

Analytical Performance Criteria The U.S. Environmental Protection Agency Environmental Technology Verification Program—An Overview

The U.S. Environmental Protection Agency (EPA) established the Environmental Technology Verification (ETV) Program in 1995 to verify the performance of innovative environmental technologies that can be used to monitor, prevent, control, and clean up pollution. The program was formed to address the need for credible performance data to help regulators and users better respond to the available choices of environmental technology.⁽¹⁾ The ETV Program develops testing protocols and verifies the performance of technologies that have the potential to improve the protection of human health and the environment.

Since its inception, the ETV Program has become one of the most comprehensive environmental technology testing programs in the world, covering innovations as diverse as alternative fuels and systems for reduction of nitrogen oxides, microturbines and leak-prevention technologies for natural gas pipelines, cryptosporidium and arsenic control in small community drinking water systems, pollution prevention technologies, and monitoring and treatment technologies with homeland security applications for protecting water resources and buildings. The goal of this voluntary, multimedia program is to provide credible, high-quality data on the performance of novel commercial environmental technologies. By providing these data to technology purchasers, regulators, financiers, vendors, and the public, EPA hopes to: (a) reduce the uncertainty surrounding the performance of new technology, (b) lower the overall cost of regulatory compliance, and (c) help remove real and perceived barriers to innovative technology use in today's marketplace.⁽²⁾

In 2005, ETV began a new program element, Environmental and Sustainable Technology Evaluation (ESTE), to respond to the highest priority needs of EPA for commercial-ready technology verification. ESTE verifications will be initiated by EPA project managers and will be selected on their promise for reducing or better characterizing risk to public health and the environment. A new feature of ESTE is that stakeholder-developed sustainability criteria will be used to evaluate these technologies.

ETV ACCOMPLISHMENTS

Since its inception in 1995, ETV has verified more than 300 environmental technologies and has developed over 80 protocols for technology testing. About half of the technologies verified are monitoring instruments for air, water, and surface/soil media. Surveys of participating vendors have demonstrated overwhelming support for the ETV Program and its results. Responses indicated that about 80% of the vendors were using ETV information in product marketing, and more than 90% of those surveyed responded that they would recommend ETV to other vendors. To date, nearly 50 vendors have had multiple products verified by ETV. All of ETV's products, including protocols, test plans, quality assurance plans, verification reports, and verification statements are available on the ETV website (www.epa.gov/etv).

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TABLE I. Structure of the EPA ETV Program

ETV Center/Effort	Verification Organization	Technology Areas/Media
ETV Advanced Monitoring Systems Center	Battelle	<ul style="list-style-type: none"> • Air, water, and soil monitoring • Biological and chemical agent detection in water • Air pollution control
ETV Air Pollution Control Technology Center	RTI International	
ETV Drinking Water Systems Center	NSF International	<ul style="list-style-type: none"> • Drinking water treatment • Biological and chemical agent water treatment
ETV Greenhouse Gas Technology Center	Southern Research Institute	<ul style="list-style-type: none"> • Greenhouse gas mitigation and monitoring
ETV Water Quality Protection Center	NSF International	<ul style="list-style-type: none"> • Storm water and wastewater control and treatment • Ballast water treatment • Biological and chemical agent wastewater treatment (ended)
ETV Pollution Prevention Coatings and Coating Equipment Pilot	Concurrent Technologies Corporation	<ul style="list-style-type: none"> • Pollution prevention for coatings

This site receives more than 100,000 hits per month, approximately 10% of which are from international entities. The ETV Program conducts extensive outreach of verification results via the Internet, conference exhibitions, public presentations, publications, press releases, media events, and information diffusion through ETV stakeholders.⁽³⁾

Numerous EPA program offices and state programs are being supported in their decision making through ETV technology testing results. These include technologies related to mercury, particulate matter, NO_x and SO_x, emissions control and monitoring, storm water control and treatment, lead in dust monitoring, greenhouse gas reduction, pathogens in drinking water, runoff control from animal feeding operations, arsenic monitoring and treatment in drinking water systems, and so on. An example of how ETV supports state drinking water programs is provided by a 2003 Association of State Drinking Water Administrators survey, which showed that more than half of all states are using ETV protocols in a variety of ways: as methods for site-specific testing, as guidance to supplement state requirements, and in reduction or elimination of pilot testing, (B. O'Grady, pers. comm., Association of State Drinking Water Administrators, February 13, 2004).

OPERATION OF ETV CENTERS

Stakeholder Guidance

The efforts of ETV centers, which are operated through partnerships with nonprofit organizations, are guided by the expertise and input of stakeholder groups. These groups consist of, for example, representatives of verification customers for a particular technology sector, buyers and users of technology, technology developers and vendors, state and federal regulatory personnel, consulting scientists and engineers, environmental organizations, and financiers and underwriters. More than

800 individuals are active in ETV stakeholder groups. Their primary functions are to assist the ETV centers in developing protocols for testing, prioritizing technologies to be verified, reviewing pertinent documents, and designing and implementing outreach activities to the verification customer groups they represent.

The ETV centers operate via a structure that allows for the verification of a wide spectrum of environmental technologies, as illustrated in Table I. The ETV Program operates as a public-private partnership through agreements between EPA and the nonprofit testing and evaluation organizations listed in Table I. These verification organizations, with input from the vendors and EPA and other technology experts, develop efficient and quality-assured protocols and test plans for verifying technology performance. They are responsible for planning and performing verification tests, as well as developing verification reports and statements designed to communicate test results. EPA provides oversight of the organizations and the verification tests, ultimately assuring the credibility of the program as a whole, including the verification process and the data.

Performance Verification Objectives, Reporting, and Funding

ETV is a voluntary program that seeks to make objective performance information available to the environmental marketplace to assist in decision making. ETV does not: (a) rank technologies, (b) compare technology performance, (c) label or list technologies as acceptable or unacceptable, (d) seek to determine "best available technology," or (e) approve or disapprove technologies. Verification activities are announced in relevant trade publications and on the ETV website and ETV listserv (which reaches over 2900 web addresses). Test plans are prepared with developers and tests are then conducted by independent third-party verification organizations. Appropriate

SCHEME I. Overview of the ETV Process

1. EPA, verification organization, and stakeholder input; or EPA-only (for ESTE)
2. Identify technology categories
3. With stakeholders: (a) develop test protocols and quality assurance plans, and (b) identify vendors and collaborators
4. Conduct technology testing
5. Write verification report

quality assurance procedures are incorporated into all aspects of the process, and all reports are subjected to external peer review. By relying on expert referees external to the ETV program, an open and unbiased review process is assured. Verification statements of three to five pages, based on the performance data in the reports, are approved by EPA and the ETV verification organization and are posted on the ETV website. The ETV verification process is summarized in Scheme I.

Vendors, private-sector entities, and government agencies (federal, state, and local) all share costs with EPA to complete ETV protocols and verifications. Since 1996, ETV vendors have contributed over \$4 million to verification efforts. ETV funding contributions from other organizations have increased manyfold since the program started. The proportion of funding from vendors and others continues to increase dramatically each year. In total, since 1996, ETV has received over \$9 million in cost sharing from other organizations. Verification testing "in-kind" contributions, which include things such as laboratory and test facilities and analytical support, has also increased considerably over the life of the program. ETV is leveraged with over 50% of total funds (cash and in-kind) generated from vendor cost sharing and other partnering.

EXAMPLES OF MONITORING TECHNOLOGIES VERIFIED

About half the technologies verified to date have been related to environmental monitoring. Effective verification of monitoring technologies is needed to assess environmental quality and to supply cost and performance data to select the most appropriate technology for that assessment. The Advanced Monitoring Systems (AMS) Center, operated through a partnership with Battelle, verifies the performance of commercially available technologies that monitor natural species and contaminants in air, water, and soil. In addition, AMS is verifying technologies that can detect and monitor intentional contamination of public drinking water supplies. The center is currently focusing on verification activities for a number of important technology areas, including ammonia continuous emission monitors (CEMs) for gas turbine facilities, portable multi-gas emission analyzers, airborne ammonia and hydrogen sulfide sensors, mercury CEMs, multiparameter water quality probes, portable water detectors for arsenic, portable cyanide analyzers, rapid methods for atrazine (a pesticide) detection in water, toxicity screening methods, immunoassay screening

methods for biotoxins in water, rapid polymerase chain reaction (PCR) screening methods, and enzymatic test kits for chemical agents. Several of these areas are highlighted below.⁽³⁾

Ambient Ammonia Sensors

Agricultural activities and waste from livestock are significant sources of atmospheric ammonia, which can result in adverse environmental and human health effects. AMS recently completed verifications of ambient ammonia sensors to gauge how well these technologies provide continuous data on ammonia emissions from agricultural sources. The center has partnered with the U.S. Department of Agriculture (USDA) on these verifications, and testing was conducted at USDA animal feeding operations. The verification reports for these ammonia sensors are currently available on the ETV website.

Mercury Continuous Emission Monitors

Mercury CEMs provide concentration measurements of this element, which are necessary to gain a better understanding of mercury emission sources, transport, and fate in the environment. AMS has completed two phases of mercury CEM verification testing, and a third phase is currently under way. Phase I testing, conducted in partnership with the Massachusetts Department of Environmental Protection, verified the performance of CEMs to measure mercury in flue gases. The center completed Phase II evaluation of CEMs to measure mercury emissions at the Toxic Substances Control Act incinerator in Oak Ridge, Tennessee.⁽³⁾ AMS is currently planning a Phase III verification test of mercury CEMs at a coal-fired power plant with support from the Illinois Clean Coal Institute and the State of Connecticut.

Mercury CEMs are just one type of technology for which ETV has conducted multiple rounds of testing. AMS and other ETV centers have conducted or will conduct multiple rounds of verifications for 12 technology categories across the program. This is indicative of continued vendor demand and perceived value of verification. Besides mercury CEMs, verification testing categories for which multiple rounds of testing have been conducted include: NO_x portable analyzers, optical open-path monitors, portable multigas emissions analyzers, turbidimeters, arsenic test kits, multiparameter water quality probes, groundwater sampling devices, lead in dust detection technologies, and explosives detection devices.

Other Monitoring Technologies

In 2005, AMS will complete verifications for dioxin monitors, personal impactor samplers for particulate matter, nutrient monitors at industrial sources and in ambient water, and rapid beach pathogen detectors.

AMS has also been conducting verification activities for technologies applicable to meeting U.S. homeland security needs for protecting drinking water supplies. The center has verified the performance of portable cyanide analyzers and rapid toxicity testing systems, both with water security applications. These were the first two rounds of verifications for homeland security to be conducted by the ETV Program,

and the verifications were completed within an unusually fast 6-month time frame.⁽³⁾ In 2004, AMS completed immunoassay and rapid PCR screening methods for biotoxins, pathogens, and weaponized agents. In addition, AMS stakeholders have prioritized multiparameter water monitors for distribution systems, mobile mass spectrometers, and enzymatic test kits, all to be completed in 2005.

OUTCOMES

Government programs are increasingly called on to go beyond showing program products or outputs by demonstrating actual program outcomes consistent with their agency missions. In ETV's case, the program has met annual commitments under the Government Performance and Results Act for very ambitious numerical targets for completing program outputs, consisting of verifications and testing protocols. Further evidence of success is shown by increasing vendor support and other collaborations, increasing website use, and repeated vendor interest in verification. Internationally, a number of countries such as Japan, Korea, and Canada, have or are developing verification programs using a model that is similar to the U.S. program.

To better demonstrate program outcomes, ETV has begun an effort to develop case studies that track implementation of verified innovative pollution control or prevention technologies by category and project environmental and public health outcomes using potential and actual market penetration combined with pollutant reduction of the verified technology as compared with state-of-the-practice technology. In the case of monitoring technologies, the relationship is not as direct as with control or prevention technologies. Improved, field-deployable, and often real- or near-real-time monitoring technologies can better characterize ambient environmental conditions and emissions sources. This information is useful in determining the need to better control pollutant sources by providing real-time data for better process control.

Fifteen case studies that focus on the outcomes of the topics below are currently in development and will be published in 2005.

- *Monitoring*: ambient ammonia monitors, atrazine test kits, lead detection on surfaces and soil, mercury CEMs
- *Air pollution control and energy efficiency*: diesel engine retrofit, baghouse filtration products for particulate matter removal, engine lubricant, vapor recovery, distributed energy generation using microturbine/combined heat and power, coatings processes that prevent volatile organics emissions

- *Drinking water treatment/water quality protection*: arsenic removal, disinfection byproducts removal, ultraviolet disinfection, residential on-site nutrient reduction, and pathogen removal with micro- and ultrafiltration.

SUMMARY

The ETV Program has produced an expansive record of accomplishments by partnering with public and private sector individuals and organizations to generate objective information that is responsive to the needs of the environmental technology marketplace. The program's collaborative nature and successes have allowed it to quickly fill an important role in homeland security verification. It has also allowed the program to continue to verify a large number of technologies that address important environmental issues at a cost that is affordable to vendors, as many of them are small businesses.

There are numerous benefits of the ETV Program. ETV provides objective, credible performance data to potential purchasers of environmental technologies such as monitoring equipment. The program facilitates technology acceptance and regulation at the state and local levels. ETV helps to reduce risk for financial investors, and facilitates export of environmental products. And, notably, the ETV Program levels the playing field among competitors through standardized tests and objective reporting.

FURTHER INFORMATION

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