most recent plans for future LTGs and APMs. The MYP should be updated annually, documenting progress, outcomes, and any necessary revisions.

**3. What changes should be made to ensure that the long-term goals are relevant to the science needs of the Agency, and the MYP situates the annual research products (APGs, APMs) on a clear path to accomplishing each of the LTGs (and APMs contribute to APGs)?**

**Comments:** The LTGs in the Mercury MYP are relevant to the science needs of the Agency as discussed in the response to Charge Question #2. The LTGs will be accomplished by completing APGs and the APGs are to be accomplished by specific, measurable APMs. This is a logical approach to organizing and assessing the research program. Generally, the APGs capture the key research needs within each LTG. The APMs, however, that provide the specifics of the research program, do not appear to place EPA on a clear path to accomplishing the LTGs. Although the APGs generally reflect the research needs as laid out in the Mercury Research Strategy, the APMs needed to support the APGs often are missing or incomplete. Further, the mechanisms for choosing the needs and prioritizing and updating the APMs within the MYP should be strengthened. A specific recommendation is provided below. The APGs and APMs in the current MYP (date May 2003) are 2 years out of date, making it difficult for a reader to assess whether ORD is on track to accomplish the LTGs. The subcommittee recommends that the MYP become a more dynamic document that is updated and distributed more frequently, mainly through annual updates of the tables in Appendix 2, as discussed below.

More importantly, the subcommittee members think that it is unlikely that the key research goals of the LTGs would be met given the current and planned level of research effort, as laid out in the APMs. EPA acknowledges this shortfall on page 17 of the MYP, noting that "shortfalls in resources will prevent ORD in the near-term from conducting risk management research on non-combustion sources of mercury, health risk assessment research, and monitoring and modeling research." In a variety of documents, including preparatory materials for the upcoming Clean Air Mercury Rule, EPA acknowledges significant unmet research needs, both in support of regulatory actions, and for adequate protection of human and ecosystem health. For example, EPA notes in its recent review of available data for CAMR, that there is a need for improved power-sector modeling tools, recognizing that assumptions used to model Hg fate and transport "are more uncertain than sulfur dioxide and NOx-related assumptions due to limited information..." Another example of gaps in the APMs is that EPA's Office of Water is using "Mercury Maps" (MMAAPS) as the best available methodology for predicting changes in fish mercury levels from changes in deposition. MMAAPS assumes a linear response without the data available to support that

assumption. The second APG under LTG 2 specifically lists a need for an improved model; however, nowhere in the APMs does EPA propose research into the magnitude and timing of ecosystem responses to changing mercury load, although both the Mercury Research Strategy and the Notice of Data Availability specifically list a need for that information. Based on the 2003 MYP, mercury fate and transport research is scheduled for completion by 2004, despite clear remaining needs.

There is one large gap in the APGs; the Report on Mercury to Congress listed monitoring as a very high priority. The effectiveness of mercury control regulations cannot adequately be assessed without the development of long-term monitoring programs in multiple matrices. Although ORD has facilitated the development of the Mercury Deposition Network (MDN) for wet deposition monitoring, ecosystem monitoring is not in place nor planned in the MYP. The subcommittee recognizes that ORD is not in the business of running monitoring programs, but it should explicitly support the development of strategies and capacity for such programs. EPA's involvement in the developing interagency strategy for long-term monitoring of mercury in multiple matrices should be encoded in the MYP.

**Recommendation:** The combination of some of the APGs would aid in the clarity of the MYP to clients and stakeholders. For example, within LTG 1, APGs #1, #2, and #4 all address concerns about the release of mercury from coal-fired utilities with an emphasis on monitoring methods and control technology performance to determine the most cost-effective approaches to reduce emissions. These three APGs could be combined to obtain a clearer picture of the extent of the Agency's activities in this area. Combining these APGs also would allow coordination of the efforts in this area. There are a number of other cases where APGs could be combined.

**4. What changes should be made to ensure that the research products and emphases over the next 5 to 7 years are sequenced appropriately to accomplish goals and meet program and regional needs?**

**Comments:** The research emphases appear to generally follow a logical sequence over the next 5 to 7 years and often reflect the need for research in support of important regulatory activities. The sequence of APGs within LTG 1 (reduce and prevent releases), with an initial emphasis on technologies to reduce combustion sources of mercury, is logical and driven by regulatory demands. Some events could occur earlier in the process, such as in LTG 2 (transport, fate, and effects) in which health risk assessment of mercury in humans occurs late in the process after transport and fate studies in fish. With the current funding for mercury research at ORD, however, it would not be possible to study the effects of mercury on human or ecosystem health in addition to the ongoing transport and fate studies. ORD has rightly chosen to focus on the area of research it is best equipped to do (i.e., the transport and fate of environmental mercury).

With the current MYP 2 years out of date, and a lack of information on progress on recent APMs in the document, it is difficult to assess whether current sequencing and prioritization in the MYP will meet EPA's needs. The subcommittee noted that target dates listed for completion of APMs in the MYP draft (Appendix 2) often have not been met, generally due to lack of funding. Under LTG 2, for example, models for the response of ecosystems to changes in mercury deposition, Total Maximum Daily Load (TMDL) models beyond two pilot studies, predictive models for spatial distribution of mercury exposures, and habitat suitability models remain incomplete despite target dates for APMs in 2004 or before. Further, the MYP does not provide cost estimates for the research required to meet EPA's regulatory needs, making it difficult to judge whether the research proposed for 2005 and beyond in the MYP will fill key scientific gaps in a timely manner.

Figure 3 of the Mercury Research Strategy prioritizes research needs by assigning funding percentages to each area of need, but this is not reflected clearly in the MYP. The mechanisms for choosing and

sequencing APMs and APGs could be strengthened in a number of ways, as noted in the recommendations below. Recommended mechanisms for linking outcomes to sequencing and prioritization also are discussed in the response to Charge Question #7 (assessment and evaluation).

**Recommendation:** The subcommittee recommends that the rationale for choosing APGs and APMs (and prioritizing them) be laid out in more detail in the MYP, and the APGs and APMs be at least roughly ranked. This requires clear summaries of the state-of-the-science, additional information on the status and outcomes of recent APMs, and a prioritized list of needs within each LTG and APG. This recommendation feeds into the need to make the MYP more of a "living" planning and communication document that is flexible in response to changing needs and funding levels. Further, the MYP should show the reader how APMs and their priorities have changed through time, without the reader having to access prior versions of the MYP to assess such changes. This might be accomplished by updating the Appendix 2 tables, noting which APMs have been dropped or added each year, and how their rankings have changed.

**5. What changes should be made to ensure that the MYP is flexible enough to adapt to future science and policy changes?**

**Comments:** It is clearly stated that the MYP is considered a "living" document that is intended to be updated to reflect the current state-of-the-science, resource availability, and emerging Agency priorities. As a general policy, this should provide the latitude to react to changes arising in both the areas of science and policy, including changes in funding. Indeed, the MYP has undergone multiple revisions, and additional reviews are planned, including external peer review. It is unreasonable to expect that all potential changes would be anticipated in the plan, particularly those based in scientific research. There is extensive discussion of the impact of the availability of additional resources on short- and long-term research in Section 3.0 (page 17) and Sections 5.0-5.3 (pages 19-20). These efforts, however, are given as a group under the assumption of a 20% increase and the plan should prioritize these future research directions in case this increase is not fully realized. There is much less discussion devoted to funding shortfalls (Section 3.0, page 17).

**Recommendation:** The process for prioritizing research should be discussed so the reader can assess the impact of budgetary and other constraints on the MYP.

**6. What changes should be made to ensure that the MYP articulates a strategy that facilitates effective communication and utilization of research products (with domestic and international parties)?**

**Comments:** In the introduction section of the Mercury MYP it is stated that the purpose of this document is to aid ORD in planning and communication. It also includes a concise discussion of how the planning and the research outcomes are communicated within and outside the Agency. The introduction provides a clear discussion of how the MYP links to the Mercury Research Strategy and its six scientific questions and their relation to the two LTGs for ORD's mercury research. How the research described in the MYP addresses various commitments of EPA offices related to the Agency's priorities and regulatory programs is discussed throughout the document. It also anticipates future programs/commitments related to pending legislation and implies ongoing attention to these developments. The MYP also takes into account what is being done by other agencies/states. Examples are provided of bilateral/multilateral programs with which ORD is linked to indicate that there is ongoing international communication of planning and research products.

The MYP states that a strategy for effective communication is an important component of the multi-year planning process. The document also indicates how research products are anticipated to contribute to the

overall strategy and to Agency priorities, but the MYP does not provide much detail about the process that will enhance the likelihood that the research products will be utilized. Although the APMs give an indication of the products, it would be useful to articulate how these products will be marketed. With regard to this as well as the overall planning effort, the MYP should better explain how states and other parties are brought into the process. Different states/regions have different perspectives on mercury issues and it is important for their representatives and constituents to know that their views are taken into account in the Mercury MYP.

**Recommendation:** The Agency is strongly encouraged to develop a detailed plan for communication with domestic and international parties. These parties include other federal agencies, states, tribes, the general public, industry, extramural research groups, and governments of other countries. The plan should address how states and these other parties are brought into the planning process. The MYP also should include a detailed plan on how the research products will be marketed and how important research results and technology can be transferred to the other parties. In addition, the communication plan should include methods to determine the outcomes of EPA's research outputs (i.e., how they were used by the other parties). Expected outcomes might include answers to such questions as: Did the new information generated by ORD result in new stronger or less stringent regulations? Did the industry apply the new EPA technology? Did the new technology decrease emissions or make the current emission control technology more affordable? The outcomes should be tracked for all activities described in the MYP. The communications should include current EPA and the other parties' research/data needs and current research plans for soon-to-be conducted research. This may allow all the parties (including EPA) to reach out to each other to develop cooperative research plans to fulfill research gaps and leverage their research funds to maximize research productivity. The communications between EPA and other parties, including grant awardees, need to be more dynamic and flow in both directions. For a detailed discussion of the needs and methods for communications to all stakeholders the Agency should refer to the Communicating Research Results report prepared by the BOSC Ad Hoc Communication Subcommittee (May, 2004).

**7. What changes should be made to ensure that there is a clear path for assessing/evaluating the MYP and progress toward its goals?**

**Comments:** The figures presented in Appendix 1 of the MYP provide a schematic of the sequence of research, as described in the APGs, toward the two LTGs and the APMs describe the products to meet the APGs. It is not clear if there is a sequence in the APMs (i.e., one must be accomplished before the next can be) or whether the sequence is determined programmatically. The MYP should indicate when an APM has been achieved and if it is not achieved by that date, the adjusted timetable for completion should be indicated.

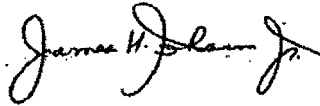
On page 8 of the MYP, the six scientific questions posed in the Mercury Research Strategy are highlighted. Although the APGs and their associated APMs are linked directly to the two LTGs, it would be useful for the reader to understand which of the six scientific questions is addressed by each APM. The reader should be able to track the progress of each of the APMs in subsequent revisions of the MYP.

The results of each APM, the products of the research, how the products of the research were utilized by the Agency or other parties, and the outcomes of the use of the products should be tracked in an annual updated document of the MYP. This annual update would only track each APM; the entire MYP would only be updated every 5 years or as indicated. This could be accomplished easily by annual revisions of the APM tables with the additional columns of product of research (e.g., development of improved emission technology; specific improvements in models for mercury exposure), applications (e.g., inserted into 100 plants in the United States and adopted by Chinese government and industry), and outcomes (e.g., reduced the emissions from the smoke stacks by 50%). This tracking and linking of APMs to outcomes will make the MYP a "living" document that has a greater impact on all of the stakeholders.

**Recommendation:** The subcommittee strongly recommends that Appendix 2 of the MYP be modified to link the APMs to the six scientific questions or, alternatively, produce another simple table/diagram that illustrates these links. It is further recommended that the proposed schedule to accomplish an APM in the current MYP be compared to the anticipated timetable provided in the previous MYP, and that some indication of the reason (e.g., funding limitation) for an APM not being accomplished be provided in a brief footnote. The Agency should develop an annual revision of the MYP document. This annual document would only track the progress of each APM and their outcomes. The results of each APM, the products of the research, how the products of the research were used by EPA and/or other parties, and the outcomes of the use of the products should be monitored, and the results published each year as the annual update of the MYP.

On behalf of the subcommittee and BOSC Executive Committee, we are pleased to provide the above advice to the Office of Research and Development. We look forward to receiving your response and are prepared to provide clarification to any of the issues or recommendations presented above.

Sincerely,



James H. Johnson, Jr.  
Chair, Board of Scientific Counselors