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August 1995

EPA AN SAB REPORT: VERIFICATION STRATEGIES FOR EnTICE

RECOMMENDATIONS FOR VERIFICATION STRATEGIES FOR THE ENVIRONMENTAL TECHNOLOGY INNOVATION AND COMMERCIALIZATION ENHANCEMENT PROGRAM (EnTICE)

A REPORT OF THE INNOVATIVE TECHNOLOGY SUBCOMMITTEE OF THE ENVIRONMENTAL ENGINEERING COMMITTEE

August 21, 1995

EPA-SAB-EEC-95-016

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

Re: EPA's Environmental Technology Innovation and Commercialization Enhancement Program (EnTICE)

Dear Ms. Browner:

At the request of the Office of Environmental Engineering and Technology Demonstration (OEETD) in the EPA Office of Research and Development (ORD), the Innovative Technology Subcommittee of the Science Advisory Board's (SAB) Environmental Engineering Committee (EEC) reviewed the Environmental Technology Innovation and Commercialization Enhancement Program (EnTICE). EnTICE is intended to verify the cost and performance of environmental technologies and thereby bolster their credibility and potential entrance into the national and international marketplace.

Overall, the Subcommittee found that EPA's mission protecting the environment requires the use of effective technologies that are based on sound scientific principles. Hence, it is in EPA's interest to foster initiatives that can potentially lead to the identification of more effective environmental technologies. However, in providing this review, the SAB is not making any recommendations as to whether or not EnTICE should be implemented.

The Subcommittee's charge was to review and comment on the strategy of establishing third-party centers, temporarily supported by EPA, to generate credible data and information for the marketplace and permitting arenas that would help decision makers promote the use of innovative technologies in a more informed and confident manner. Both primary and secondary

issues were included in the charge. The Subcommittee addressed each issue through discussion, opinions and recommendations. Of necessity, the review participants based their contributions on their experiences and expertise on technical issues and on related policy implications. The attached report presents the Subcommittee's major findings which briefly are summarized as follows:

a) EPA has an opportunity to play a leadership role in addressing technology development and U.S. competitiveness in the national and international environmental marketplace. A successful program of verification of environmental technology performance could enhance this role.

b) The existence of a good, third-party center verification program likely will not be sufficient in and of itself to substantially accelerate commercial acceptance of new technologies, and likelihood of success will be low without complementary targeted emphasis on credible performance and cost data and parallel programs addressing critical issues that act as barriers to infusion of alternative technologies into specific market sectors.

c) The use of third-party verifications centers for EnTICE is a preferred implementation model, but it is impractical to expect that every verification center will be self-supporting in three years.

d) The customer is not likely to bear the cost of verification without incentives or tangible benefits; the possibility of imposing long-term financial obligations on EPA if the centers fail to become fiscally independent should be avoided.

e) If the verification process is to succeed, the EPA imprimatur is considered essential as an official indicator of fair and impartial evaluation, especially in international markets, provided it is not misrepresented as EPA giving approval or certification of a technology.

f) Verification protocols should be developed to assure there is no technology bias, and must be based upon detailed examination by all stakeholders of issues specific to each class of technology for each market sector, coupled with strong EPA oversight and audit to assure fairness and consistency in the application of the verification process.

g) A middle management committee linking verification activities and EPA efforts to remove other barriers to acceptance of new technologies is considered critical not only to the appropriate selection of pilot projects, but to the potential success of EnTICE.

h) EPA needs to reassess its potential pilot program based on those areas where verification is expected to make a difference to acceptance of a particular technology in a particular market sector when all existing impediments are considered.

i) EPA's recognition of stakeholders as technology users and purchasers, technology enablers (permit writers and consulting engineers), and technology developers and vendors should be broadened to include EPA as an important customer, and particularly the rule and regulation writers, who are engaged in the process that leads to specification of new technologies on the basis of verification data used in regulatory impact and cost-to-benefit performance analyses.

j) If structured to optimize opportunities for confidence building with broad stakeholder representation, and credibility established by carefully selected pilot project testing, verification could facilitate permitting of new technologies by states, with reciprocal use of data and information.

In summary, a successful program of verification of environmental technology performance also could enhance EPA's role. Yet, the likelihood of success of EnTICE is low unless EPA is willing to set into motion parallel and complementary programs to address other critical issues that act as barriers to infusion of alternative technologies into specific market sectors. The existence of a good, third-party center verification program likely will not be sufficient in and of itself to substantially accelerate commercial acceptance of new technologies.

The SAB appreciates the opportunity to provide this review of the EnTICE initiative, an initiative that could help promote the development and use of environmental technologies. We look forward to a written response to our recommendations.

Sincerely,

Dr. Genevieve M. Matanoski, Chair
Executive Committee
Science Advisory Board

Dr. Ishwar P. Murarka, Chair
Environmental Engineering Committee
Science Advisory Board

Dr. Frederick G. Pohland, Chair
Innovative Technology Subcommittee
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ABSTRACT

The Innovative Technology Subcommittee of the EPA Science Advisory Board's (SAB) Environmental Engineering Committee (EEC) reviewed the Environmental Technology Innovation and Commercialization Enhancement Program. Overall, the Subcommittee found that EPA's mission protecting the environment requires the use of effective technologies that are based on sound scientific principles. Hence, it is in EPA's interest to foster initiatives that can potentially lead to the identification of more effective environmental technologies. In addition, because of the growing worldwide interest in applying environmental technologies, EPA now has the opportunity to participate with other public and private entities in enhancing U.S. competitiveness in the national and international environmental marketplace. However, in providing this review, the SAB is not making any recommendations as to whether or not EnTICE should be implemented. A successful program of verification of environmental technology performance also could enhance EPA's role. Yet, the likelihood of success of EnTICE is low unless EPA is willing to set into motion parallel and complementary programs to address other critical issues that act as barriers to infusion of alternative technologies into specific market sectors. The existence of a good, third-party center verification program likely will not be sufficient in and of itself to substantially accelerate commercial acceptance of new technologies. The Subcommittee provided thirteen findings and recommendations addressing: EPA's role, goals, enabling strategies, imprimatur, verification protocols, barriers and incentives, stakeholders and pilot programs.

Keywords: environmental technology, innovation, commercialization, third-party centers, verification, demonstration, pollution prevention, permitting

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1. EXECUTIVE SUMMARY

At the request of the Office of Environmental Engineering and Technology Demonstration (OEETD) in the EPA Office of Research and Development (ORD), the Innovative Technology Subcommittee of the EPA Science Advisory Board's (SAB) Environmental Engineering Committee (EEC) conducted a review of the Environmental Technology Innovation and Commercialization Enhancement Program (EnTICE). EPA has initiated EnTICE with the intent to verify the cost and performance of environmental technologies, and thereby bolster their credibility and potential for entrance into the national and international marketplace. In providing this review, the Subcommittee is not making any recommendations as to whether or not EnTICE should be implemented.

The proposed strategy is to establish third-party centers, temporarily supported by EPA, to generate credible data and information for the marketplace and permitting arenas, that would help decision-makers promote the use of innovative technologies in a more informed and confident manner. The Subcommittee's charge was to review this strategy and both primary and secondary issues. The responses to primary issues focused on costs and early self-sufficiency of verification centers, EPA imprimatur and oversight, accountability, and measures of success. Responses to secondary issues focused on the stakeholders, barriers and incentives, verification protocols, pollution prevention, technology categories and priorities, and state permitting and reciprocity. To address the charge and breadth of issues, the discussions, opinions and recommendations sometimes verged on or were related to policy matters as well as the technical assessments reflecting the experiences and expertise of the review participants.

The Subcommittee's major findings and recommendations are summarized as follows:

a) EPA has an opportunity to play a leadership role in addressing technology development and U.S. competitiveness in the environmental marketplace. A successful program of verification of environmental technology performance could enhance this leadership role.

b) The goal statement for EnTICE is too broad to guide the selection of pilot programs on a priority basis. To enhance the potential for EnTICE to successfully accomplish its goals in a timely fashion, a modified goals statement is proposed, i.e., "To produce credible performance and cost data on new environmental technologies so that the entrance of new technologies into the domestic and international marketplace can be encouraged."

c) The existence of a good, third-party center verification program likely will not be sufficient in and of itself to substantially accelerate commercial acceptance of new technologies. The likelihood for success of EnTICE is low unless EPA sets into motion parallel and complementary programs to address other critical issues that act as barriers to infusion of alternative technologies into specific market sectors. Therefore, EnTICE should be initially focused on those market and technology areas where the existence of a verification program is likely to make a difference to market acceptance.

d) The establishment of third-party verification centers is a preferred implementing model, but it is impractical to expect that every verification center will be self-supporting in three years, and that the customer will bear the cost of testing without incentives or tangible benefits. This is a significant problem for small businesses, where verification may be seen as an additional barrier for technology developers to overcome. Moreover, full endorsement of the verification center program is not warranted if EPA incurs long-term obligations should the centers fail to become fiscally independent.

e) The EPA imprimatur is considered essential to verification, especially in international markets. However, it is important that the imprimatur not be misrepresented as EPA giving approval or certification of a technology, and that EPA provide strong oversight and audit programs to assure fairness and consistency in the application of the verification process. Only data generated in a prospective manner according to EPA-approved protocols and audit procedures should be considered proof of verification if an EPA "seal" is to be provided.

f) An EPA "seal" should be conferred only on the verification protocol, with accountability and measures of success established up front. Effective use of advisory panels representing all stakeholders would help establish these elements, consonant with the goal of EnTICE and its verification protocols.

g) The development of a generic protocol for the various environmental technology classes is not recommended. Rather, a detailed examination of issues surrounding various verification protocols specific to each class of technology designated for a specific market is advocated. All impediments need to be comprehensively reviewed with broad stakeholder involvement early in the execution of the verification process for each technology class for each market sector.

h) The EPA has recognized many of the stakeholders, i.e., technology users and purchasers, technology enablers (permit writers and consulting engineers), and

technology developers and vendors. In addition, one of the most important customers is EPA itself, particularly those engaged in writing rules and regulations who can better specify new technologies on the basis of verification data used in regulatory impact and cost-to-benefit performance analysis. Therefore, the regulation writer for each specific market sector should be involved early in the process of defining market impediments and the proper role of verification.

i) The EPA distinction between verification and certification, and the intent to verify and not certify innovative environmental technologies, is endorsed. The concern is not so much with the definition to establish or prove the validity of performance of a technology under specific, predetermined criteria or protocols, and post-data collection quality assurance procedures, but the issue of whether verification can make a difference in meeting EnTICE goals in the final analysis.

j) It is not appropriate to characterize pollution prevention as a potential environmental technology class. Rather, pollution prevention should be considered an integral part of sound environmental management strategies involving a hierarchy of choices, i.e, treatment, recycling and treatment avoidance. The role of pollution prevention in the EnTICE program should be explored within this context.

k) The EPA should select initial priority technology categories for verification on the basis of those areas where verification is expected to make a significant difference to market acceptance. Therefore, EPA should reassess its potential pilot program with this criterion preeminently in mind, and make choices with the explicit use of this criterion in testing the fundamental premises of EnTICE, i.e., that verification will bolster the credibility of technology and thereby accelerate entrance into the marketplace.

l) The formulation of a middle management committee to make the vital link between the verification activities and EPA efforts to remove other barriers to acceptance of new technologies is considered critical to success of EnTICE. Each pilot project should engage all stakeholders to help define barriers to implementation and the proper role of the verification process in addressing these barriers.

m) Verification has the potential to facilitate permitting by the states, because it is likely to give permit writers more confidence in accepting the performance of new technologies with which they are not personally familiar. Reciprocal use of data between the states in permitting technologies is also a potentially desirable feature of the verification program. Establishing and using an informational network on

EnTICE technologies between states would further enhance the process and likelihood of success.

Details of each of these findings and recommendations, along with fortifying commentary, are presented herein.

2. INTRODUCTION

2.1 Background

At the request of the Office of Environmental Engineering and Technology Demonstration (OEETD) in the EPA Office of Research and Development (ORD), the Innovative Technology Subcommittee of the EPA Science Advisory Board's (SAB) Environmental Engineering Committee (EEC) conducted a review of the Environmental Technology Innovation and Commercialization Enhancement Program (EnTICE). The EPA has initiated EnTICE with the intent to verify the cost and performance of environmental technologies and thereby bolster their credibility and potential for entrance into the marketplace. The proposed strategy is to establish third-party centers with initial EPA support. These centers would generate credible data and information for the marketplace and permitting arenas, where decision-makers then can promote the use of innovative technologies in a more informed and confident manner.

The Subcommittee received an OEETD white paper describing EnTICE and options for structuring, as well as a written charge for review and comment. EPA personnel briefed the Subcommittee at its May 2-3, 1994 public meeting.

The charge to the Subcommittee was more directed toward economic and policy issues than is usually the case with SAB reviews which, in general, focus on more technical questions. The SAB believes that it is appropriate to respond to this charge in this case because a) the Agency made the request, and b) the scientific and engineering disciplines includes a sensitivity toward applying technologies within a social context. To address this latter concern, the Subcommittee membership was augmented with individuals having considerable experience dealing with such issues. For these reasons, this report contains management- and policy-oriented recommendations.

The written charge included a request for the views and advice of the EEC on the following primary and secondary issues. (These issues are presented from the charge verbatim.)

2.2 Charge

2.2.1 Primary Issues

a) Is it practical to target each center to be self-supporting in 3 years ($\pm$)? Can industry bear the expense?

b) How important is it that the verifications carry EPA's imprimatur? Would verifications that don't carry EPA's seal but just that of a 3rd party center have sufficient credibility to open doors in the marketplace and the permitting arena? How important is EPA's oversight in ensuring consistency and rigor across 3rd party centers?

2.2.2 Secondary Issues

a) Roles within the Alternative Approach to Verification

i) What is the appropriate mix of federal, state, 3rd party, and vendor roles and responsibilities?
ii) Are there incentives that are necessary for any or all of the parties to ensure success?
iii) Will verification contribute to more rapid, broader acceptance of new technologies and accelerate reciprocal use of data among states?

b) Verification vs. Certification -- Related to the value of verification is the distinction between verification and certification. Verify: To establish or prove the truth of the performance of a technology under specific, predetermined criteria or protocols and post-data collections quality assurance procedures. Synonyms are confirm, corroborate, substantiate, and validate. Certify: To guarantee a technology as meeting a standard or performance criteria into the future. Synonyms are ensure, warrant, and guarantee. EPA has designed the EnTICE program to verify, not certify.

c) Is there value in verifying pollution prevention technology? Are the customers different?

d) Are there particular technology categories such as small drinking water systems for which verification would be particularly useful? How should initial priority technologies be selected?

e) Will verification facilitate permitting done by states? Will it lead to reciprocal use of data in permitting between states?

f) Verification process credibility is clearly a central value. How can accountability and credibility best be assured in designing the program? Must the data be independently generated or will vendor data be adequate?

g) What are the measures of success for a verification program? Number of technologies verified? Sales records? Increased number of permits? Faster processing of permits? Some measure of environmental improvement? Reciprocal permitting agreements among the states? Breadth (or depth) of coverage of the verification process in terms of types of technologies, processes, and products covered? Reduction of time to market or of time for permit decisions?

For the benefit of the Agency and the public, the Subcommittee summarized its preliminary findings at the end of the meeting on May 3, 1995. This information exchange resulted in some realignment of the primary and secondary issues of the charge, i.e., accountability and measures of success were considered primary issues by the Subcommittee and were, therefore, moved to that category in the following presentation of findings and recommendations.

3. FINDINGS AND RECOMMENDATIONS

3.1 General Comments

EPA's mission of protecting the environment requires the use of effective technologies that are based on sound scientific principles. Hence, it is in EPA's interest to foster initiatives like EnTICE that can potentially lead to the identification of more effective environmental technologies. In addition, because of the growing worldwide interest in applying environmental technologies, EPA now has the opportunity to participate with other public and private entities in enhancing U.S. competitiveness in the national and international environmental marketplace. A successful program of verification of environmental technology performance likely will enhance EPA's role.

After reviewing the various documents provided by the Agency, receiving the EPA briefing, and holding discussions on the relative merits and potential directions of the EnTICE initiative, the Subcommittee concluded that the stated goal of substantially accelerating the entrance of new environmental technology into the domestic and international marketplace is too broad to be attained as currently constructed and scheduled. The Subcommittee also concludes that the existence of a good verification program will not be sufficient in and of itself to substantially accelerate commercial acceptance of new technologies. In addition, the goal statement, i.e., "to accelerate the development and use of environmentally beneficial technology by systematically evaluating, verifying, and broadly disseminating information on the performance of technology innovation," was considered too broad to be useful in selecting or supporting pilot programs on a priority basis. Therefore, to enhance the potential for EnTICE to successfully accomplish its goal in a timely fashion, the Subcommittee suggests the goal statement for EnTICE be modified to read:

> *To produce credible performance and cost data on new environmental technologies so that their entrance into the domestic and international marketplace can be encouraged.*

While an appropriate level of verification of a technology may be desirable and necessary, it will not be sufficient to guarantee market acceptance for a new technology, because there are so many other controlling factors, e.g., economic, social, and political barriers. Verification may be more desirable in certain market sectors or technology categories than in others, with the possibility that simple verification might not make any difference at all, i.e., if barriers are significant, some resolution may need to precede verification for EnTICE to succeed. Therefore, the efforts of EnTICE should be primarily focused on *those market and technology areas where the existence of a verification program is likely to make a difference to market acceptance.*

In developing the framework for EnTICE, EPA needs to address both how verification can succeed and how barriers can be diminished. Otherwise, such barriers may adversely affect market entry and impede the potential success of new technologies. It is not clear to the Subcommittee how EnTICE, with centers operated on a third-party franchise basis within the context of the Environmental Technology Initiative (ETI), will or should address the variety of regulatory, market, financial, and technology barriers which are usually far more critical to determining market acceptance. The issue appears to be a systems problem, which cannot be resolved by addressing only one element, such as technology verification. Expectations for EnTICE as currently structured should not be set so high that, without attending to all crucial elements, success will be limited. Hence, based upon the evidence presented, the likelihood for success of EnTICE is low unless EPA sets into motion parallel and complementary programs to address other critical issues, especially impacts of regulations on acceptance of alternative technologies in specific market sectors.

There is some concern whether the premise that verification will increase market acceptance of a new technology is always valid. Hence, this premise needs to be tested early, preferably by the selection of appropriate pilot programs. Yet, it does not appear that the pilot programs presented for consideration were developed with this purpose in mind. If this assessment is correct, such a premise may constitute a fatal flaw in the program, and lead to needless expenditure of resources without achieving the success so urgently sought.

3.2 Response to Primary Issues

The primary issues are addressed herein in the order of their listing in the charge, with the exception that the original secondary issues on accountability and measures of success (issues 2.2.2.f) and 2.2.2g)), as noted previously, were considered of primary concern.

3.2.1 Self-Sufficiency and Costs of Verification Centers

It is not practical to expect that every verification center will be self-supporting within three years. This finding partially is based on the fact that there are no existing center models in the environmental field that indicate such financial performance is probable. Therefore, verification centers will represent a concept whose tangible benefits to industry will take time to develop and demonstrate. The goal of self-sufficiency is a particularly significant problem for small businesses that can least bear the cost.

If a customer stands to benefit from the verification process, the customer should share at least some part of the cost of testing. On this basis, some centers supporting certain technology areas can be expected to do better financially than others. However, it is very unlikely that all centers will be self-sufficient within three years--or, in fact, within five-to-seven years--and

some centers may never become self-supporting. Such temporal dimensions reflect some of the current barriers that exist regarding market introduction of new environmental technologies.

The Subcommittee's views on the difficulties that verification centers will face in becoming self-sufficient are based on the following:

a) The benefits of verification in the marketplace are not likely to be immediately recognized by the private sector in terms of increased sales. It will take verification centers several years to develop widely accepted protocols, build credibility among all stakeholders, and demonstrate the value of their testing results. These activities must occur before a significant market response is likely. Based on other experiences, e.g., the findings of the National Environmental Technology Applications Corporation (NETAC),[1] a three-year time frame. Environmental technology innovation, development, demonstration and commercialization typically takes ten years or longer.

b) Overcoming the verification barrier for innovative technologies will not necessarily remove the host of other barriers impeding the introduction and acceptance of new technologies, whether engendered in the public or private sectors. Thus, the intensity of any positive impact that verification centers can have will be reduced in the short term and delay their ultimate benefit beyond a three-year time frame.

c) Verification centers cannot be expected to be self-supporting until such time as the benefits provided by their programs clearly outweigh the costs to the users. It may take many years for this to happen, based on the approval and technology selection cycles operating in the environmental field at the time. For some technology sectors, it may never happen without major systemic changes.

d) Because the majority of the technology developers are small businesses without substantial resources, their ability to participate in verification is likely to be low. They will have a difficult time absorbing an added development cost in an uncertain marketplace. Therefore, the verification centers will likely have to subsidize small business participation on an ongoing basis, which will further affect their ability to become financially self-sustaining.

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[1] National Environmental Technology Applications Center (NETAC), April 1994. Barriers to Environmental Technology Commercialization, 400-5408-00, Pittsburgh, PA.

The Subcommittee has great concern that operation of the verification centers will come to be seen as an additional barrier for technology developers to overcome. This concern would be especially true if the protocols eventually developed for use by the centers are costly to implement. Under this circumstance, the use of the centers by the customer (especially small business) will be limited, and their likelihood of becoming self-sufficient will be decreased.

The ability of industry and other private enterprise to bear the expense of the verification center program is unclear at this time. Industry will bear it if they receive a benefit directly related to what the centers provide. They will not bear it if they do not sense a clear benefit. At the present time, a compelling benefit to be provided by the centers is not clear, again because verification is only one of the many barriers that must be overcome. Industry will recognize this and expect a more systematic approach to the removal of other barriers if they are to pay for verification.

Finally, the Agency should recognize that the verification center program could impose long-term obligations on EPA, should the centers fail to become fiscally independent. This, again emphasizes the need for EPA to undertake a series of integrated actions to overcome or dramatically reduce all barriers to infusion of new technologies into the marketplace.

3.2.2 EPA Imprimatur and Oversight

EPA's imprimatur is essential to verification, especially for international markets. However, it is important that the imprimatur not be misrepresented as EPA giving approval or certification of a technology. A process of third-party verification is considered better than nothing, but is unlikely to open doors in the marketplace until it becomes recognized as essential. Moreover, the reputation of the third-party center will determine the degree of impact in the permitting arena. Yet, the Subcommittee concludes that to derive the expected benefits from verification, the verifier's "seal" must be linked directly with EPA. Therefore, strong EPA oversight is absolutely essential and will require a correspondingly strong audit program to assure fairness, consistency and accuracy of applications of the verification process.

Environmental technology performance verifications must be accomplished through a cost-effective, timely, and efficient process that is organized in a holistic manner and audited by the Agency with an EPA imprimatur recognized worldwide. However, the process must not be self-defeating, bureaucratic, or burdensome. Hence, for EnTICE to be a successful endeavor, the development and careful design and operation of the proposed third-party franchise model of focused verification centers is the approach preferred by the Subcommittee in lieu of the other potential options, i.e., EPA SITE Model, the Institute Model, and the Independent Centers Model. The system could take several forms, but must result in verifications that are clearly consonant with the goal of the program and then carry EPA's "seal". Where possible, EPA

should supervise and approve preparation of verification procedures and protocols for sectors as well as protocols for verification of specific technologies. Moreover, verification procedures should be developed to be consistent with those followed by other countries, thereby facilitating international competitiveness and data compatibility, e.g., performance-based specifications have been published by the International Organization for Standards (ISO). In addition, EPA verification should include both system and performance audits of individual technologies, independent of the verification process. Performance audits must be conducted with "open door" access to minimize the potential for fraudulent practices.

The Subcommittee also recommends consideration of another technology verification approach which could serve as a valuable adjunct to the third-party center concept. This approach would be prospective rather than retrospective, and would engage the assistance of technology developers in generating the test data needed for verification. Only data generated with EPA-approved protocols and audit procedures would be considered for proof of verification. Historical data, regardless of its origin or quality, would not be used for verification. Such a prospective approach is considered advantageous to ensure and sustain the credibility of the EPA "seal".

3.2.3 Accountability and Measures of Success

To establish accountability and credibility for the verification process envisioned by EnTICE, the program must be designed to embrace standard and/or EPA-approved methods. Effective use of an advisory panel representing the stakeholders, as well as internal and external specialists and possible third-party auditors, would provide quality assurance with responsibility for verification assigned accordingly. Hence, those responsible for the verification protocol and its use would share accountability for the efficacy of a particular technology. In such a manner, accountability protocols could also stipulate levels of liability shared by all stakeholders from technology conception to implementation.

Key to accountability will be the sufficiency of the verification protocols, which should include such elements as sample acquisition, storage, testing/analysis and evaluation, developed in a manner that each integral element can also be verified by a third-party entity. If developed to include quality assurance/quality control procedures, with an opportunity to track costs, such data could encourage more efficient and cost-effective technology development and use. Formalized verification reports, including performance data, would reveal the capacity of a particular technology to achieve a defined target, e.g., cleanup standards, pollution prevention goals, resource conservation goals, or any number of other goals, all of which would need to be stipulated in advance by EPA in conjunction with the stakeholders. Such a prospective procedure essentially would establish relative measures of success that would be both tangible and quantifiable, and would facilitate the final decision on assigning EPA's imprimatur. Moreover, it

would allow technology comparisons, thereby promoting further development and refinement. These comparisons could be both quantitative and qualitative, i.e., better, cheaper, faster and safer, with the latter based on quantitative information, e.g., meeting standards, lower costs, speed of permitting/actual cleanup, and public/worker protection, respectively.

The EPA "seal" should be conferred only on the verification protocol, and not on the various entities engaged in its implementation. The Agency should not "bless without intent" by endorsing a verification process that allows extension beyond establishing or providing performance of a technology under specific, predetermined criteria or protocols and quality assurance procedures. Hence, measures of success need to be established up front, and although in the final analysis, responsibility for verification within the EnTICE initiative rests with EPA through oversight and audit, third-party entities play a role and could be engaged by an appropriate permitting system. Early involvement of the stakeholder groups would help formulate the elements of a verification protocol leading to EPA validation of a particular technology in whatever manner is deemed appropriate by consensus.

3.3 Response to Secondary Issues

3.3.1 Technology Classes/Markets, Barriers/Incentives, Stakeholders

The Agency has defined a number of potential environmental technology classes that represent a broad range of industry sectors, technologies, regulatory structures, and media. Based on the collective experiences of its members, the Subcommittee concludes that the development of generic protocol for such a broad range of technology classes would be technically infeasible, and thus advocates a more detailed examination of the issues surrounding the various verification protocols specific to each class of technologies designated for the specific markets. Moreover, the verification process cannot be separated from addressing the other barriers or impediments to entrance of new environmental technology in a particular technology class for a particular market segment. The basic premise of the EnTICE initiative as currently proposed is that the lack of properly structured verification protocols for innovative technology is the critical barrier to market entry and success of new technologies. However, the Subcommittee suggests that *the lack of an adequate verification protocol is most likely only one of the barriers to the commercialization of innovative technologies and often is not the most critical.* Economics, liability, and regulatory uncertainty are examples of other often more critical barriers to commercialization. Thus, the impediments need to be comprehensively reviewed with broad stakeholder involvement early in the execution of the initiative for each technology class for each market sector.

Barriers to the acceptance of new technologies can be broadly classified into the following categories; regulatory, market, technology, financial and management. At the present

time, there are few incentives which encourage regulators and technology purchasers and users to introduce new technologies. Clear benefits must be established for all stakeholders to increase their acceptance of new technologies. Therefore, the Agency should first determine all of the barriers for the particular market sector and innovative technology class, and then address them in a systematic and integrated manner. An understanding of what drives the development of new technology is key to this determination. Even the most effective verification process will be unsuccessful if there are not adequate markets to warrant the efforts of technology suppliers. After reviewing the issues with the stakeholders, the Agency can then consider where the verification process fits into the process of developing a new innovative technology for the particular market sector. The goal of the verification process is then to generate credible data for a particular technology class for a particular market segment that can then be appropriately integrated with the results of other efforts to minimize impediments to commercialization. Thus, specific stakeholders must be engaged early in the process for each market segment and each technology class.

The EPA has recognized many of the customers who should be included as stakeholders, i.e., technology users and purchasers, technology enablers (permit writers and consulting engineers), and technology developers and vendors. In addition, one of the most important customers is EPA itself and, in particular, regulation writers who are responsible for establishing new compliance standards. Therefore, these rule or regulation writers are engaged in the process that leads to specification of new technology markets through standards such as Reasonably Achievable Control Technology (RACT), Best Available Control Technology, (BACT) and Maximum Achievable Control Technology (MACT), and they are clear consumers of verification data on innovative technologies. Without this process and the response to performance-based standards, many of the markets for environmental technologies will not be developed. These regulation writers can use the verification data on new technologies in their regulatory impact and technology cost-to-benefit performance analysis. Without the data, the regulation writer has little tangible basis to embrace new technologies and thereby encourage implementation. Therefore, the regulation writer for each specific market sector should be engaged along with others early in the process of defining market impediments and the proper role of verification processes.

3.3.2 Verification vs. Certification

The Subcommittee agrees with the EPA distinction between verification and certification, and the intent to verify and not certify innovative environmental technologies. The Subcommittee's concern is not so much with the definition to establish or prove the validity of performance of a technology under specific, predetermined criteria or protocols and post-data collection quality assurance procedures, but whether such verification can make a difference in meeting EnTICE goals in the final analysis.

3.3.3 Pollution Prevention

Pollution prevention has been characterized in the EnTICE materials as a potential environmental technology class. In actuality, pollution prevention is an integral part of a sound environmental management strategy. It involves choices being made in a hierarchy as follows:

a) using treatment technology (end-of-pipe);

b) reducing need for treatment technology by utilizing recycling; and,

c) avoiding the need for treatment technology by using pollution prevention practices and technology (i.e., often referred to as cleaner production).

Environmental and regulatory goals often can be obtained using any of these approaches. However, the treatment technology often shifts the contaminants from one medium to another if destruction, degradation and/or isolation are not achieved.

As described below, there clearly is value in verifying pollution technologies, because application of the hierarchy leads to discrete decision-making on technologies. Viewed in the way described, the customers of verification are not really any different in this area.

Using the proposed "Coatings/Pollution Prevention" verification pilot as an example, a company could utilize the following options within the hierarchy:

a) install a fume incinerator to destroy volatile organic compounds (VOCs) and combustible hazardous air pollutants (HAPs);

b) recycle solvents and paints; and,

c) use low-VOC or no-VOC coatings and hardware that allow for the more efficient transfer of paint to the surface.

Each of these choices could benefit from a verification activity as proposed by EnTICE. For the treatment technology, the most efficient destruction of pollutants without transferring them to other media should receive independent verification. This information is often difficult to evaluate from vendor claims. The extent to which recycling technology does not shift contaminants between media and leads to resource conservation should also be verified. Finally, vendor claims for the hardware and substitute coating material are often misleading. Independent, objective and credible verification would lead to more informed decision-making on the part of the user.

The Subcommittee encourages the EPA to explore the proper role of pollution prevention in EnTICE and within the context of what has been stated above. Other fruitful areas of such exploration include that of cleaning technologies as another potential pilot demonstration.

3.3.4 Technology Categories and Prioritization

EPA should select initial priority technology categories for verification solely on the basis of those areas *where verification is expected to really make a difference to market acceptance*. This is the key criterion with respect to piloting the verification center concept. Unfortunately, not all currently identified pilot program areas necessarily satisfy this criterion. From the Subcommittee's cursory review of these programs, it is not at all clear that verification will make a real difference in most of the areas being considered in EnTICE. However, there may be key issues or circumstances with which the Subcommittee is not aware. Therefore, the Subcommittee recommends that EPA reassess the potential pilot programs with this criterion preeminently in mind, and make choices with the explicit use of this criterion. This will make evaluation of the pilot program more effective as a way to test the premise of EnTICE.

The verification action plan indicates that the EPA "is considering the formulation of a middle manager committee to make the vital link between the Agency's verification activities and its efforts to remove" other barriers. The Subcommittee concludes that this link is critical and should not be an afterthought, but rather the verification process should be integrated fully with the other efforts. From initiation, each pilot project should work to define the other barriers to implementation and the proper role of verification with stakeholders, and then the verification process should be fully integrated with other efforts to address these barriers.

3.3.5 State Permits and Reciprocity

Based on the collective experiences of its members, the Subcommittee believes that verification has the potential to facilitate permitting done by the states, because it is likely to give permit writers more confidence in accepting the performance of new technologies with which they are not personally familiar. In the same vein, reciprocal use of data in permitting between the states is also likely to increase through such a verification program.

Potentially beneficial results from verification accrue because they address the current reluctance of permit writers and regulators to accept new technology. Permit writers at the state level are often unwilling to take risks on newer technologies with which they have little experience or personal knowledge. Independent verification will provide some level of technical confidence to them, especially if the protocols on which the results are based are well conceived and implemented. However, verification may have no impact if the proposed use of a new

technology is different from its verified application. In addition, the other key barriers must also be addressed by the Agency in a holistic fashion.

States must be important participants in the verification center process, in order to improve the likelihood that ultimate permitting and reciprocity will be facilitated. EnTICE should also keep a database of state permit writers who have allowed the use of innovative technologies. The language they utilized may be of interest to their colleagues in other states as they prepare similar permits. As in the case of the rule writers, permit writers must be actively involved in the stakeholder group for each segment of the program. In addition, because consulting engineers often assume the lead role in permit negotiations and the specification of technologies, they should also be actively involved with their clients and the ultimate users of the EnTICE program in the stakeholder groups.

With all groups actively involved in the EnTICE program development, there is an increased likelihood that there would be reciprocal use of data in permitting and rule-making between the states. An extensive, but informal, informational network already exists in this area. Providing timely verification information on EnTICE technologies to this network will be critical to the success of the program. Previous EPA efforts have neither effectively utilized this network nor provided timely information to these constituencies.

GLOSSARY

BACT	Best Available Control Technology
Certify	To guarantee a technology as meeting a standard or performance criteria into the future.
CFR	Code of Federal Regulations
EEC	Environmental Engineering Committee of the Science Advisory Board, U.S. EPA
EnTICE	Environmental Technology Innovation and Commercialization Enhancement
EPA "seal"	an official indicator of fair and impartial evaluation, not certification or verification
ETI	Environmental Technology Initiative
HAPs	Hazardous Air Pollutants
Imprimatur	a sign or mark of approval
Independent Centers Model	as described in the EPA document, "Verification Program: Independent Centers Model"
Institute Model	as described in the EPA document, "Verification Program: Institute Model"
ISO	International Organization for Standards
MACT	Maximum Achievable Control Technology
NETAC	National Environmental Technology Applications Center
OEETD	Office of Environmental Engineering and Technology Demonstration
ORD	Office of Research and Development
RACT	Reasonably Achievable Control Technology
SAB	Science Advisory Board
SITE Model	as described in the EPA document, "Verification Program: EPA SITE Model"
Third-Party Franchise Model	as described in the EPA document, "Verification Program: 3rd Party Franchise Model"
Verify	To establish or prove the truth of the performance of a technology under specific, predetermined criteria or protocols and post-data collections quality assurance procedures.
VOCs	Volatile Organic Compounds

APPENDIX A: Documents Received from the Agency

1. Memorandum, "EnTICE Review" from Mr. Alfred Lindsey, March 13, 1995 (with attachments named below)

2. "SAB Engineering Committee Review, EnTICE, Environmental Technology Innovation and Commercialization Enhancement Program" (undated)

3. "Draft Verification Action Plan," Environmental Technology Innovation, Commercialization and Enhancement Program, January 18, 1995

4. "Verification Program: EPA SITE Model", (undated)

5. "Verification Program: 3rd Party Franchise Model", (undated)

6. "Verification Program: Institute Model", (undated)

7. "Verification Program: "Independent Centers Model", (undated)

8. EnTICE brochure, February 1995

9. EnTICE: EPA's Technology Verification Program, distributed at May 2-3, 1995, Environmental Engineering Committee meeting.

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