August 21, 1995

EPA-SAB-EEC-95-018

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

RE: Science Advisory Board Subcommittee Review on Verification of Innovative Continuous Air Emission Monitors

Dear Administrator Browner:

The Hazardous Air Pollutant Monitoring Subcommittee of the Science Advisory Board's Environmental Engineering Committee (EEC) has completed its review of the Office of Research and Development's planned initiative in the Verification of Innovative Continuous Air Emissions Monitors. The Subcommittee was composed of EEC members, consultants, and invited participants with expertise in continuous emissions monitors, air emissions from stationary sources, measurement systems, analytical instrumentation manufacturing and emissions regulations. The Subcommittee met April 24-25, 1995, to address the following charge:

a) The technical framework of the proposed Continuous Emissions Monitoring (CEM) verification may require more flexibility than is currently allowed under existing ambient air reference and equivalent methods regulations. What would increase general applicability, modify technical concepts, or otherwise improve the ambient air equivalency procedures for use in CEM verification?

b) The EPA is considering a CEM verification program that combines the best features of the ambient air equivalency program (40 CFR 53) and the German "TUV" field verification program. What variables need to be considered in developing the optimal CEM verification program?

c) Method 301 of Title 40 CFR, Part 63 is a protocol for the field validation of measurement methods written specifically for manual test methods

where a discrete sample is collected, usually for analysis at a later time. What modifications would be reasonable?"

The Subcommittee also considered barriers to the commercialization of innovative CEMS.

The Verification of Innovative Continuous Air Emissions Monitors initiative is a proposed pilot project under the Environmental Technology Innovation and Commercialization Enhancement (EnTICE) program and the initiative has not yet been actively pursued by the Agency. The Subcommittee, therefore, is providing prospective input regarding this proposed initiative and is not reviewing a completed project or even a project in progress. The Committee believes that such an early input on a broad range of related issues is an effective use of SAB expertise and processes which allows advisory inputs to be given to the Agency before a program becomes more intractable to change.

Continuous emissions monitors (CEMs) for criteria and acid rain pollutants (e.g., NOx, SOx, CO) have been routinely utilized in the past due to regulatory requirements and industrial practices. However, the Clean Air Act Amendments of 1990 addresses a broader range of air pollutants including particulate matter and hazardous air pollutants (HAPs). There is interest in continuously monitoring some HAPs. For example, when there is significant process variability or when more continuous performance assurance of health and environmental protection is needed. For many of these HAPs, CEMs are currently not available commercially, and hence in those instances, the development and commercialization of innovative CEMs is encouraged.

The lack of CEMs for HAPs is caused by a number of barriers to commercialization of innovative CEMs. However, the barriers to the development and commercialization of innovative CEMs are more complex than currently articulated in the initiative documents and presentations. These barriers need to be comprehensively reviewed and evaluated early in the execution of the initiative. The Agency should first determine all of the barriers and then address them in a systematic manner following an integrated approach. After reviewing the barriers the Agency should consider where the verification process properly fits into the process of promoting the development and commercialization of innovative HAP CEMs.

The Subcommittee identified several potential barriers to the availability of commercial, cost-effective CEMs in the marketplace. These barriers can be categorized as technical uncertainties related directly to CEM technologies and market uncertainties related to industry's willingness to invest money and resources in bringing these technologies to market. The Subcommittee concluded that EPA's regulatory mandates control many of the market drivers and uncertainties and that these mandates need to be addressed along with the other technical and market uncertainties that exist. The Subcommittee recommends that both the technical and market barriers and uncertainties be defined further through broad stakeholder involvement and Agency evaluation.

After the EPA has defined and prioritized the barriers to CEM commercialization such as those defined above, the program could be structured to address how EPA can systematically

reduce the barriers. The Subcommittee suggested several potential actions that EPA could consider in eliminating perceived and real barriers.

Finally, any CEM system verification procedures to be developed in the United States need to be consistent with those followed by other countries to provide for international competitiveness and widespread data acceptance. Performance-based specifications have been published by the International Organization for Standards (ISO). The adoption of verification methods that differ too greatly from the international performance-based standards, or that are perceived as being less rigorous, can result in questions regarding the validity of the data obtained and may do harm to the international markets for CEMs based on these verification methods.

We appreciate the opportunity to review this planned program. Our most important recommendation is that the Agency determine all of the barriers and then address them in a systematic manner following an integrated approach. After reviewing the barriers the Agency should consider where the verification process properly fits into the process of promoting the development and commercialization of innovative continuous emissions monitors for hazardous air pollutants. We look forward to your response to our recommendations.

Sincerely,

Genevieve M. Matanoski

Dr. Genevieve M. Matanoski, Chair
Executive Committee

Dr. Ishwar P. Murarka, Chair
Environmental Engineering Committee

Wm Randall Seeker

Dr. Wm. Randall Seeker, Chair
Hazardous Air Pollutant Monitoring Subcommittee

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ABSTRACT

The Hazardous Air Pollutant Monitoring Subcommittee of the EPA Science Advisory Board's Environmental Engineering Committee (EEC) reviewed a planned program on the Verification of Innovative Continuous Air Emissions Monitors (CEMs).

Continuous air emissions monitors for criteria and acid rain pollutants are routine due to regulations and industrial practices. New requirements dictate the need to control a broader range of air pollutants including particulate matter and hazardous air pollutants (HAPs). In some instances there may be a need or desire to continuously monitor these HAPs and for many of these HAPs, CEMs are currently not available commercially. Hence, in those instances, the development and commercialization of innovative CEMs is encouraged.

The basic premise of the Verification of Innovative Continuous Air Emissions Monitors initiative is that the lack of a properly structured verification protocols for innovative CEMs is the critical barrier to commercialization of new CEMs. This premise may be wrong and needs to be thoroughly reviewed as part of the program. The Subcommittee concluded that the lack of CEMs for HAPs is caused by a number of barriers to commercialization of innovative CEMs. The barriers to the development and commercialization of innovative CEMs are more complex than articulated in the initiative documents and need to be comprehensively reviewed and evaluated early in the execution of the initiative. The Agency should first determine all of the barriers and then address them in a systematic and integrated approach. After reviewing the barriers, the Agency should consider where the verification process properly fits into the process of promoting the development and commercialization of innovative continuous emissions monitors.

KEY WORDS: Continuous Emissions Monitors, Hazardous Air Pollutants, Verification, Commercialization, Environmental Technology

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1. EXECUTIVE SUMMARY

The Environmental Engineering Committee (EEC) of the EPA Science Advisory Board was requested to provide input to a project planned by the Source Methods Research Branch of the Atmospheric Research and Exposure Assessment Laboratory (AREAL) to be carried out under the Environmental Technology Innovation, Commercialization, and Enhancement (EnTICE) program. The EEC formed a technical subcommittee which included EEC members, consultants, and invited participants with expertise in continuous emissions monitors, air emissions from stationary sources, measurement systems, analytical instrumentation manufacturing and emissions regulations.

The Verification of Innovative Continuous Air Emissions Monitors initiative is a part of the proposed EnTICE program and has not yet been actively pursued by the Agency. The SAB's Hazardous Air Pollutant Monitoring Subcommittee was structured to provide advice and consultation to the Agency on the program as currently planned and as presented to the Subcommittee. The Subcommittee is providing prospective input regarding this proposed program and is not reviewing a completed project or even a project in progress. The Subcommittee believes that this advisory role is an effective use of SAB expertise and processes which allows input and advice to be given on a broad range of related issues before a program becomes more intractable to change.

Continuous air emissions monitors (CEMs) for criteria and acid rain pollutants (e.g., NOx, SOx, CO) have been implemented routinely in the past due to regulations and industrial practices. However, new requirements dictate the need to control a broader range of air pollutants including particulate matter and hazardous air pollutants (HAPs) as specified in the Clean Air Act Amendments of 1990. In some instances there may be a need or desire to continuously monitor these HAPs, such as when there is significant process variability or when a more continuous performance assurance of health and environmental protection is needed. For many of these HAPs, CEMs currently are not available commercially and hence, in those instances, the development and commercialization of innovative CEMs is encouraged.

The Subcommittee concluded that the lack of CEMs for HAPs is caused by a number of barriers to commercialization of innovative CEMs. However, the Subcommittee concluded that the barriers to the development and commercialization of innovative CEMs are more complex than currently articulated in the initiative documents and presentations and need to be comprehensively reviewed and evaluated early in the execution of the initiative. The basic premise of the Verification of Innovative Continuous Air Emissions Monitors initiative, as currently proposed, is that the lack of properly structured verification protocols for innovative CEMs is the critical barrier to commercialization of new CEMs. The Subcommittee concluded

that this premise may be wrong and needs to be thoroughly reviewed as part of the program. The Agency should first determine all of the barriers and then address them in a systematic and integrated approach. After reviewing the barriers, the Agency should consider where the verification process properly fits into the process of promoting the development and commercialization of innovative CEMs.

The Subcommittee identified several potential barriers to the development of commercial, cost-effective CEMs and to their introduction to the marketplace. These barriers can be categorized as technical uncertainties related directly to CEM technologies and market uncertainties related to industry's willingness to invest money and resources in bringing these technologies to market. The technical barriers identified included:

a) The technical difficulty of producing a rugged, reliable, accurate and cost-effective CEM;

b) The need for performance specifications for CEMs that are suitable for assuring performance with technology based standards such as Maximum Achievable Control Technologies; and

c) The relatively poor precision achieved when using HAP reference methods for certain pollutants and applications and the lack of reference methods for others.

The Subcommittee identified several market barriers and uncertainties that can also represent significant barriers to the development and commercialization of innovative CEMs, including:

a) Whether the use of CEMs for regulatory compliance is mandated or is optional;

b) The number and extent of verification procedures required for separate source categories;

c) The consistency of Agency policy. If the policy is not consistent, the manufacturers will tend to avoid a market that is changing so rapidly that it impedes business development; and

d) Excessive segmentation of the verification procedures for specific source subcategories.

The Subcommittee concluded that often EPA mandates drive the market and that these mandates and uncertainties in these mandates, need to be recognized along with other technical and market uncertainties that exist.

The Subcommittee recommends that both the technical and market barriers and uncertainties be further defined through broad stakeholder involvement and Agency evaluation. After the EPA has defined and prioritized the barriers to CEM commercialization, the program could be structured to address how EPA can systematically reduce the barriers. The Subcommittee suggested several potential actions that EPA could undertake to eliminate perceived and real barriers.

In the present system, a monitoring system is tested for conformance to the requirements of the Performance Specification as described in 40 CFR 60 Appendix B. The difficulty in evaluating whether the proposed program is an improvement or barrier relative to the current system depends very strongly on the detailed technical requirements and procedures that will apply. The removal of the relative accuracy test requirement may not be realistic in the majority of applications, and EPA should consider this issue very carefully. Until a better definition of the alternative verification protocols and QA requirements is available, it is difficult to see how the proposed verification process would represent an improvement to the current system.

Any CEM system verification procedures developed in the United States should be consistent with those followed by other countries to provide for international competitiveness and data acceptance. Performance-based specifications have been published by the International Organization for Standards (ISO), other countries and international organizations. The adoption of verification methods that differ too greatly from the international performance-based standards, or that are perceived as being less rigorous can result in questions regarding the validity of the data obtained and may do harm to the international markets for U. S. developed CEMs based on these verification methods.

The pilot project has proposed the use of one CEM technology, called Laser Imaging Direction and Ranging (LIDAR), as a case study for CEM verification. This case study, as currently envisioned was selected primarily as a target of opportunity and may not be a good candidate for an innovative CEM verification. Specifically, LIDAR as proposed, is designed to monitor NOx in ambient environments. However, NOx instruments for stacks and ambient monitors are already in wide commercial use. In addition, this technology is still highly developmental and there remains significant technical issues associated with its calibration due to the line-of-site nature of the technology; thus it is not a suitable test for verification since it is innovative, does not measure HAPs, and is not well suited to stack measurements.

2. INTRODUCTION

2.1 Background

The Environmental Engineering Committee (EEC) of the EPA Science Advisory Board (SAB) was requested to provide input to a project planned by the Source Methods Research Branch of the Atmospheric Research and Exposure Assessment Laboratory (AREAL) to be carried out under the Environmental Technology Innovation, Commercialization, and Enhancement (EnTICE) program. The AREAL initiative is entitled: "Verification of Innovative Continuous Air Emissions Monitors". The EEC formed a technical subcommittee which included both EEC members, consultants, and invited participants with expertise in continuous emissions monitors, air emissions from stationary sources, measurement systems, analytical instrumentation manufacturing and emissions regulations. A list of panelists is provided in the roster.

2.2 Charge to the Committee

The Agency and the EEC agreed upon the following charge to guide the review:

a) The "Ambient Air Monitoring Reference and Equivalent Methods" requirements are contained in 40 CFR, Part 53. The technical framework of the proposed Continuous Emissions Monitoring (CEM) verification may require more flexibility than is currently allowed under 40 CFR 53. In reviewing the proposed program on enhanced monitoring in light of 40 CFR 53, what would increase general applicability, modify technical concepts, or otherwise improve the documents?

b) The field component of the CEM verification program should be conducted at a site which is representative of the industry conditions and over a period of time which adequately tests for process changes and instrument performance. The German TUV field verification program appears to accomplish this. EPA might arrive at a Continuous Emissions Monitor (CEM) verification program that combines the best features of the 40 CFR 53 equivalency program and the TUV field verification program. What variables need to be considered in developing the optimal CEM verification program?

c) Method 301 of Title 40 CFR, Part 63 is a protocol for the "Field Validation of Pollutant Measurement Methods from Various Waste Media." Method

301 was written specifically for manual test methods where a discrete sample is collected, usually for analysis at a later time. Therefore, as currently written, the Method 301 Procedures are not applicable for use with CEM data. Thus, many of the concepts of Method 301 need to be modified so that a relationship can be established between the reference test method and the CEM results. The SAB is asked to comment on the nature of modifications that would be reasonable to use.

A full text of the project description and the charge is provided in Appendix A. The Agency provided a series of documents to the Subcommittee which address the Verification of Innovative Continuous Air Emissions Monitors initiative. This information also included aspects of potentially affected rules along with material on several prospective model protocols for the verification program. A list of this reference material is provided in Section 4. The Subcommittee held a review meeting on April 24 and 25th in Research Triangle Park, NC wherein representatives of AREAL presented background material and a discussion of the verification proposal along with concepts for integration of the proposal concepts into new Clean Air Act Rules.

The program, which is the subject of this review, was conceived and proposed as part of the EnTICE program. The goal of the EnTICE program is to substantially accelerate the entrance of new environmental technology into the domestic and international marketplaces. The function of the EnTICE program is to provide purchasers and permitters with credible performance/cost data which are generated by unbiased third parties under EPA auspices. A separate review of the overall EnTICE program by the SAB EEC took place after this review was undertaken and is the subject of a separate report currently under preparation by the Environmental Engineering Committee. No effort was made to integrate the findings of the Innovative Technology Subcommittee's EnTICE review into this report. However, it is worth noting that the general findings of the two subcommittees are similar.

The Verification of Innovative Continuous Air Emissions Monitors initiative is a proposed EnTICE pilot project and has not yet been actively pursued by the Agency. The SAB's Hazardous Air Pollutant Monitoring Subcommittee is structured to provide advice and consultation to the Agency on the program as currently planned and as presented to the Subcommittee. The Subcommittee is providing prospective input regarding this proposed program and is not reviewing a completed project or even a project in progress. The Subcommittee feels that this prospective advisory role is an effective use of SAB expertise and processes which allows input and advice to be given on a broad range of related issues before a program becomes more intractable to change.

2.3 Content of Report

The Subcommittee addressed the charge, as well as a number of broader issues associated with the proper role of verification in the promotion of innovative CEM commercialization. This SAB report first addresses the panelists' perspective on innovative CEMs for Hazardous Air Pollutants (HAPs), then addresses the various technical and market barriers to commercialization of new CEMs. Recommendations are made on how EPA can identify and reduce these barriers. The charge to the SAB provided three models that may potentially be used in the new verification process. These various models were discussed along with other models identified by the panelists. These models are discussed in the section entitled "The Verification Barrier to Innovative CEMs." The report includes a specific recommendation on a verification model that can also be considered. Finally the report addresses the pilot project currently envisioned involving the use of the Laser Imaging Direction and Ranging (LIDAR) technology.

3. FINDINGS AND CONCLUSIONS

3.1 Innovative Continuous Emissions Monitoring Systems

Continuous air emissions monitoring can provide several potential benefits over periodic sampling and analysis of flue gas, including: a) an increased level of compliance assurance, b) an increased level of performance assurance to the public, c) new insight into the temporal characteristics of emissions that are important to the establishment of protective emissions standards and operating parameters which control emissions, and d) in some cases, more real-time, direct control schemes. The Subcommittee decided to remain neutral relative to advocating the increased use of HAP CEMs. However, when situations indicate that continuous monitoring is necessary to better indicate the variations in emissions, then a CEM may be preferred. Development of CEMs will need to progress as these situations are identified.

CEMs must be properly designed, operated, and maintained to function in a regulatory and/or process control mode. They often are designed to function in very specific environments, which can limit their flexibility. Hence they are not always readily interchangeable. For example, a monitor designed to measure a parameter in a dry gas stream sometimes will not necessarily function in a stream with a high moisture content.

After reviewing the various documents provided by the Agency and discussing the merits and potential directions of the Verification of Innovative Continuous Air Emissions Monitors initiative, it is clear that the verification of HAP CEMS is important. Continuous air emissions monitors CEMs for criteria and acid rain pollutants (e.g., NOx, SOx, CO) have been routinely implemented in the past due to regulations and industrial practices. However, new requirements dictate the need to control a broader range of air pollutants including particulate matter and hazardous air pollutants (HAPs) as specified in the Clean Air Act Amendments of 1990. In some instances there may be a need or desire to continuously monitor these HAPs such as when there is significant process variability or when more continuous performance assurance of health and environmental protection is needed. For many of these HAPs, CEMs currently are not commercially available, and hence in those instances, the development and commercialization of innovative CEMs should be encouraged.

While a number of commercially available CEM instruments are available for criteria and acid rain pollutants, developing and implementing CEMs for hazardous air pollutants (HAPs) represent a significant additional technical challenge largely due to the significant number of species and the much lower concentration levels of interest. There are substantial problems and limitations with both reference method procedures and monitoring performance specifications for many of these applications. Furthermore, EPA must consider the number of different industrial

processes, the range of effluent conditions, difficult sample matrix problems, the need to simultaneously monitor multiple pollutant concentrations, as well as the relatively primitive understanding about HAP emissions that exists today. New approaches are needed and the approval of new technologies will certainly present problems which are unforeseen at this time.

In the past, the EPA regulatory offices have not specified the use of continuous emission monitors for HAPs in regulations sometimes due to the lack of available CEMs for the pollutants of interest. The Subcommittee noted that this is a quandary related to what must come first; namely, the regulatory mandate for CEMs that drives the market, or commercially available CEMs that allow the regulators to mandate the use of CEMs. Some regulation writers working on MACT standards have indicated that there are benefits associated with the specification of new continuous monitoring requirements in standards development, but they cannot mandate CEM use until they are assured that there are cost-effective, commercially available instruments. When the Agency, in the rule-making process, has determined that the HAP CEMs are necessary, then cost-effective HAP CEMs need to be available.

The above factors result in a fundamental conflict in priorities. On one hand, the Agency must have the confidence that a CEM is capable of fulfilling its performance needs before the rule is written incorporating that monitoring technology. On the other hand, instrument developers and manufacturers are not likely to conduct the expensive R&D required to make CEMs available unless the Agency mandates their use. Some means of breaking this deadlock is necessary before the Agency can move ahead with the appropriate implementation of CEMs.

3.2 Barriers to the Commercialization of Innovative CEMs

The lack of CEMs for HAPs is caused by a number of barriers to commercialization of innovative CEMs. However, the barriers to the development and commercialization of innovative CEMs are more complex than currently articulated in the initiative documents and presentations. The basic premise of the Verification of Innovative Continuous Air Emissions Monitors initiative, as currently proposed, is that the lack of a properly structured verification protocol for innovative CEMs is the critical barrier to commercialization of new CEMs. This premise may be wrong and needs to be thoroughly reviewed as part of the program.

The Agency should first determine all of the barriers and then address them in a systematic manner following an integrated approach. After reviewing the barriers, the Agency should consider where the verification process properly fits into the process of promoting the development and commercialization of innovative continuous emissions monitors. An

understanding of the drivers for new technology development is key to this review. Even the most effective verification process will be unsuccessful if there are not adequate markets to warrant the efforts of analyzer suppliers. After reviewing the entire process, the Agency should then consider where and how a verification process could be supportive of the innovative CEM development and commercialization in a manner consistent with regulatory policy and technology development needs.

Any inadequacies in the current CEM verification process that is to be addressed in this Verification of Innovative Continuous Air Emissions Monitors initiative are equaled or even overshadowed by a more fundamental problem: the general lack of commercialized CEMs for the majority of HAPs. As indicated, there appear to be several causes for this lack of CEMs:

a) The technical difficulty of producing a rugged, reliable, accurate and cost-effective CEM;

b) The absence of economic incentive for instrument manufacturers to invest in the development of CEMs for the regulatory market. The necessary R&D for their availability is not likely to occur unless instrumentation developers have sufficient market incentive to fund internal CEM development projects; and

c) The relatively poor precision achieved when using HAP reference methods for certain pollutants and applications and the lack of reference methods for others.

The technical uncertainties identified by the Subcommittee can be put in the form of the following questions:

a) What are appropriate performance specifications for CEMs?

b) How should Maximum Achievable Control Technology (MACT)-based emission limits be coupled with CEM data e.g., for Office of Solid Waste (OSW) hazardous waste combustion rule-making currently underway?

c) What are the performance specification verification procedures (i.e., Verification of Innovative Continuous Air Emissions Monitors initiative)?

The market uncertainties represent barriers at least as important as the technical uncertainties. The Subcommittee identified several market barriers and uncertainties that also can

represent significant barriers to the development and commercialization of innovative CEMs, including the following:

a) Will manufacturers invest in commercialization of CEMs if CEMs' are not mandated for regulatory compliance? Will both large and small manufacturers invest?

b) Will users buy CEMs or use CEM data if not mandated by EPA for regulatory compliance?

c) Will the proposed verification program over-burden CEM development and commercialization by adding excessive costs and procedures?

d) Will the proposed verification program lead to market segmentation in sizes too small to entice industry to invest in CEM technology?

e) How does inconsistent EPA policy (e.g. the elimination of CEMS from the proposed enhanced monitoring rule) affect industry's willingness to invest money in the technology?

f) How can EPA assist industry?

The primary incentive for the instrument manufacturer to develop new CEMs is the existence of sufficient market size to provide a return on investment for development costs. In a very real way, the Agency drives the CEM market and is ultimately responsible for the overall availability of innovative CEMs. The factors - all under Agency control - that define the market are: a) whether the use of CEMs for regulatory compliance is mandated or optional, b) the number and extent of verification procedures required for separate source categories, and c) the consistency of Agency policy. Each of the above issues drive the market and therefore affect CEM availability.

The most significant market driver is the mandated use of CEMs. Unless their implementation is required, the number of potential installed units is insufficient to justify development costs. This opinion is borne out by statements of both end users and the instrument manufacturers.

Another potential impediment to general CEM availability is excessive segmentation of the verification procedures for specific source subcategories. Verification procedures can be expensive for both the manufacturers and the end user. Although it is certainly recognized that CEM performance must be verified for major differences in source characteristics, decreasing the

number of source sub-categories requiring individual verification procedures will increase the attractiveness of the CEM market to instrument manufacturers.

The recent EPA re-evaluation of the Enhanced Monitoring program and the withdrawal of CEM mandates has resulted in severe reservations on the part of instrument developers about being able to build long-term development plans around Agency policy. If the policy is not consistent, the manufacturers will tend to avoid a market that is changing so rapidly that it impedes business development.

3.3 Recommendations for Potential Action to Identify and Reduce Barriers

CEM verification must be put in context with other barriers that affect innovation and availability of CEMs. The development and manufacturing of CEMs need to be encouraged so that when EPA decides that CEMs are necessary, they will be available at appropriate costs. Technology innovation and commercialization of CEMs are taking place in both larger and smaller companies and hence enticements for both types of companies need to be evaluated and fostered.

The Subcommittee identified several potential barriers to availability of commercial cost-effective CEM's in the market place. These barriers can be categorized as technical uncertainties related directly to CEM technologies and market uncertainties related to industry's willingness to invest money and resources in bringing these technologies to market. The Subcommittee concluded that often EPA regulatory mandates determines the markets and their uncertainties and that these mandates need to be addressed along with the other technical and market uncertainties that exist. The Subcommittee recommends that both the technical and market barriers and uncertainties be further defined through broad stakeholder involvement and Agency evaluation.

The potential stakeholders that could be engaged in these discussions include: a) CEM Developers; b) Federal Regulation Writers (e.g., OSW, OAQPS); c) State and Federal Permitting Authorities; d) User Industry (affected sources and their consultants); e) Enforcement and Compliance Staff; f) Academia; g) Office of General Council.

As part of this process, the EPA needs to evaluate the relative importance of the uncertainties identified and to develop a priority for the effort so as to address the most important barriers first.

After the EPA has defined, evaluated, and prioritized the barriers, such as those defined above, to innovative CEM commercialization, the EPA could address the barriers in a systematic and integrated fashion. Several potential actions that EPA could consider in eliminating real and perceived barriers are:

a) Work with rule writers to define appropriate performance requirements. Acquire CEM data from several sources to examine performance and determine how reduced risk through the use of CEMs should be considered in MACT-based emissions limits.

b) Establish an instrument verification program such that rule writers accept (i.e. not oppose during rule-making) and use CEMs for regulatory compliance.

c) EPA mandates control the market. Where possible, establish policy that "promises" to mandate CEMs if they meet pre-defined criteria, thereby encouraging manufacturers to invest in technology by creating a market.

d) Structure a verification program to insure that it does not add another layer of bureaucracy and expense (see discussion in next section), e.g. these verification tests can be simplified for generic applications to avoid segmenting market into too small of pieces.

e) Be aware of effects of changing policy on manufacturers certainty of market potential and communicate directly with developers and manufacturers on EPA intentions.

f) Ensure that establishing of emission limits and CEM performance capabilities are consistent and compatible. (e.g., MACT-based emission limits can be very low with respect to risk-based limits and are generally based upon emissions data generated by manual methods with long sampling times. Therefore, specifications of continuous emission monitors for assurance with compliance to MACT-based rules will need to be compatible with these differences in sampling duration and frequency with the recognition of the enhanced monitoring capabilities of CEMS.)

g) Develop reference methods and calibration techniques for HAP CEMs.

3.4 The Verification Barrier to Innovative CEMs

The Verification of Innovative Continuous Air Emissions Monitors initiative would attempt to address the lack of HAP CEMs by developing new or alternative procedures for verifying innovative CEMs. Three models for such verification were proposed and discussed. The model procedures proposed by AREAL (as presented in the charge to the SAB) were the German TUV Field Verification Program, Method 301 for Field Validation of Pollutant Measurement Methods from Various Waste Media (40 CFR, Part 63), and the Ambient Air Monitoring Reference and Equivalent Methods.

In reviewing the Agency proposal for the development of a verification process for continuous emissions monitors there seems to be an unstated assumption that the present system does not work. In the present system, a monitoring system is developed and tested for conformance to the requirements in the Performance Specifications. The present system (40 CFR 60 Appendix B) has been around for twenty years and it is not clear that it has failed in this instance. There are limitations relative to monitoring HAPs due to lack of reference methods for all HAPs and often a lack of techniques to calibrate CEMs for trace levels of HAPs. Replacing the old program in and of itself, would not necessarily promote the development and commercialization of innovative CEMs.

The proposed verification system is intended as an improvement. However, if not properly established, it may actually become an additional barrier to the introduction of new monitoring technologies. The critical issue is likely to be the specific technical requirements or QA procedures which would be required at the time a particular monitoring system is installed. EPA should evaluate this issue very carefully at the outset of the proposed program.

The purpose of the project is to develop an improved system for verifying the performance of air emission monitoring systems. Based on the proposal and other information presented by the EPA, and pending the successful completion of a three-year pilot program and other development efforts, third-party independent verification entities would be in place, capable, and authorized to implement evaluation protocols for new monitoring technologies. An important aspect of the proposed program is that the verification entities would eventually operate on a self-sufficient basis, obtaining funds for conducting the evaluations through fees charged to the sponsors or developers of the new technology to be evaluated.

It is expected that the protocols for conducting these performance verifications would include appropriate laboratory and field evaluations to verify monitor performance for specific industry applications, although the technical requirements are not known at this time. It has been suggested in charge question (b) that these tests might be similar to the German TUV suitability tests for particular monitor types or models. Additional performance tests or quality assurance activities might also be required to be performed for each monitoring system at the time that it is installed, but again these requirements are not known at this time. Such tests are required as part of the German program for certain types of monitors and similar requirements are adopted by other countries and the International Organization for Standards (ISO).

Based on the Subcommittee's discussions and review of the charge, it would seem that one of the major cost savings anticipated from the suggested approach derives from elimination of the current relative accuracy test requirement for CEMs. (This requirement is by far the most expensive component of performance test approach, because it involves side-by-side comparisons with manual reference methods.) However, if it is subsequently decided that the relative accuracy

test requirement must be retained, then the cost of conducting a monitor performance test at the time of monitor installation remains largely unchanged. In this event, the fees paid by technology developers to the verification entities would represent additional costs relative to the current performance testing approach for CEMs. Hence, rather than creating a cost savings, the proposed program could in fact increase the cost of verifying the performance of a new monitoring technique. The additional step required in this scenario could actually delay the acceptance of the new monitoring technology, thus further increasing the cost and risk to the instrument developer.

The difficulty in evaluating whether the proposed program is an improvement or barrier relative to the current system depends very strongly on the detailed technical requirements and procedures that will apply. The Subcommittee questions whether the removal of the relative accuracy test requirement is realistic in the majority of applications and encourages EPA to consider this issue very carefully. Until a better understanding of the verification protocols and QA requirements is available, it is difficult to see how the proposed verification process would represent an improvement to the current system.

EPA should consider whether the proposed verification program should supplement the current performance specification testing approach or serve as a new approval process for innovative technologies and alternative monitoring techniques or procedures. The proposal seems to suggest that the verification system to be developed will replace the existing performance specification test approach. It may be appropriate to evaluate this for existing criteria pollutant CEMs and hazardous air pollutant monitors as separate cases. For criteria pollutants, there may be good cause to reduce the currently required QA activities or modify calibration requirements based on accumulated information, but there is not a great need to modify initial performance verification procedures. Some simplification of procedures for the replacement of CEMs or major components could be developed quite simply and quickly. The EPA should evaluate carefully whether the development of an entirely new approval program is justified for these applications.

Finally, any CEM system verification procedures to be developed in the United States need to be consistent with those followed by other countries to provide for international competitiveness and data comparability. Performance-based specifications have been published by the International Organization for Standards (ISO), other countries and international organizations. The adoption of verification methods that differ too greatly from the performance-based standards, or that are perceived as being less rigorous can result in questions regarding the validity of the data obtained. With respect to the U.S.-Canadian Clean Air Accords, dissimilar methods of system approvals could lead to problems in achieving program goals if data were not accepted as being comparable.

3.5 Recommendations on the Verification Process for HAP CEMs

EPA should consider the option of developing an alternate, parallel approval path for new monitoring technology and/or new procedures while retaining the existing approach. Perhaps the affected industrial facility would be able to choose to use a CEM demonstrated to perform according to traditional performance specifications or verified by a new procedure. Perhaps, this choice would only be available on a source category basis in some cases. Nevertheless, the parallel verification approach avoids upsetting the apple cart or creating long delays for new programs. It also does not try to fix what is not broken. A parallel approach offering two approval paths will probably be ineffective unless both paths are widely considered as equivalent by federal, state, and local control agencies.

An alternative approval path for innovative monitoring approaches may be particularly appropriate in a number of applications, including:

a) Situations where reference test methods have not been developed or where the application of existing methods is problematic such as when results have poor repeatability and thus relative accuracy testing is infeasible.

b) Facilities where measurement of multiple pollutants is required (e.g., numerous volatile organic hazardous air pollutants) and where alternate calibration procedures are appropriate to accommodate new technology.

c) Cases where alternative calibration procedures or QA activities can be demonstrated to provide adequate data quality at reduced costs for either new or existing monitoring applications.

A monitor certification program similar to the existing 40 CFR 60, Appendix B, Performance Specification 1 provides an example of a self-certification program carried out by monitor manufacturers. This procedure may be less costly and more expedient to implement and could provide many of the advantages sought by the proposed initiative. The EPA should consider adopting appropriate elements of this approach in a revised monitor verification procedure. Performance Specification 1 for opacity CEMs provides an important example for cases where an appropriate method does not exist for performing relative accuracy tests. In developing and implementing this specification for many years, EPA has correctly realized that the comparison of in-stack opacity as measured by a transmissometer and visible emission observation measurements of a human observer are not necessarily directly comparable. Thus, the EPA has employed a different approach for opacity monitors than for gas monitors throughout its source monitoring regulations.

The Performance Specification 1 approach includes a number of important design specifications in addition to performance specifications. Opacity monitor manufacturers are required to conduct specific tests to determine conformance with the design specifications for each group of instruments produced. The manufacturer then provides a certificate of conformance which, together with a simplified set of field performance tests, constitute the verification procedure. Provisions for conducting audits of installed monitors are also required as a design specification to facilitate subsequent performance evaluations.

Elements of the self-certification approach should be considered in developing the applicable evaluation protocols. Such procedures may incorporate many benefits of an expanded monitor verification procedure. For example, poorly designed monitors may not be able to operate properly over the full range of expected ambient temperatures. This is most easily determined through tests which should be performed by the manufacturer and at the manufacturer's facility rather than through empirical operating experience in the field. A set of requirements that cause manufacturers to fully evaluate instrument performance prior to sale would eliminate many problems which are difficult to avoid with the existing procedures. The implementation of such requirements might be best accomplished through a self-certification process.

3.6 Pilot Project for Verification of CEMs

The Subcommittee had specific concerns about the pilot project as proposed. The pilot project proposed the use of one CEM technology, called LIDAR, as a case study for CEM verification. This case study as currently envisioned was selected as a target of opportunity and may not be a good candidate for an innovative CEM verification. Specifically, LIDAR is designed to monitor NOx in ambient environments. However, NOx instruments for stacks and ambient monitors are already in wide spread commercial use. In addition, this technology is still highly developmental, and there remains significant technical issues associated with calibration (e.g., among other reasons, due to the line-of-site nature of the measurement). Thus it is not a suitable test of the verification protocols since it is too innovative and not commercially ready, does not measure HAPS, but rather is for a criteria pollutant and is not well suited to stack measurements.

Case studies should be carefully selected to fully investigate the verification issues associated with innovative CEM issues. Some possible selection criteria include the following:

a) high EPA monitoring priority,

b) good chance of success relative to laboratory and field verification,

c) techniques already verified by German TUV process in order to compare procedures, and

d) targets of opportunity (cost sharing by industry).

The selection criteria should first be established and then a competitive cooperative agreement should be developed based upon the responses.

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GLOSSARY

AREAL	Atmospheric Research and Exposure Assessment Laboratory
CEM	Continuous Emission Monitor
CFR	Code of Federal Regulations
EEC	Environmental Engineering Committee of the Science Advisory Board, U.S. EPA
EnTICE	Environmental Technology Innovation and Commercialization Enhancement
HAP	Hazardous Air Pollutant
ISO	International Organization for Standards
LIDAR	Laser Imaging Direction and Ranging
MACT	Maximum Achievable Control Technology
ORD	Office of Research and Development
SAB	Science Advisory Board, U.S. EPA
TUV	Technisher Ueberwachungs-Verein, a German Technical Institute

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