

**Today's Environmental Technologies—Innovative Solutions
for Regional Issues
U.S. EPA ETV and SBIR Programs Regional Workshop,
October 7–8, 2008, U.S. EPA Region 2,
New York City, New York
Meeting Summary Report**

By:

The Scientific Consulting Group, Inc.
Gaithersburg, Maryland 20878-1409

Under Contract No. GS-23F-0175L
Task Order No. EP07C000273

Abby Waits, EPA Task Order Project Officer
Environmental Technology Verification Program
National Risk Management Research Laboratory
Cincinnati, Ohio 45268

National Risk Management Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, Ohio 45268

DISCLAIMER

This report was funded by the U.S. Environmental Protection Agency (EPA) under General Services Administration Contract Number GS-23F-0175L, EPA Task Order Number EP07C000273 to The Scientific Consulting Group, Inc. The EPA Environmental Technology Verification (ETV) Program is a public/private partnership conducted, in part, through competitive cooperative agreements with nonprofit research institutes. ETV verifies the performance of innovative environmental technologies through quality-assured testing procedures, and provides credible, third-party performance data for these technologies. In this report, ETV representatives presented data on technologies that have been or are in process of being performance tested and verified through the EPA ETV Program. The SBIR Program issues annual solicitations for research proposals from science and technology-based companies. Through SBIR, EPA awards funding to developers to investigate the scientific merit and technical feasibility of a proposed technology concept, and to develop and commercialize the technology. In this report, SBIR technology vendors presented their own technology performance claims and/or data, which have not necessarily been tested or verified by EPA or another third-party testing organization. EPA does not endorse the purchase or sale of any products or services from companies mentioned in this document. This report has been subjected to the Agency's peer and administrative reviews and has been approved for publication as an EPA document. The views expressed by individual speakers/participants, however, are their own, and do not necessarily reflect those of the U.S. EPA.

FOREWORD

The U.S. Environmental Protection Agency (EPA) is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory (NRMRL) is the Agency's center for investigation of technological and management approaches for preventing and reducing risks from pollution that threaten human health and the environment. The focus of the Laboratory's research program is on methods and their cost-effectiveness for prevention and control of pollution to land, air, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites, sediments and ground water; prevention and control of indoor air pollution; and restoration of ecosystems. NRMRL collaborates with both public and private sector partners to foster technologies that reduce the cost of compliance and to anticipate emerging problems. NRMRL's research provides solutions to environmental problems by: developing and promoting technologies that protect and improve the environment; advancing scientific and engineering information to support regulatory and policy decisions; and providing the technical support and information transfer to ensure implementation of environmental regulations and strategies at the national, state, and community levels.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

Sally Gutierrez, Director
National Risk Management Research Laboratory

ACKNOWLEDGEMENTS

The U.S. EPA Environmental Technology Verification and Small Business Innovation Research Programs wish to extend their appreciation to U.S. EPA Region 2 for hosting this workshop and, in particular, to Alan Steinberg, Regional Administrator; Marie O'Shea, Regional Science Liaison; Roland Hemmett, Regional Science Advisor; and Andrew Bellina, Regional Technology Advocate, for their help in and support of planning for this event. The ETV and SBIR Programs would also like to thank the following workshop sessions chairs for their help in providing regional expertise and perspective: Douglas Pabst, Avi Teitz, Bruce Kiselica, Michael Lowry, John Filippelli, Karen O'Brien, Jehuda Menczel, and Robert Runyon. A special thanks to the following ETV stakeholders and collaborators for their participation and presentations at the event: Vito Minei, Division of Environmental Quality, Suffolk County Department of Health Services; Philip Galvin, New York State Department of Environmental Conservation; James Foster, New York State Energy Research and Development Authority; Barry Liebowitz, New York State Energy Research and Development Authority; Michael Brody, EPA Office of the Chief Financial Officer; and Stuart Nagourney, New Jersey Department of Environmental Protection.

U.S. EPA ETV and SBIR Program Regional Technology Workshop Steering Committee:

Andrew Bellina, EPA Region 2
Julius Enriquez, EPA Office of Research and Development
James Gallup, EPA Office of Research and Development
Teresa Harten, EPA Office of Research and Development
Evelyn Hartzell, EPA Office of Research and Development
Roland Hemmett, EPA Region 2
Jon Josephs, EPA Region 2
Marie O'Shea, EPA Region 2
Maggie Theroux, EPA Office of Research and Development
Abby Waits, EPA Office of Research and Development

Logistical planning and onsite support for the workshop were provided by The Scientific Consulting Group, Inc., under contract to EPA.

ABSTRACT

The U.S. Environmental Protection Agency (EPA) Environmental Technology Verification (ETV) and Small Business Innovation Research (SBIR) Programs hosted a workshop on October 7–8, 2008, at the EPA Region 2 office in New York City, New York. The goals of the workshop were to: (1) provide information about new innovative technologies to help solve important regional environmental issues; (2) learn about the specific technology priorities and needs of the regional and local participants; and (3) identify opportunities for collaboration among ETV, SBIR, and regional and local organizations on technology development and verification activities for high-priority areas.

Some of the technologies discussed included:

- ✧ An improved rapid detector for viable waterborne pathogens
- ✧ A remote sensing instrument for on-road heavy-duty diesel nitrogen oxides and particulate matter
- ✧ A sensitive and affordable compact ammonia monitor
- ✧ A continuous real-time fine particulate matter chemical speciation monitor for ambient aerosols
- ✧ An inexpensive drinking water chlorination unit for small communities
- ✧ A handheld laser-based sensor for remote detection of gas leaks
- ✧ Membranes for air venting and retaining volatile organic compounds in gasoline storage tanks
- ✧ Retrofitted diesel electric generators for emission reduction
- ✧ A spot test kit for lead in paint and dust
- ✧ A field screening detector for metals in soil.

A total of 137 participants representing EPA regional offices, state and local governments, technology developers, academia, and others participated in the workshop. Representatives from ETV centers and their collaborators presented information about recent and upcoming technology verifications. SBIR technology developers discussed technology development and commercialization supported by EPA. ETV and SBIR vendors exhibited and demonstrated their technologies, and ETV provided posters highlighting collaborative verifications. Representatives from EPA Region 2 presented on regional technology information needs and priorities.

The ETV Program verifies the performance of innovative environmental technologies through quality-assured testing procedures, and provides credible, third-party performance data for these technologies. Representatives from ETV centers presented data on technologies that have been or are in process of being tested and verified through the ETV Program. The SBIR Program issues annual solicitations for research proposals from science and technology-based companies. Through SBIR, EPA awards funding to developers to investigate the scientific merit and technical feasibility of a proposed technology concept (Phase I), and then to develop and commercialize the technology (Phase II). At the workshop, individual SBIR vendors presented their own technology performance claims and/or data.

CONTENTS

DISCLAIMER	ii
FOREWORD	iii
ACKNOWLEDGEMENTS	iv
ABSTRACT	v
ABBREVIATIONS AND ACRONYMS	viii
SUMMARY	1
WELCOME	1
PLENARY SESSION	2
Region 2 Technology Information Needs and Priorities	2
Environmental Technology Verification Program	3
Small Business Innovation Research Program	3
Discussion.....	4
WATER SESSION 1A: WATER MONITORING TECHNOLOGIES	5
Region 2 Water Monitoring Technology Priorities	5
SBIR Vendor: Improved Rapid Detector for Viable Waterborne Pathogens	5
ETV Verification of Advanced Water Monitoring Systems	5
Discussion.....	7
AIR SESSION 2A: AIR MONITORING TECHNOLOGIES	7
ETV Verification of Advanced Air Monitoring Systems	7
SBIR Vendor: Remote Sensing Instrument for On-Road Heavy-Duty Diesel NO _x and PM; Sensitive and Affordable Compact Ammonia Monitor; Continuous Real-Time PM _{2.5} Chemical Speciation Monitor for Ambient Aerosols.....	9
Region 2 Air Monitoring Technology Priorities	10
Discussion.....	10
WATER SESSION 1B: DRINKING WATER TREATMENT TECHNOLOGIES	10
Region 2 Drinking Water Technology Priorities	10
SBIR Vendor: Inexpensive Drinking Water Chlorination Unit for Small Communities	11
ETV Verification of Drinking Water Treatment Systems	11
Discussion.....	13
AIR SESSION 2B: GREENHOUSE GAS AND ENERGY TECHNOLOGIES	13
ETV Verification of Greenhouse Gas Technologies	13
Region 2 Greenhouse Gas/Energy Technology Priorities	14
SBIR Vendor: Handheld Laser-Based Sensor for Remote Detection of Gas Leaks	15
Environmental and Sustainable Technology Evaluation of Fuel Characteristics and Emissions from Biomass Co-Fired Boilers.....	16
Discussion.....	17
BREAKOUT DISCUSSION SESSIONS	17
Breakout Session 1A: Water Monitoring Technologies—Beach Water Quality Monitoring	17
Breakout Session 1B: Drinking Water Treatment Technologies.....	18
Breakout Session 2B: Greenhouse Gas and Energy Technologies—Greenhouse Gas Technology Areas	20
WATER SESSION 1C: WATER QUALITY AND WASTEWATER TREATMENT TECHNOLOGIES	22
ETV Verification of Water Quality Protection Technologies	22
SBIR Vendor: Balloon Platforms for Remote Sensing of Water Quality in Mixing Zones	23
Region 2 Water Quality and Wastewater Treatment Technology Priorities	24
Discussion.....	24
AIR SESSION 2C: AIR POLLUTION CONTROL TECHNOLOGIES	25
Region 2 Air Pollution Control Technology Priorities	25

SBIR Vendor: Membranes for Air Venting and Retaining VOCs in Gasoline Storage Tanks; Retrofitting Diesel Electric Generators for Emission Reduction	25
ETV Verification of Air Pollution Control Technologies	26
Discussion.....	29
BREAKOUT DISCUSSION SESSIONS	29
Breakout Session 1C: Water Quality and Wastewater Treatment Technologies—Technology Verification Role in Region 2	29
Breakout Session 2C: Air Pollution Control Technologies—Outdoor Wood-Fired Hydronic Heaters	30
WASTE SESSION 3A: SOILS, SURFACES, AND SITE CHARACTERIZATION TECHNOLOGIES	32
Region 2 Waste Technology Priorities	32
ETV Verification of Advanced Monitoring Systems for Soils, Surfaces, and Site Characterization.....	32
ETV Verification of Materials Management and Remediation Technologies	33
Environmental and Sustainable Technology Evaluation of Qualitative Spot Test Kits for Lead in Paint	33
SBIR Vendor: Development of a Reliable, Low-Cost, and User Friendly Spot Test Kit for Leaded Paint and Dust.....	34
SBIR Vendor: Field Screening Detector for Metals in Soil	34
Discussion.....	34
Breakout Session 3A: Soils, Surfaces, and Site Characterization Technologies—Vapor Intrusion.....	35
APPENDIX A – Breakout Sessions Participant Lists.....	36
APPENDIX B – Workshop Participant List	42
APPENDIX C – Exhibitor List.....	47

ABBREVIATIONS AND ACRONYMS

ACSM	Aerosol Chemical Speciation Monitor
AMS	Advanced Monitoring Systems Center
APCT	Air Pollution Control Technology Center
ARI	Aerodyne Research, Inc.
ASERTTI	Association of State Energy Research and Technology Transfer Institutions
ASOP	advanced simultaneous oxidation process
ASTM	American Society for Testing and Materials
BACT	best available control technology
BFP	baghouse filtration product
Btu/lb	British thermal unit per pound
CARB	California Air Resources Board
CARD	chemistry and reagent device
CEM	continuous emission monitor
CFD	computational fluid dynamics
CHP	combined heat and power
CMS	Compact Membrane Systems, Inc.
CO	carbon monoxide
CO ₂	carbon dioxide
CRT®	Continuous Regenerating Technology®
DG	distributed generation
DOE	U.S. Department of Energy
EDC	endocrine disrupting compound
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESTE	Environmental and Sustainable Technology Evaluations
ETV	Environmental Technology Verification (Program)
EUWP	Expeditionary Unit Water Purifier
FEM	Federal Equivalent Method
FRM	Federal Reference Method
GHG	Greenhouse Gas Technology Center
HAP	hazardous air pollutant
H ₂ S	hydrogen sulfide
HCl	hydrogen chloride
IBI	Innovative Biotechnologies International, Inc.
ISO	International Organization for Standardization
kwh	kilowatt hour
LDAR	leak detection and repair
LRV	log reduction value
LT2	Long Term 2
MACT	maximum achievable control technology
MDBP	Microbial and Disinfection By-Product
MEA	membrane-and-electrode assembly
mg/kg	milligrams per kilogram
MMBtu	million British thermal units
MOA	Memorandum of Agreement
NCDC	National Clean Diesel Campaign
NEA	nitrogen-enriched air

NESCAUM	Northeast States for Coordinated Air Use Management
NH ₃	ammonia
NIST	National Institute of Standards and Technology
NJDEP	New Jersey Department of Environmental Protection
nm	nanometer
NO _x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRMRL	National Risk Management Research Laboratory
NSF	National Science Foundation
NYSERDA	New York State Energy Research and Development Authority
O ₃	ozone
OAQPS	Office of Air Quality Planning and Standards
ORD	Office of Research and Development
OSHA	Occupational Safety and Health Administration
OTAQ	Office of Transportation and Air Quality
OWHH	outdoor wood-fired hydronic heaters
PCRT®	Partial Continuous Regenerating Technology®
PM	particulate matter
PM _{2.5}	fine particulate matter
POE	point-of-entry
POU	point-of-use
ppb	parts per billion
ppbv	parts per billion by volume
ppm	parts per million
PCCP	pharmaceutical and personal care product
PSI	Physical Sciences, Inc.
QCL	quantum cascade laser
r ²	coefficient of determination
REMAP	Regional Environmental Monitoring and Assessment Program
RH	relative humidity
RMLD	Remote Methane Leak Detector
RO	reverse osmosis
RPS	renewable portfolio standards
SBIR	Small Business Innovation Research (Program)
SCAQMD	South Coast Air Quality Management District
SCR	selective catalytic reduction
SCRT®	Selective Catalytic Reduction Technology®
SIP	state implementation plan
SITE	Superfund Innovative Technology Evaluation (Program)
SJVAPCD	San Joaquin Valley Air Pollution Control District
SO ₂	sulfur dioxide
TMDL	total maximum daily load
TTE	temporary total enclosure
TWA	time-weighted average
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
UV	ultraviolet
VOC	volatile organic compound
WQP	Water Quality Protection Center
%R	percent recovery

SUMMARY

The U.S. Environmental Protection Agency (EPA) Environmental Technology Verification (ETV) and Small Business Innovation Research (SBIR) Programs hosted a workshop on October 7–8, 2008, at the EPA Region 2 office in New York City, New York. The goals of the workshop were to: (1) provide information about new innovative technologies to help solve important regional environmental issues; (2) learn about the specific technology priorities and needs of the regional and local participants; and (3) identify opportunities for collaboration among ETV, SBIR, and regional and local organizations on technology development and verification activities for high-priority areas.

Some of the technologies discussed included:

- ✧ An improved rapid detector for viable waterborne pathogens
- ✧ A remote sensing instrument for on-road heavy-duty diesel nitrogen oxides (NO_x) and particulate matter (PM)
- ✧ A sensitive and affordable compact ammonia monitor
- ✧ A continuous real-time fine particulate matter (PM_{2.5}) chemical speciation monitor for ambient aerosols
- ✧ An inexpensive drinking water chlorination unit for small communities
- ✧ A handheld laser-based sensor for remote detection of gas leaks
- ✧ Membranes for air venting and retaining volatile organic compounds (VOCs) in gasoline storage tanks
- ✧ Retrofitted diesel electric generators for emission reduction
- ✧ A spot test kit for lead in paint and dust
- ✧ A field screening detector for metals in soil.

A total of 137 participants representing EPA regional offices, state and local governments, technology developers, academia, and others participated in the workshop. Representatives from ETV centers and their collaborators presented information about recent and upcoming technology verifications. SBIR technology developers discussed technology development and commercialization supported by EPA. ETV and SBIR vendors exhibited and demonstrated their technologies, and ETV provided posters highlighting collaborative verifications. Representatives from EPA Region 2 presented on regional technology information needs and priorities.

TUESDAY, OCTOBER 7, 2008

WELCOME

Roland Hemmett, Science Advisor, EPA Region 2

Roland Hemmett welcomed participants to New York City and Region 2 and thanked the organizers of the workshop, including Abby Waits, Teresa Harten, James Gallup, and Marie O'Shea. He introduced Alan Steinberg.

Alan Steinberg, Regional Administrator, EPA Region 2

Alan Steinberg welcomed participants to Region 2. He stated that the core of EPA's mission is sound science. The draft Environmental Impact Statement (EIS) for West Valley, New York, was announced the previous day. This draft EIS evaluates the reasonable range of alternatives for decommissioning and/or

long-term stewardship of the facilities at the West Valley Demonstration Project and Western New York Nuclear Service Center. He stated that EPA led the way in 2006 to devise a strategy regarding nuclear energy. Nuclear energy is imperative to deal with greenhouse gas emissions, but the environmental impacts of nuclear waste must be managed to develop nuclear energy. He described a meeting with the Secretary of Energy, the conclusion of which was that the key to solving this issue is sound science; with good scientific research, there is no end to what can be accomplished to meet future challenges while maintaining economic stability and energy independence. Applying sound science will allow the country to move forward, and sound science drives EPA.

Alan Steinberg thanked Roland Hemmett and Marie O'Shea for their help in organizing this workshop, which is an important element of the Regional Science and Technology Council's education strategy for addressing the region's innovative environmental measurement and technology needs. He urged participants to remember that, in dealing with environmental problems and issues, regulations will not help if the technologies are not available so that industry can comply with the regulations. The key to any good environmental program is sound science and good scientific research.

Sally Gutierrez, Director, EPA National Risk Management Research Laboratory

Sally Gutierrez thanked everyone for attending the workshop and welcomed the international attendees. She thanked her Region 2 colleagues, Andrew Bellina, Marie O'Shea, and Roland Hemmett; EPA staff, including Teresa Harten, Abby Waits, Julius Enriquez, Evelyn Hartzell, and James Gallup; and The Scientific Consulting Group, Inc., for their efforts in planning the workshop, which will showcase technologies that EPA has supported and verified through its SBIR and ETV Programs, respectively.

The ETV Program was established 13 years ago to help new technologies enter the marketplace by providing a venue for third-party testing and reporting. The testing creates the verification information. To date, there have been more than 400 verifications in a variety of categories, which have created a strong dataset regarding how to test the various technologies. The established quality assurance process for verification testing lends credibility to the robust datasets. For example, many states allow permitting of technologies on the basis of verification without any additional testing. The objectives of the ETV Program have come to pass, and there is a great deal of international interest in establishing verification programs globally. The programs in place in Canada, the European Union, and Japan, and the interest from China and Singapore indicate that verification is moving across the globe.

The SBIR Program, established by the U.S. government and available within 15 federal agencies, supports the early development of new technologies. EPA's SBIR Program has been developed over the past 35 years and is a tremendous source for support. The private sector now is becoming involved with the effort. It is necessary to examine what current technology can do and support the next generation of environmental technology. There is a need for new technologies in areas that are at the end of their life (e.g., water infrastructure). This is an over-arching, cross-cutting issue as it includes environmental monitoring. Currently, broadly applied technologies are not available to indicate the condition of air, water, soil, and other environmental conditions at any given point in time.

PLENARY SESSION

Region 2 Technology Information Needs and Priorities
Andrew Bellina, Regional Technology Advocate, EPA Region 2

Roland Hemmett explained that this workshop is structured to emphasize regional technology needs. He introduced Andrew Bellina who thanked participants for attending. Holding a technology forum such as this within an EPA region promotes the fundamental reason that technology is important: to meet the

needs of society. The regional technology needs highlighted at the workshop can direct future technology plans. Declining budgets will increase Agency pressure to develop cost-effective measures to properly manage and oversee its programs; states face the same challenges and look to EPA for innovative methods to manage their programs. EPA must re-dedicate some research and development dollars to confirm that actual needs, versus perceived needs, are being met. This is a forum for discussion, and attendees' opinions and knowledge are important. Additionally, Region 2 personnel need to know what technologies are or are not feasible to aid their planning efforts. Effective communication is necessary to ensure that developed technology meets the appropriate needs. A recommended outcome from this workshop is to form a workgroup to follow-up on identified technology needs, issues, and opportunities for collaboration.

Environmental Technology Verification Program

Teresa Harten, Director, EPA ETV Program

Teresa Harten provided an overview of the ETV Program, including: program objectives, ETV support of technology commercialization and innovation, operational statistics, program scope as defined by its centers and Environmental and Sustainable Technology Evaluations (ESTE) projects, the verification process, case studies and examples of human health and environmental outcomes of verification, and international activities.

The ETV Program was created in 1995 to develop protocols and conduct verification testing to provide credible performance information for commercial-ready technology to help solve high-risk environmental problems and speed implementation for the benefit of purchasers, policymakers and regulators, vendors and developers, and the public. As such, ETV assists technology commercialization and innovation.

Teresa Harten provided the following highlights of the ETV Program.

- ✧ Collaborations and vendor cost-sharing leverage ETV funding and generate approximately 50 percent of the total funds.
- ✧ A total of 403 verifications and 90 protocols have been completed.
- ✧ More than 300 stakeholders are active in ETV advisory groups and technical panels.
- ✧ The ETV Web Site has had more than 2.5 million hits per year.
- ✧ Case study booklets document and project human health and environmental outcomes for 15 verified technology categories.
- ✧ ETV operates through six centers covering a broad range of technology areas.
- ✧ Changes are being considered for a new, expanded ETV, including better integration with other international verification programs.

Small Business Innovation Research Program

James Gallup, Director, EPA SBIR Program

James Gallup provided an overview of the EPA SBIR Program, including: background on the federal SBIR program, annual budgets, a National Science Foundation (NSF) collaboration, the proposal evaluation and selection process, the annual solicitation schedule, and solicitation topics.

EPA issues annual solicitations for Phase I and Phase II research proposals from science and technology-based firms. Under Phase I, the scientific merit and technical feasibility of the proposed concept are

investigated. EPA awards Phase I contracts of up to \$70,000 for a typical period of performance of six months. Through this phased approach to SBIR funding, EPA can determine whether the research idea (often based on high-risk, advanced concepts) is technically feasible, whether the firm can do high-quality research, and whether sufficient progress has been made to justify a larger Phase II effort.

Phase II contracts are limited to small businesses that have successfully completed their Phase I contracts. The objective of Phase II is to commercialize the Phase I technology. Competitive awards are based on the results of Phase I and the commercialization potential of the Phase II technology. In Phase II, EPA awards contracts up to \$225,000; the period of performance typically is two years. As part of Phase II, SBIR also offers additional commercialization funding options to bring the total award to \$345,000; one of the options provides funding for firms whose technologies have been accepted into an EPA verification program, such as the ETV Program.

The collaboration with NSF will leverage \$50 million. EPA and NSF will promote their solicitations together, allowing vendors to submit proposals to both agencies. Only one grant may be accepted by a vendor for the same project, however. NSF has a current environmental solicitation; EPA's will open in March 2009. Collaboration with Region 2 allows development of research topics, proposal relevancy review, mentoring, and promotion of developed technologies. The Region 2 mentors will guide NSF Phase I awardees to develop the most relevant, successful technologies as possible, and this guidance will continue into Phase II as commercialization occurs.

Discussion

Roland Hemmett highlighted the geographic attributes and challenges of Region 2, including its diverse geography, population densities, climates, socio-economic status, and so forth. Two important areas of focus are monitoring and control, including treatment technologies to support various areas and situations.

A question and answer session followed in which James Gallup explained the following.

- ✧ NSF SBIR solicitations will not include specific funding for the ETV option. Portions of Phase II awards will be necessary to cover any expenses.
- ✧ EPA is not likely to forward outstanding SBIR applications to NSF when EPA falls short of funding.
- ✧ The SBIR water infrastructure solicitation topic includes drinking water (treatment plants and collection systems) and wastewater technologies (leak detection, etc.).
- ✧ Technologies are needed to replace certain elements within water treatment systems that were built in the early 1970s, but whole systems may not need to be replaced.

James Goodrich explained that EPA's Office of Research and Development (ORD) is working with contractors, universities, and trade organizations on an aging water infrastructure research program that includes research regarding drinking water and wastewater assessment, decisionmaking, and advanced concepts.

Roland Hemmett concluded the discussion by noting that although pollution is better controlled than in the past, there is a need for simpler and less expensive monitoring and remediation technologies.

WATER SESSION 1A: WATER MONITORING TECHNOLOGIES

Region 2 Water Monitoring Technology Priorities

Douglas Pabst, EPA Region 2, Session Chair

Douglas Pabst highlighted Region 2's water monitoring priorities, defined as topics that need additional research. There is a need for information on emerging contaminants, monitoring strategies, methods for analysis, and human health and environmental effects. Methods and tools need to be developed to evaluate the environmental benefit of regulatory actions, management and restoration activities, mitigation efforts, and voluntary programs. Rapid detection techniques are needed for waterborne pathogens and pathogen-indicating organisms. There is a need for technical support, research, and pilot projects to evaluate the applicability in tropical climate of new methodologies to assess the water quality of beaches. In addition, information is needed on indicators that integrate ecosystem status and function that can be used to evaluate protection programs and progress toward goals. He also highlighted current Region 2 monitoring programs, including: Helicopter Monitoring Program (to prevent floatable wash-ups on bathing beaches and beach closures), Floatables Monitoring Program, Coral Reef Program, New York City Watershed Surveillance Monitoring Program, Bioassessment Program, Biocriteria Monitoring Program, and Lake Ontario Tributary Monitoring Program.

SBIR Vendor: Improved Rapid Detector for Viable Waterborne Pathogens

Richard Montagna, Innovative Biotechnologies International, Inc.

Richard Montagna explained that the goal of this SBIR project was to allow water treatment plants to perform onsite testing for *Cryptosporidium parvum*, differentiate between viable and nonviable oocysts, and remove subjectivity from the current EPA-approved method, which is prone to subjective interpretation that leads to potential false positive results. The method developed in the project, *CryptoDetect*[™], is based on nucleic acid sequence-based amplification, which does not require a thermal cycler, although it is similar to polymerase chain reaction. The liposome is the workhorse of the technology, with probes placed on their external surface. The *CryptoDetect*[™] process, which takes only 4–6 hours, disrupts *C. parvum* oocysts and detects *C. parvum* mRNA with visually detectable results that utilize a numerical cut-off value; digital output of results is underway. The method can detect the presence of a single oocyst, and tests confirm that there is no false positive detection of nonviable oocysts. Additionally, no cross reaction with 28 other test organisms was observed. Tests confirmed that all replicates remained cleanly positive, and no interference was observed. Third-party testing confirmed the results of the in-house tests.

Innovative Biotechnologies International, Inc. (IBI), based in Grand Island, New York, is merging with Rheonix, Inc., allowing IBI's biosensor capabilities to be merged with Rheonix's microfluidic capabilities, resulting in a fully integrated "Chemistry and Reagent Device" (CARD). The CARD platform will allow "sample in–results out" capabilities with no hands-on effort required. Raw samples may be used, and unskilled individuals can successfully perform the testing. Testing indicates that the CARD produces results similar to the current benchtop method, with much less effort, sample, and expertise required. The next steps are to initiate the SBIR commercialization option to finalize CARD and then initiate the verification option.

ETV Verification of Advanced Water Monitoring Systems

Amy Dindal, ETV Advanced Monitoring Systems Center, Battelle, and Vito Minei, Division of Environmental Quality, Suffolk County Department of Health Services

Amy Dindal presented an overview of the Advanced Monitoring Systems (AMS) Center, which has verified 129 technologies, including 69 water monitoring and 60 air monitoring technologies, and

developed 28 test plans. There is active stakeholder participation in two standing committees that serve as advisory groups for air and water monitoring. The AMS Center has published the first international joint protocol and is working on the first international joint ETV verification test. Tests have been completed in 13 technical areas to date.

Vito Minei, a member of the AMS Center water stakeholder committee, provided an overview of Suffolk County, New York's \$50,000 monitoring buoy that resides in Long Island Sound. Since 1985, more than 60,000 stations have been sampled by the Suffolk County Department of Health Services for a variety of parameters. Suffolk County has four monitoring boats that are deployed 6–8 hours per day and spend approximately 20 minutes at each monitoring station. The monitoring buoy includes telemetry, solar panels, and a tether. Use of the monitoring buoy has several benefits, including more reliable, upgraded dissolved oxygen sensors and the ability to collect continuous, real-time data to assess diurnal conditions. The disadvantages, however, are that the probes do not measure some important parameters, the buoy and telemetry equipment and parts are expensive, and deployment and maintenance procedures are more intensive and complex.

Amy Dindal provided an overview of two of the technical areas in which the AMS Center has completed testing: multiparameter water monitors and nutrient monitors. Several methods are used to monitor water quality parameters in a variety of conditions. Four multiparameter water monitoring probes, five on-line water quality monitors for distribution systems, and one water sensor technology have been tested. The general observations from the verification tests for the probes were that the probes were set up and deployed with minimal difficulty, the level of maintenance varied between probes, and some environmental impacts were observed when deploying the probes. The verification test for multiparameter online monitors for distribution systems included three stages (accuracy, response to contaminant injection, and extended deployment) for all of the technologies tested and a fourth stage (contaminant identification) for one technology at the vendor's request. One multiparameter water sensor has been tested; the test results were similar to the reference laboratory's results and similar over the lifespan of the sensor. Field tests also were performed on the unit, which ultimately was found to be user friendly with a long battery life despite the limited number of samples each sensor can measure before disposal.

A protocol for verification testing of beach water quality monitors has been published, but technologies have not to this point been ready for verification testing due to the lack of commercialization. Amy Dindal stated that a breakout session on beach water quality monitoring would be held at the end of the day to further discuss this topic.

Excessive nutrient loading is a major problem for a variety of reasons. Although there are several types of nutrient monitors, Amy Dindal focused on online monitors for industrial applications because this is the area that was tested under the ETV Program. Two nutrient analyzers were tested offline with deionized water and wastewater-spiked samples in two phases; four weeks of continuous online effluent monitoring was performed. The test results were reproducible and fairly linear.

As endocrine disrupting compounds (EDCs) are a growing concern, four ELISA test kits for EDCs were tested. The four-phased testing was co-funded by ETV and EPA Region 3. Significant in-kind support was provided by EPA NRMRL and the U.S. Geological Survey (USGS). Data analysis is ongoing, and the results will be reported in fiscal year 2009.

Several other water monitoring verification tests also are under development.

Discussion

In response to various questions, Richard Montagna of Innovative Biotechnologies International, Inc., explained the following.

- ✧ Testing of the *CryptoDetect*TM method included mixed cultures of viable and nonviable organisms, and only mRNA from viable organisms was detected.
- ✧ Currently, one sample at a time can be processed with *CryptoDetect*TM, but CARD will increase the capability to approximately 5-10 samples.
- ✧ The concentration step of *CryptoDetect*TM utilizes immunomagnetic beads similar to the current EPA Method 1622.
- ✧ The CARD method will reduce the time needed for testing from 4–6 hours to 90 minutes and cost \$25 per test.
- ✧ The CARD is durable and plastic, but the reagents limit the shelf life to approximately 2–3 years.

A participant asked Vito Minei whether the monitoring buoy experienced vandalism, and he responded that there were incidents of vandalism as well as accidents with fishing boats.

Vito Minei explained that water toxicity testing is more focused on homeland security issues and soil rapid toxicity testing is focused on site characterization and environmental situations.

The USGS has a good deal of monitoring experience and is willing to collaborate with EPA (and ETV specifically). It was agreed that USGS and state regulators were necessary allies in this effort, and a meeting between EPA, USGS, and state regulators could be convened to discuss these opportunities. EPA is interested in performing quick, efficient testing in the New York City Watershed.

AIR SESSION 2A: AIR MONITORING TECHNOLOGIES

ETV Verification of Advanced Air Monitoring Systems

Tom Kelly, ETV Advanced Monitoring Systems Center, Battelle, and Philip Galvin, New York State Department of Environmental Conservation

Tom Kelly introduced Philip Galvin, a member of the AMS Center air stakeholder committee, who stated that the New York State Department of Environmental Conservation's air monitoring interests include: distinction of diesel from non-mobile particulate carbon, rapid volatile organic compound and air toxics monitoring, ambient ammonia monitoring, ambient mercury monitoring, and monitoring to confirm carbon dioxide sequestration. He provided maps of upstate and downstate New York ambient air quality monitoring sites. The basic measurements of PM_{2.5} are adequate, but additional precursor measurements are needed. There is a need for measurements for ammonia and a way to distinguish between mobile versus non-mobile carbon. There also is need for a real-time monitoring system for remediation work, accidental release, and fires. Toxic compound monitoring is needed for incineration and new fuels. Other monitoring needs include opacity monitoring of plumes at remote sources, carbon dioxide leak detection for managing carbon sequestration, and ambient mercury monitoring.

Tom Kelly presented an overview of verification testing by the AMS Center for four air technology categories that were of interest to Region 2. First, he discussed JS OPTEC Ltd.'s chemiluminescent ozone analyzer, a continuous monitor for determining ozone in air. EPA designates a Federal Reference Method

(FRM) and Federal Equivalent Method (FEM) for ambient ozone (O₃) monitoring for compliance purposes. The FRM is based on gas-phase reaction of ozone with ethylene; the resulting chemiluminescence is detected as an indicator of O₃ concentration. The FEM is based on absorption of ultraviolet (UV) light by O₃. The AMS Center verified the performance of this monitor based on a different measurement principle, emission of light from a solid agent rather than gas. The American Petroleum Institute collaborated and provided co-funding for this verification. The accuracy of the analyzer was assessed in terms of percent recovery (%R). When ozone was added to clean air in the test chamber in stepwise concentrations of 51–257 parts per billion by volume (ppbv) at high humidity [~80% relative humidity (RH)], the average %R was 93–110 percent. At concentrations of 69–260 ppbv in dry test conditions (< 5% RH), the average %R was 83–88 percent. Linearity was evaluated in terms of slope, intercept, and coefficient of determination (r²). The linearity of the analyzer under ~80% RH test conditions showed a slope of 0.914, an intercept of 6.2 ppbv, and an r² value of 0.998 over a concentration range of 51–257 ppbv. The linearity of the analyzer in < 5% RH conditions showed a slope of 0.838, an intercept of 1.0 ppbv, and an r² value of 0.999 over a concentration range of 69–260 ppbv. None of the interferents tested caused any response from the analyzer. As a result, all interferent response ratios were zero. The verification statement and report are posted on the ETV Web Site.

The AMS Center is in the process of testing leak detection and repair (LDAR) technologies. These technologies are infrared cameras that allow visualization of leakage from valves, flanges, seals, etc., in industrial facilities. The technologies are potentially more cost-effective than current EPA Method 21 technologies that rely on “sniffing” every component with an organic vapor monitor. This technology category originated through an ETV ESTE project. The American Chemistry Council and the Texas Chemical Council are co-funding the verification testing. The LDAR performance parameters include: detection of leaks relative to EPA Method 21, minimum detectable leak rate (laboratory test only), inter-unit reproducibility, confounding factors (field test only), and operational factors. Laboratory tests will be conducted in October 2008, and field tests will be conducted in December 2008 and spring 2009. The final reports should be completed by fall 2009.

The AMS Center completed verification testing of ambient ammonia (NH₃) and hydrogen sulfide (H₂S) monitors. The field-testing of continuous NH₃ monitoring instruments at animal feeding operations was done in partnership with the U.S. Department of Agriculture (USDA). The ambient ammonia monitor tests were conducted in two phases. Four technologies participated in the Phase I test, which was conducted September to October 2003, at a swine finishing farm in Ames, Iowa. Seven technologies participated in the Phase II test, which was conducted October to November 2003, at a cattle feedlot in Carroll, Iowa. The test involved comparisons to a reference method and challenges with NH₃ standards during continuous monitoring. The seven vendors who participated in the ambient ammonia monitors test included: Aerodyne Research, Inc. (tunable diode laser absorption spectroscopy); Bruker Daltonics, Inc. (open-path Fourier transform infrared absorption spectroscopy) (Phase II only); Molecular Analytics (ion-mobility spectrometry) (Phase II only); Omnisens SA (photoacoustic infrared absorption spectroscopy) (Phase II only); Pranalytica, Inc. (photoacoustic infrared absorption spectroscopy); Mechatronics Instruments BV (selective membrane permeation with conductivity detection); and Thermo Electron Corporation (catalytic oxidation and chemiluminescence). The verification statements and reports are posted on the ETV Web Site.

The AMS Center completed a verification test of H₂S monitors. The test was conducted at a swine finishing farm near Ames, Iowa (same site as the Phase I ambient NH₃ monitor test). The test involved comparisons to a reference method and challenges with H₂S standards during continuous monitoring. The test was conducted in collaboration with USDA. The two vendors participating in the test were Horiba Instruments (APSA-360A H₂S) and Teledyne Instruments API (Model 101E). The monitors were evaluated for accuracy, bias, precision, linearity, span and zero drift, response time, interference effects, comparability, data completeness, and operational factors. The verification statements and reports are posted on the ETV Web Site.

Tom Kelly stated that the Clean Air Mercury Rule, issued in 2005, requires utility plants emitting more than minimal amounts of mercury to begin reporting stack gas mercury levels by January 1, 2009. In 2007, the AMS Center completed four verifications for two types of mercury emission monitoring systems: continuous emission monitors (CEMs) and sorbent systems. The AMS Center collaborated with the Illinois Clean Coal Institute, which provided funding for the test, and the Northern Indiana Public Service Company, which provided the testing site and logistical assistance at the site. Nine additional CEMs were verified in previous verification tests in collaboration with the State of Massachusetts and the Department of Energy (DOE).

The AMS Center is looking at other air monitoring technology areas, including field deployable ion chromatographs for gas and aerosol species; cavity ringdown spectroscopy for NH₃, carbon monoxide (CO), and carbon dioxide (CO₂) in power plants; semi-continuous x-ray fluorescence-based analyzers for multiple metals in ambient particulate matter; facility scale odor detection/management systems; fungal contamination monitors; and digital opacity measurement.

SBIR Vendor: Remote Sensing Instrument for On-Road Heavy-Duty Diesel NO_x and PM; Sensitive and Affordable Compact Ammonia Monitor; Continuous Real-Time PM_{2.5} Chemical Speciation Monitor for Ambient Aerosols
Scott Herndon, Aerodyne Research, Inc.

Scott Herndon presented an overview of Aerodyne Research, Inc.'s (ARI's) remote sensing instrument for on-road heavy-duty diesel NO_x and PM. ARI, based in Billerica, Massachusetts, has successfully completed a prototype instrument for soot, indexed to CO₂ and measured in an open path. The soot measurement is based on four co-aligned lasers, from the blue to the near infrared [405, 635, 690, and 980 nanometers (nm)]. CO₂ is measured on the same path with a 2,000 nm laser. The firm has used its instrument to measure soot up to a range of 50 meters. The Rainbow Soot instrument worked well enough in tests to observe plume CO₂ and opacity for a diesel vehicle with relatively low particulate emissions. Despite the fact that the truck plume was not visually smoky, ARI observed correlated multi-wavelength plume opacity and CO₂ column for a diesel vehicle while stationary and when driven through the sensing beam. In multiple traverses of the sensing beam, ARI observed CO₂ in the exhaust plume, at approximately 2,000 to 3,000 parts per million metres, and associated opacities of approximately 0.02 to 0.04, with a data rate of 10 hertz. Additional work is needed to produce user interface and automatic data processing software, and to compare the instrument to others.

During ARI's SBIR Phase I project, their goal was to develop an affordable, highly sensitive, rapid response, robust, and portable instrument for autonomous real-time monitoring of ammonia. The instrument uses mid-infrared quantum cascade laser (QCL) absorption to accurately quantify ammonia with a precision of 0.3 ppbv in a 1-second measurement without cryogenics or calibration gases. The compact ammonia monitor is possible with the development of a novel astigmatic multipass absorption cell based on an in-line construction. The novel cell allows a QCL instrument to be reduced to its optical essentials: laser, absorption volume, and detector. ARI is submitting a proposal for SBIR Phase II funding in October 2008. During Phase II, ARI will develop the multipass cell and explore options to reduce the cost of the instrument. ARI has sold 40 units over the past 4 years. The current price of the instrument is from \$100,000 to \$200,000. The present market is mainly research institutions, and there is a future market for monitoring networks as the cost declines and the simplicity increases. The instrument will attract a larger industrial monitoring market after the reliability of the devices and components are proven.

During a SBIR Phase II project, ARI developed a prototype Aerosol Chemical Speciation Monitor (ACSM) that measures ambient aerosol mass and chemical composition of nonrefractory submicron aerosol particles in real time. The ACSM is designed to run autonomously for extended periods of time

and does not need expensive post-processing analysis. The ACSM was based on technology developed for ARI's Aerosol Mass Spectrometer instrument.

Scott Herndon stated that the organic fraction of ambient aerosol can be a significant fraction of total aerosol mass, and it is a complex mixture of many individual compounds. Advances depend on faster real-time characterization methods. There is a trade-off between the ability to chemically speciate and measure the total aerosol mass.

Region 2 Air Monitoring Technology Priorities

Avi Teitz, EPA Region 2, Session Chair

Avi Teitz stated that he is involved in auditing ambient air stations operated by state and local agencies. Region 2 has a problem trying to find standards to use to verify that the vendors' instruments are accurate. Instruments have to be kept within a certain level of accuracy to be considered valid for monitoring purposes. Current EPA protocol gas standards are used and vendors must certify that their instruments are within plus or minus 1 percent of the standard. In the field, EPA has found that the instruments can be off by 3 to 4 percent. EPA audits normally look at 35-40 cylinders per year, and they usually find one or two failures to meet EPA protocol specifications each year. These failures do not come from any one vendor. Standards for NO_x and sulfur dioxide (SO₂) are most typically affected. This has been confirmed by the New York State Department of Environmental Conservation Quality Assurance Staff. The region has a number of concerns, including: National Institute of Standards and Technology (NIST) standards are often unavailable; the EPA Office of Air Quality Planning and Standards (OAQPS) is no longer doing testing/recertification of standards; certifications are done on an *ad hoc* basis in the regions; some standards are unavailable (e.g., NO_x); NIST is considering reducing the standard gas program; and EPA is aware of the problem, but has not proposed any formal solution. The region's greatest need is for a reliable source of standards or standards verification.

Discussion

A participant asked if the field tests for the LDAR verification would capture seasonal variation. Tom Kelly replied that the technology should work as well in either hot or cold weather.

WATER SESSION 1B: DRINKING WATER TREATMENT TECHNOLOGIES

Region 2 Drinking Water Technology Priorities

Michael Lowy, EPA Region 2, Session Chair

Michael Lowy explained that technology needs will increase as a result of increased regulations and the complexity involved with complying with these regulations. Region 2 has a wide variety of drinking water systems, the largest of which is in New York City. The region also encompasses isolated and outdated small surface water systems in Puerto Rico and roof catchment systems and a desalination plant in the U.S. Virgin Islands.

There are three main technology needs within Region 2: (1) those dealing with pharmaceuticals and personal care products (PPCPs) and their fate in the environment, (2) those applied during natural disasters to get the drinking water systems operational again, and (3) those dealing with the microbial and disinfection by-product (MDBP) rules. For PPCPs, media attention has been intense recently, and EPA has a great deal of work to accomplish in this area. Technologies are needed to determine PPCPs' currents and fates, what occurs when contaminants are chlorinated or transformed, health effects of by-products and degradants, and best removal methods. Analytical methods with high sensitivity are needed.

For the MDBP rules, systems must balance compliance between protection from microbial contamination (e.g., Long Term 2 Enhanced Surface Water Treatment Rule [LT2 Rule]) and the application of disinfectants (e.g., Stage 2 Disinfectants/Disinfection Byproducts Rule). New York State has more than 800 systems that must comply with the LT2 Rule, which was one of a series of surface water rules promulgated because of the Milwaukee *Cryptosporidium* outbreak and requires source water monitoring based on the system's population. "Toolbox" options that systems can choose from to help with compliance are provided in LT2 guidance. The Ground Water Rule was recently promulgated, and systems must be compliant by December 2009. Ground water systems that install 4-log treatment must perform monitoring of that treatment, and those systems in which significant deficiencies are found must find a new source or provide treatment. Smaller systems will need simple and inexpensive technologies to comply.

SBIR Vendor: Inexpensive Drinking Water Chlorination Unit for Small Communities

Benjamin Slote, Reactive Innovations, LLC

Benjamin Slote stated that because many of the drinking water systems in Puerto Rico have insufficient levels of disinfection, novel chlorination methods for disinfecting water are needed. In response, Reactive Innovations, LLC, based in Littleton, Massachusetts, is developing an onsite hypochlorite generator for continuous ground water chlorination. Shipped sodium hypochlorite, chlorine tablets, and current onsite hypochlorite generators have a number of disadvantages. Reactive Innovations' chlor-alkali reactor incorporates an array of tubular electrochemical cells, which is more efficient than the traditional planar cell design. This innovative tubular electrochemical reactor technology is highly scalable, depending on the application and/or community size, and incorporates a membrane-and-electrode assembly (MEA). MEAs connected in parallel give consistent, balanced electrical and fluid flow through the tubes, which optimizes efficiency and simplifies plant operation.

To better understand MEA capabilities, the researchers performed tests with a single MEA, focusing on catholyte and anolyte pathway locations, temperature, flow rates, brine concentration, and voltage and current relationship. The polarization study of the chlor-alkali process shows that increased temperatures increase efficiency, but the nature of the system allows the use of ambient water temperature, which is beneficial because chlorine gas is most stable in water at room temperature. Benjamin Slote described the various parameters that were needed to design the reactor, including efficiency, robustness, durability, ease of operation, and cost. Polarization data indicate that performance depends on applied current and not water flow rate. The system exhibits robust performance, as data indicate that there is good voltage stability for a variety of flow rates and current densities. At the present time, however, the inline mixer is insufficient, even with the flow rate control valve partially open. The company is working on designing an eductor to improve mixing. This process can be refined to meet the requirements of small municipal systems. High water throughput and a reduced number of process control units increase the reliability and decrease the cost of the system. The typical return on investment for this technology, which is simpler and more efficient than existing systems, is three years.

ETV Verification of Drinking Water Treatment Systems

Bruce Bartley, ETV Drinking Water Systems Center, NSF International, and Jeff Adams, ETV Drinking Water Systems Center, EPA Office of Research and Development

Bruce Bartley described the LT2 Rule toolbox of technologies, which are technologies that regulators can use to treat and reduce the risk of viruses, *Giardia*, and *Cryptosporidium* in drinking water. The LT2 Rule sets log removal credits for various technologies based on the history of use. The LT2 Rule also allows membranes for *Cryptosporidium* removal, but there is no automatic credit based on technology; log removal credit is established by product-specific challenge testing and direct integrity testing. There is no restriction on how log reduction value (LRV) is calculated, but if fewer than 20 modules are tested, the

LRV for the test is the lowest LRV for the individual modules; if 20 modules or more are tested, the LRV for the test is the lowest of the measured LRV range. It is advantageous to be conservative. The log removal credit is the lower of either the test LRV or the sensitivity of the field direct integrity test. The LT2 Rule does not specify a test for the direct integrity test.

ETV microbial removal verification testing involves a product-specific test and can be conducted in a laboratory. Small-scale modules must use the same membrane material as full-scale modules. ETV challenge organisms include live *Cryptosporidium* oocysts, bacteria, and viruses. The case study illustrated the need to challenge the full-scale module or a representative of a fully assembled membrane with end caps and seals; direct integrity testing depends on the time interval in the decay curve.

Primary components of the LT2 Rule requirements for UV radiation are reactor validation, monitoring with accurate sensors, and detailed reporting. EPA UV dose requirements account for uncertainty in the UV dose-response relationships of the target pathogens and must address other significant sources of uncertainty in full-scale UV disinfection. As a result, the LT2 Rule requires UV reactor validation testing. UV reactor validation testing must determine the operating conditions under which the reactor delivers the required UV dose for the log removal credits, and validation testing must involve full-scale testing of the reactor to be used by a utility with no up- or down-scaling; each make and model must be validated. The EPA Office of Water, *Ultraviolet Disinfection Guidance Manual for the Final Long Term 2 Enhanced Surface Water Treatment Rule* allows for different log removal credits depending on the validation standards; this allows small and large systems to customize according to their needs. The UV calculated dose monitoring approach generally is more beneficial for larger systems.

Bruce Bartley described the LT2 Rule bag and cartridge requirements, including that challenge testing must be conducted on full-scale filters that include the materials and construction of housing and seals. The LRV is calculated for each of the three required challenge periods, and testing of 20 filters is preferred. Currently, neither NSF Standard 53 nor the ETV protocol meets all LT2 Rule test requirements, so NSF will offer a combination test involving NSF Standard 53 with additional ETV protocol tests to provide an ETV report that would meet the LT2 Rule test requirements. The LT2 Rule requires technologies to be challenge tested, by any organization, before use and to determine LRVs that are used for log removal credits. Third-party testing, such as that completed by ETV, can reduce redundant review of test data and save utilities money.

Jeff Adams explained that EPA has completed a number of studies on point-of-use (POU) devices to assess their capabilities beyond current small systems compliance applications, but also in terms of emerging pathogens, chemicals, EPA's Contaminant Candidate List, water security, mobile treatment systems, and emergency relief. Testing results were presented for four different POU products employing a similar reverse osmosis (RO) and carbon adsorption treatment combination to determine removal capabilities using *Brevundimonas diminut*, *Hydrogenophaga pseudoflava*, and bacteriophage MS2 as challenge organisms. Five to ten POU devices of each of the four products were tested to assess inter-model variability. Overall, all four POU products provided good reduction of bacteria and viruses, although there was significant variability of performance among devices from different production lots within the same POU product-line models. Chemical removal studies were performed on three different POU products, and target concentrations were extremely high, mimicking an intentional water security breach. The RO membrane and carbon treatment processes were assessed separately for each unit. Some chemicals were better removed with the RO portion versus the carbon portion and vice versa. In general, for some individual units among the three POU product-lines, the overall combination of RO and carbon treatment provided nearly 99 percent reductions of all the challenge chemicals. The tests showed no major membrane or seal failure. In conclusion, POU devices with multiple treatment components provide additional barriers of protection and removal, but none of the tested POU products provided complete contaminant removals. Significant performance variability among the different POU product-lines and among the various production lots of the same POU product-line point to the need for continued product-

specific verification testing of drinking water treatment devices.

Point-of-entry (POE) systems provide significant microbial reductions, but are not as good as POU systems; this reflects the type of membrane materials used. It is important to test each RO system, because the source of most variability is at the manufacturer level (production of seals and materials). Again, testing indicated that a combination of RO and carbon filters removes chemicals most efficiently. A POE system has been developed that uses an advanced simultaneous oxidation process (ASOP) that utilizes UV and ozone in addition to RO and carbon filters. The ASOP portion was tested, and its performance varied by chemical. The complete system is likely to reduce challenge chemicals significantly and could be incorporated in a high-asset facility or system. A recently developed mobile water treatment system for emergency relief, the Expeditionary Unit Water Purifier (EUWP), is one of the first emergency mobile units that will be verified. The current challenge is encouraging vendors to third-party test their existing emergency mobile units so that they can be incorporated into community emergency plans. The EUWP was found to significantly remove viruses and bacteria from drinking water. The EUWP also performed well in field tests; the field testing, however, reiterated the need to perform full-scale testing to determine seal integrity. The EUWP study reports are expected to be published in late 2008 or early 2009.

Discussion

Reactive Innovations' onsite hypochlorite generator was discussed as a possible technology to address Puerto Rico's unique challenges, such as high temperatures and extreme turbidity. The generator will need to be tested in conditions that mirror those experienced in Puerto Rico.

AIR SESSION 2B: GREENHOUSE GAS AND ENERGY TECHNOLOGIES

ETV Verification of Greenhouse Gas Technologies

Tim Hansen, ETV Greenhouse Gas Technology Center, Southern Research Institute, and James Foster, Transportation and Power Systems Research, New York State Energy Research and Development Authority

Tim Hansen provided an overview of the Greenhouse Gas Technology (GHG) Center, including technology categories, current verifications, technology verification outcomes, planned verifications, collaborations, and other planned activities. The GHG Center has 36 technologies that have completed or entered the center's verification process. Their focus areas include: oil and gas industries, transportation industry, greenhouse gas monitoring, power industry, and energy efficient/green building technologies.

GHG Center technologies are the subject of three ETV case studies: microturbine-combined heat and power (CHP) systems, an oil and gas vapor recovery system, and fuel cells. These case studies summarize the results of verifications, and provide estimated outcomes of broader market penetration, emission reductions, cost savings, and other factors. He presented examples of outcomes from the case studies for the microturbine-CHP systems, vapor recovery system, and fuel cell systems. Tim Hansen briefly discussed three recently completed verifications for a commercial hot water heater, a molten carbonate fuel cell CHP, and a biogas-fired engine CHP. The verification statements and reports are posted on the ETV Web Site.

The GHG Center has had a partnership with the New York State Energy Research and Development Authority (NYSERDA) for a number of years. NYSERDA has contributed support for 10 distributed generation (DG)/CHP technology verifications under ETV, and there is potential to partner with them for additional verifications in other areas. The GHG Center provided ETV verification information to four

vendors who were applying for SBIR Phase II funding. The center is holding discussions with EPA regarding the Climate Choice/Climate Technology Initiative, which is developing a Technology Promotion/Award/Commercialization Program. EPA would like third-party verification for this program. Their initial focus will be on micro-CHP, lighting, and other energy efficiency technologies, and they will need protocols developed for these areas. The GHG Center has one project underway and another project proposed with the Department of Defense Environmental Security Technology Certification Program. Tim Hansen briefly discussed other planned activities, including: GHG standard and protocol integration, stakeholder involvement, and other technology focus areas.

James Foster stated that NYSERDA is a public benefit corporation, created in 1975 by the New York State Legislature. NYSERDA's mission is to improve New York State's energy, environmental, and economic future by sponsoring energy analysis, research and development, and efficiency deployment programs. He provided a brief overview of one of their major programs, the DG/CHP program. CHP technology benefits include: most viable, economic use of DG; modern equipment is environmentally friendly; use of available heat improves fuel-use efficiency; diversifies electric supplies to the end-user and enhances energy security; and onsite generation alleviates geographical transmission and distribution load constraints. NYSERDA recognized the benefits offered by DG/CHP, as well as the risks and hurdles, and initiated a DG/CHP program in 2001. Since then, NYSERDA has contributed more than \$50 million to the DG/CHP program, completed more than 100 CHP demonstration projects, and completed more than 150 feasibility studies. There are more than 50 operational DG/CHP demonstration projects, producing more than 25 megawatts of electricity.

NYSERDA has had a very successful collaboration with the ETV GHG Center. NYSERDA has another collaborative effort with DOE and the Association of State Energy Research and Technology Transfer Institutions (ASERTTI) Consortium to develop CHP test protocols. The Field Test Protocol was developed by the GHG Center for laboratory testing, field testing, and long-term monitoring. An on-line searchable database has been established for access to the protocols and test reports at <http://www.dgdata.org/>. He provided a brief overview of the results from two recent ETV verifications (molten carbonate fuel cell CHP and biogas-fired engine CHP) and three planned verifications. DG/CHP program results can be found at the following sites: NYSERDA DG/CHP Integrated Data System (<http://chp.nyserdera.org/home/index.cfm>); NYSERDA DG/CHP sites being remotely and automatically monitored by connected energy (<http://www.enerview.com/ny/>); and Distributed Generation Testing Protocols and the National Performance Database (<http://www.dgdata.org/>).

Region 2 Greenhouse Gas/Energy Technology Priorities

John Filippelli, EPA Region 2, Session Chair

John Filippelli provided an overview of Region 2's needs and areas where the region might get involved in technology evaluations. The region issues permits for air, water, and waste projects. In reviewing these projects, Region 2 has the opportunity to recommend a cleaner or more environmentally friendly approach. The region reviews environmental impact statements, provides grants for wastewater treatment facilities and drinking water supply products, and has Superfund cleanup sites, where EPA is advocating using clean technologies. He stated that technology evaluation would be useful to determine the impacts of carbon sequestration at specific facility sites and the waste-to-energy potential in the Caribbean, where CHP and micro-grids should be pursued in the region, and the green energy potential of the region. There also is an interest in life cycle analysis of energy choices (e.g., biofuel feedstocks). At the metro/neighborhood scale, there is a need for analyses to: quantify the impacts of local actions on energy demand (e.g., green buildings, free planting); quantify urban heat island impacts on human health, energy demand, and energy quality; and identify the potential for implementation of micro-grids. There is a need for a systematic analysis of several issues, including: the region's energy needs and options, constrictions in the grid and the obstacles to importing clean energy, the consequences of "no action" on siting

decisions, and to what extent energy efficiency can reduce greenhouse gas emissions and the region's need for new facilities.

SBIR Vendor: Handheld Laser-Based Sensor for Remote Detection of Gas Leaks
Mickey Frish, Physical Sciences, Inc.

Mickey Frish provided an overview of the Remote Methane Leak Detector (RMLD) developed by Physical Sciences, Inc. (PSI) (based in Andover, Massachusetts) with funding from the EPA SBIR Program, DOE, Northeast Gas Association, and Health Consultants, Inc. This technology uses an optical detector that does not need to be located within the gas leak plume. The leak detection device is based on tunable diode laser absorption spectroscopy. Remote detection of a specific gas (methane) is achieved by projecting a laser beam through the air to a target (such as grass, foliage, or buildings). A fraction of the laser beam scatters from the surface and returns to the source, where it is collected and focused onto a detector. Gas molecules in the air path absorb specific frequencies of light in a unique pattern as dictated by their structure and spectroscopy. Because the laser beam is easily scanned over the survey area, leaks, if present, are quickly identified. The RMLD is a handheld device used for walking pipeline leak surveys. The device, about the size of a breadbox, also can be mounted on top of a vehicle. The laser beam can be projected from the road or sidewalk above the path of the pipeline to the home and indicate the presence or absence of gas. If gas is detected, the survey crew then walks the length of the pipeline to locate the leak. Because most surveys are negative, the tool eliminates the need to walk the full length of each pipe, reducing survey times (it takes only seconds to make each measurement) and enabling more efficient use of manpower. It also enables surveying areas that are difficult to access, such as overhead pipes, congested streets, and fenced enclosures. The RMLD can be used to remotely determine the presence of natural gas inside a building or confined space. The RMLD also could be a valuable tool for use by first responders to determine if an area or building is safe for occupation or to locate the source of a leak after a natural disaster causes a pipeline rupture. PSI also has developed a mobile natural gas detector, which demonstrated the ability to spot natural gas leaks from a distance of up to 30 feet from a vehicle moving at speeds approaching 20 miles per hour. The device can detect methane plumes with concentrations comparable to those of a pilot light as far away as 100 feet. The RMLD has been successful at locating all types of leaks under a variety of field conditions.

The prospect of replacing currently available gas detectors, which deploy technologies such as flame ionization units and combustible gas indicators, with a laser-based device that can rapidly survey off-road pipelines has great appeal to leak detection companies. A conservative estimate indicates that members of NYSEARCH—a premier natural gas research, development, and demonstration program—can save more than \$1 million annually if a remote gas leak detector is developed and implemented. Preliminary estimates for walking survey operations have projected savings in the range of 25 to 40 percent. Health Consultants, Inc., and PSI worked together to build pre-commercial instruments in spring 2004, and NYSEARCH companies field-tested the device. The RMLD was released for commercial sale by Health Consultants, Inc., in 2005. To date, more than 500 units have been sold worldwide, representing more than \$7 million in gross sales revenue. This SBIR project has led to more than \$1 million in additional funding to bring this technology to the commercial market. Several derivative products have been developed, including a high-powered version of the RMLD that can detect gas leaks from airborne platforms flying as high as 10,000 feet. In addition, the RMLD platform has been used to develop sensors for CO₂, hydrogen peroxide, and oxygen. The RMLD platform also can be adapted for other gases.

Environmental and Sustainable Technology Evaluation of Fuel Characteristics and Emissions from Biomass Co-Fired Boilers

Tim Hansen, Southern Research Institute, and Jim Mennell, Renewafuel, LLC

Tim Hansen stated that co-firing of biomass in coal-fired boilers offers the opportunity of reducing emissions of criteria pollutants and greenhouse gases while also reducing use of finite fossil fuel resources. This ETV ESTE project measured the reductions of these emissions from biomass co-fired industrial-scale stoker boilers in the range of 100 to 1000 million British thermal unit (MMBtu) per hour. The primary objectives of this project were to: (1) evaluate changes in boiler emissions due to biomass co-firing, (2) evaluate boiler efficiency with biomass co-firing, (3) determine if the value of ash for beneficial uses is reduced due to added carbon and metals content, and (4) evaluate sustainability indicators, including sourcing of biomass and disposal of ash. The project partners who provided financial and in-kind contributions included the ETV ESTE Program, EPA ORD, EPA CHP Partnership, University of Iowa, Minnesota Power's Rapids Energy Center, and Renewafuel, LLC.

Testing was conducted on two industrial boilers that are capable of co-firing woody biomass: University of Iowa Main Power Plant's Boiler 10, which co-fires wood-derived pelletized fuel with coal; and Minnesota Power's Rapids Energy Center Boiler 5, which co-fires bark with coal. Testing at both sites was completed in March 2007, and the final reports are available on the ETV Web Site. Testing results for the University of Iowa boiler showed: 13 percent reduction in SO₂ emissions while co-firing at the 15 percent biomass blend; 10 percent increase in NO_x emissions; 30 percent reduction in total particulate emissions; 28 percent reduction in hydrogen chloride (HCl) emissions; no significant impact on direct CO₂ emissions; and no significant change in metals emissions. Testing results for the Minnesota Power boiler showed: 90 percent reduction in particulate emissions while co-firing at the 92 percent biomass blend; elimination of SO₂ emissions; 92 percent reduction in NO_x emissions; 78 percent reduction in HCl emissions; insignificant change in CO₂ emissions; and 47 percent reduction in primary metals emissions. Additional parameters were evaluated, including sustainability issues (transportation, supply of biomass), CO₂ offsets through combustion of biomass, and fly ash analyses (changes in fly ash composition, Toxicity Characteristic Leaching Procedure metals in ash, and suitability for end use in concrete).

Jim Mennell stated that Renewafuel, LLC, a subsidiary of Cleveland-Cliffs Inc., based in Cleveland, Ohio, is a next-generation biofuel manufacturer. The company aggregates, engineers, and distributes coal-sized renewable energy cubes from renewable feedstock for use in industrial and institutional furnaces and boilers that result in substantial environmental benefits compared to fossil fuels. They have spent more than three years researching feedstock options and availability, assessing fuel characteristics, developing innovative processing systems, developing proprietary product formulations, and completing operational and environmental demonstrations. Renewafuel participated in the recent ETV ESTE verification test of fuel characteristics and emissions from biomass co-fired boilers. Renewafuel received the following benefits from the ESTE verification testing process: (1) provided important and comprehensive baseline data; (2) demonstrated operational feasibility and environmental benefits; (3) highlighted advantages of high-Btu product over raw biofuels, including no loss of boiler efficiency and no increase in CO emissions; (4) identified a small increase in NO_x emissions that led to the development of best operating practices and lower NO_x-producing product formulations; and (5) aided in permitting of subsequent test burns and sale/growth of the company. Renewafuel's ongoing research includes development and use of commercially viable feedstock materials and dedicated energy crops, innovative aggregation technologies and strategies, and new biofuel formulations. They recently completed expansion of their Battle Creek, Michigan facility, and they currently are permitting and building two additional production facilities for a total production capacity of approximately 500,000 tons per year. Company plans call for growth to 2.5 million tons of annual biofuel production capacity by the end of 2012. According to Jim Mennell, Renewafuel adds value to local farms and businesses, creates jobs, reduces energy costs, and reduces energy-related environmental impacts.

Discussion

- ✧ In response to a question, Tim Hansen stated that green building technologies are a gray area because there is a problem in defining “green building.” It is a very broad area and it is hard to identify specific focus areas. It includes such things as energy management systems, software, and modeling, and there are no protocols to evaluate these types of technologies. Stakeholder input in this area is needed to identify where there is a need for green technology and how to verify it.
- ✧ A participant asked if the fly ash could be used for concrete. Jim Mennell of Renewafuel, LLC, responded that there was minimal change in the fly ash composition. The fly ash was not suitable for concrete because the American Society for Testing and Materials (ASTM) standards do not allow the use of ash unless it is from coal.
- ✧ A participant asked if Renewafuel’s biofuel price relative to coal would increase over time. Jim Mennell responded that in five years, Renewafuel’s biofuel price relative to coal should not change from today’s price because Renewafuel has negotiated long-term contracts for its product.
- ✧ A participant asked why the biomass had to be put into a cubed form. Jim Mennell responded that the biomass needs to be put into a cubed form because it is designed for the more traditional stoker units that operate like barbecues with a grill on top. Otherwise, the biomass would ignite and burn too quickly or fall through the cracks.
- ✧ A participant asked how the energy value of Renewafuel’s products compared to western coal. Jim Mennell responded that Renewafuel’s products are designed to have an energy value of 8,000 to 8,200 British thermal unit per pound (Btu/lb); green wood is 4,600 Btu/lb; and western coal is 8,700 Btu/lb. Therefore, Renewafuel’s product is 93 percent of the energy value of western coal.
- ✧ A participant asked if Renewafuel handled municipal solid waste. Jim Mennell responded that Renewafuel has not handled municipal solid waste. The company has tried to focus on being a sustainable and environmentally beneficial green company.

BREAKOUT DISCUSSION SESSIONS

Breakout Session 1A: Water Monitoring Technologies—Beach Water Quality Monitoring

Facilitator: *Douglas Pabst, EPA Region 2*

Presenter: *Vito Minei, Division of Environmental Quality, Suffolk County Department of Health Services*

Rapid detection techniques for waterborne pathogens and pathogen-indicating organisms are of broad environmental interest. Coastal applications such as beach quality monitoring are of particular interest as pathogen contamination in recreational waters can have a direct effect on the public. During this breakout session, participants discussed current practices being employed within EPA Region 2 and in Suffolk County, New York, for rapid beach water quality monitoring and explored opportunities for verification testing in this area.

Amy Dindal noted that the ETV AMS Center has prioritized verifying the performance of beach pathogen detectors for more than three years and has developed a draft protocol for verifying these technologies, which focuses on their ability to detect and measure *E. coli* and *enterococci*. In addition to requesting

input on other water quality indicators, Amy Dindal also requested ideas for developing collaborations that will enable these technologies to be verified.

Ease of use is important, as are correlations to standard methods, such as Method 1622. Participants noted that monitor results need to be defensible, since beaches will be opened and closed based, in part, on these results. Because beaches are public resources, social science analyses may need to be performed to determine how to notify the public, what is an acceptable level of false positives, etc. Also, a lot of emphasis has been placed on the method used to measure pathogen levels, rather than how to manage response and public notification. Data from rainfall runoff models could be coupled with measurement data during rainfall related closures.

Breakout Session 1B: Drinking Water Treatment Technologies

Facilitators: *Michael Lowy, EPA Region 2*
Bruce Bartley, ETV Drinking Water Systems Center, NSF International
Jeff Adams, ETV Drinking Water Systems Center, EPA Office of Research and Development

Applications Associated with Meeting the Ground Water, LT2, and MDBP Rules for Technologies Using UV and Alternative Disinfection, Membranes, and Bag/Cartridge Filtration

Under the LT2 Rule, EPA developed a toolbox of technologies to assist applicable public water systems, communities, and regulators in their selection of treatment technologies that would reduce the risk of exposure to viruses, *Giardia*, and *Cryptosporidium* in drinking water. The LT2 Rule requires technologies to be challenge tested under controlled conditions in the laboratory along with field piloting. The two types of data then may be used for determining site-specific log removal credits. Testing can be done by any organization; however, the rule encourages third-party testing such as ETV. Third-party ETV testing can reduce redundant review of test data and save utilities and engineers costs and time where, otherwise, each utility would incur the cost of consultant review of these tests. Evaluation of technologies that address the Ground Water Rule and the MDBP rules also have specific requirements that must be considered.

Technologies for Application in Natural Disasters and Other Security Emergencies

When natural disasters such as hurricanes, floods, and earthquakes occur, safe drinking water can be compromised, limited, or unavailable. In preparation for such situations, communities should have emergency response plans. One option for providing safe water during emergency situations is to use mobile water treatment systems that can create potable water from water of unknown quality. These systems can provide potable water to critical infrastructure, such as hospitals, fire stations, or police stations. Depending on the situation, point-of-use (POU) or point-of-entry (POE) treatment systems could be used for smaller volumes of water. Individual consumers may desire to voluntarily install a POU/POE treatment system as an additional multi-barrier approach to achieving higher quality drinking water. Some consumers with health concerns may consider POU/POE as a proactive measure to reduce exposure to pathogens and trace chemicals not currently monitored or regulated. Also, some may be concerned about security threats to their water supply. Despite potential benefits of mobile treatment devices, there is concern about the long-term capabilities of various systems and concerns about some vendors who have made questionable performance claims for their products. There is a significant need for credible verification of performance capabilities and maintenance requirements for various types of systems by independent testing organizations, such as the ETV Program.

This breakout session focused on technology applications and needs, stakeholders/partners/resources, testing methodologies, and other topics related to the above drinking water treatment technology areas.

The main points discussed during the breakout session were as follows.

- ✧ A primary challenge is that in many small (trailer park) systems, the operator's main job is not drinking water system operations, and these operators do not understand the public health aspect.
- ✧ Although there are many sources of training, many operators are not interested.
- ✧ The knowledge that drinking water system operators must possess continues to increase.
- ✧ Primary enforcement responsibility (e.g., primacy) must be established for enforcement to occur.
- ✧ The Drinking Water State Revolving Fund is an issue for smaller systems; larger, more sophisticated systems are able to take advantage of these funds. Making it easier to navigate this process will increase compliance and encourage more small systems to utilize this resource.
- ✧ A trained circuit rider could visit multiple trailer park systems to provide maintenance and ensure quality instead of relying on the trailer park operator.
- ✧ Motivation is a key issue for compliance and optimization of systems.
- ✧ Some scholarship programs are based on community service requirements. One approach to maintaining and improving trailer park systems is to teach bright scholarship students basic analytical assessments and deploy them to help maintain these systems as part of their community service requirements.
- ✧ Turnover is another issue. EPA has an outreach effort to acquire top young students and train them for this type of work when the current, aging operators retire.
- ✧ In terms of exposure to EDCs, the effects are chronic (versus acute) and cannot be predicted; therefore, a multidimensional approach that includes prevention and awareness is needed.
- ✧ Outreach is important so that community systems know what technologies are available in the event that a natural disaster or terrorist attack necessitates local water purification.
- ✧ The toolbox for available emergency mobile water treatment units is lacking because manufacturers have not had their technologies third-party tested, and there are no solid performance data. Such a toolbox, with a wide range of solutions, is necessary as a result of the various logistical issues that different areas face. There is no motivation for these manufacturers to get verified because communities will use technologies based on manufacturer claims in cases of emergency. It is necessary to interface with the right agencies (e.g., the Federal Emergency Management Agency) to make them aware of the problem and convince them that verification of these technologies is necessary; a regulation that technologies cannot be deployed in emergencies until they are verified would help.
- ✧ ORD has organized a working group comprised of stakeholders, including regulators, vendors, users, and researchers/academia, to determine priority technology application areas; this has been a huge factor in the success of the program.

- ✧ EPA recognizes that leadership is needed to solve aging water infrastructure problems and has programs and initiatives in place to identify rehabilitation technologies for various water infrastructure issues. There is funding to perform verification for these technologies.

Breakout Session 2B: Greenhouse Gas and Energy Technologies—Greenhouse Gas Technology Areas

Facilitators: *John Filippelli, EPA Region 2*
Tim Hansen, ETV Greenhouse Gas Technology Center, Southern Research Institute

With increasing worldwide energy demand and carbon emission concerns, a wide variety of energy options that help address both problems are receiving renewed attention. Some of these technologies have played a limited role in the energy sector for decades, and new technologies are emerging with increasing frequency. To gain broader public acceptance and capture a significant share of the commercial market, however, performance verification and demonstration of economic viability is essential. This breakout session focused on the following technology areas.

- ✧ Combined heat and power (CHP)—Also known as cogeneration, CHP is an efficient, clean, and proven approach to generating power and thermal energy from a single fuel source. CHP systems designed to meet the thermal and electrical base loads of a facility can greatly increase operational efficiency and decrease energy costs, as well as reduce the emission of greenhouse gases. The ETV Program has evaluated the performance of several CHP technologies, including microturbines, fuel cells, and engines in conjunction with NYSERDA and other partners, utilizing nationally accepted field evaluation protocols developed in collaboration with ASERTTI.
- ✧ Renewable energy/green power—This broad category includes electricity produced from renewable resources, such as solar, wind, geothermal, low-impact biomass, and low-impact hydro. With the establishment of renewable portfolio standards (RPSs) in many states and an increased demand for technologies to reduce foreign oil consumption, many new technologies are being developed and commercialized. Nationally accepted testing protocols for renewable technologies and projects that are utilized by EPA, states, carbon offset programs, and others could lead to wide acceptance and ease of permitting, RPS credits, carbon credits, and other benefits.
- ✧ Biofuels/bio-energy—With the advent of renewable fuel standards, RPSs, and efforts to reduce carbon emissions, the use of biomass and the production of biofuels have become significant technology growth areas. Analyses of various biofuels production and biomass utilization processes, however, have not been completed in a uniform, widely accepted format. Additionally, life-cycle analysis of the entire production, distribution, and use process may provide a more complete assessment of impacts and benefits. Collaborations to develop standard evaluation protocols for various technologies and processes may be formed to ensure national acceptance. Such evaluation programs would allow users, regulators, and others to determine which fuels and processes are the most environmentally and energy favorable.

The main points discussed during the breakout session were as follows.

- ✧ It is important to have verification for carbon sequestration. On the green building side, a lot of construction waste is produced. It would help to have a regulation or policy for a deconstruction waste program, which involves taking reused materials out of landfills. Right now it is easier for construction companies to take their waste to the landfill.

- ✧ NYSERDA is conducting a demonstration project with Taylor Recycling in New York, where they are separating out elements of demolition waste. They will build a power plant on the site. The waste will be gasified and they will burn the synthetic gas in gas turbines. These technologies are not yet commercialized so ETV cannot verify their performance at this time. Also, there are regulatory barriers.
- ✧ Solar-assisted fuel generation is a process that combines the ingredients of carbon, hydrogen and sunlight to create a petrol-like product. CO₂ can be made the source of carbon and used with solar energy to create liquid fuels.
- ✧ There is a variation on solar technology which uses mirrors to concentrate solar energy on water pipes to produce steam and, ultimately, electricity. Ausra, a start-up company in Palo Alto, California, has developed this technology and will have its first installation in 2011; it should power more than 100,000 homes.
- ✧ The October 3, 2008 issue of the *New York Times Magazine* reported on Bloom technology, which is a fuel cell-based technology that converts a fuel, such as natural gas or ethanol, into electricity through a chemical reaction rather than combustion. It is a fuel flexible power source that was developed by a scientist at the University of Arizona in 2002. In theory, the units, called Bloom boxes, would be reliable, quiet, and very low in carbon emissions. A 5-kilowatt Bloom box, which looks like a squat refrigerator and produces about as much electricity as a typical home requires, has been tested by the University of Tennessee. One of the first units was demonstrated to assess its durability and performance. The box ran nonstop on natural gas for 6,000 hours, and its performance exceeded expectations. The box was twice as efficient as a boiler burning natural gas, and its carbon emissions were 60 percent lower.
- ✧ NYSERDA is assessing the potential of using solar technology for hot water and heating in New York City.
- ✧ NYSERDA has provided funding to support the commercialization of Plug Power's residential micro-CHP fuel cell system.
- ✧ Solid oxide fuel cell is a technology that is being pursued globally. It is a 1,000-watt system. The technology is more successful in Japan than in the United States; the primary difference is that electricity costs approximately \$0.21 per kilowatt hour (kwh) in Japan versus \$0.09/kwh in the U.S., so the technology payback in Japan is much faster. The technology is not yet ready for verification.
- ✧ Climate Energy and Honda have a micro-CHP system called Freewatt™. Sales of the Honda-powered generator with a warm-air heating system have begun in the Northeastern states, where sales are boosted by the relatively cool climate and legislation promoting net-metering, which allows owners of alternative energy systems to recover costs by feeding electricity back into the networks. There are plans to add a hot-water boiler system and other configurations to the product. Freewatt™ is appropriately sized for the needs of the average single-family home. Similar systems have sold over 50,000 units in Japan since their introduction in 2003. The low noise level of the Honda generator, which is compared to a refrigerator, is a strong selling point for the Freewatt™. The price for a Freewatt™ micro-CHP with warm-air heater is approximately \$13,000 installed, depending upon the complexity of the installation.
- ✧ An economic analysis should be included in ETV verifications to tease out the economics and robustness of the technology.

- ✧ The potential hurdle for small farmers to producing energy is that farmers tend to be traditional and operate on small budgets. The GHG Center and NYSERDA tested an electric power and heat production technology fueled by renewable biogas generated from a dairy farm (Patterson Farms, Auburn, New York).
- ✧ NYSERDA is demonstrating the EMG International, Inc.'s package system for anaerobic digestion of manure. Rather than building a digester onsite, they are transporting a digester tank to the site. This technology is specifically designed for small farms.
- ✧ There are some high solids digesters for converting methane for farms.
- ✧ There are standards for performance testing for wind turbines. NYSERDA is looking at small wind turbines.
- ✧ NYSERDA holds an Annual Innovations in Agriculture Conference as outreach to New York State farmers. NYSERDA offers incentives and funding opportunities for farms in New York State to produce electricity from biogas generated from treating farm wastes in anaerobic digesters.
- ✧ Public outreach is needed at the grass roots level to get more information to the right people. As an example, EPA does an excellent job of outreach for total maximum daily loads (TMDLs) and through the nonpoint source water program.
- ✧ Potential funding sources include: EPA's Regional Applied Research Effort, the annual regional pollution prevention competition, ETV and ORD, and USDA. The National Clean Diesel Program funds installations but not testing. The pollution prevention grants are being scrutinized for metrics, which takes them out of the research mode and into implementation. States such as Texas and California might also be sources for funding.
- ✧ There has not been a regulatory (air quality) driver for greenhouse gas technology in the U.S.; it has been strictly an energy efficiency driver, which means that a technology has to save significant money (energy) for users to buy it. An air quality driver (i.e., GHG regulation), plus the energy efficiency driver, is needed to make more greenhouse gas technologies viable.

WEDNESDAY, OCTOBER 8, 2008

WATER SESSION 1C: WATER QUALITY AND WASTEWATER TREATMENT TECHNOLOGIES

ETV Verification of Water Quality Protection Technologies

Tom Stevens, ETV Water Quality Protection Center, NSF International; Ray Frederick, ETV Water Quality Protection Center, EPA Office of Research and Development; and Robert Andoh, Hydro International

Tom Stevens explained that the Water Quality Protection (WQP) Center has completed 32 verifications in four stakeholder areas. The challenge for the center from the start has been the wide variety of potential technology verifications that could be performed under water quality, as almost any activity can impact water in one way or another (e.g., ground water, surface water, wastewater, etc.).

Ray Frederick described current efforts for infrastructure rehabilitation technologies. The WQP Center identifies testing opportunities at other institutions to maximize leveraging; the center currently is working with the University of Houston on rehabilitation technologies involving coatings and grouts; necessary ETV protocols were added to the process. Potential future areas of focus include pipe liner materials, pipe bursting, and manhole rehabilitation. Stakeholder participation is important to assist with protocol development and determine focus areas. Ray Frederick described the factors involved with verification of coatings and grouts and explained that testing of these materials was ongoing.

Tom Stevens explained that 15 wet weather flow treatment technologies have been verified in the areas of stormwater treatment, flowmeters, induction mixers for high-rate disinfection, and urban runoff models. It is difficult to motivate vendors to test technologies in the area of high-rate solids separation for stormwater applications because they can get paid to perform this testing elsewhere. All stormwater work has been a collaborative effort with multiple agencies in a wide variety of locations; the current effort is to develop the best protocol from the multiple protocols available for controlled testing sites. Stormwater protocol development is a challenge because of the difficulty in sampling stormwater. A qualified sampling event has many requirements. ETV used a variety of performance indicators to challenge the technologies and found that acquiring consistent 80 percent removal of total suspended solids is generally not achievable. An effective sediment monitoring program includes total suspended solids, suspended sediment concentration, and particle size distribution analysis. Additionally, hydrocarbons are present, but it was not possible to collect samples to allow for quantitative measurement of them.

Robert Andoh stated that Hydro International (Hydro), based in Portland, Maine, offers innovative technologies and cost-effective solutions for a cleaner environment; the company has the facilities to provide full-scale testing. Hydro addresses quantity and quality control for stormwater management. Several of Hydro's stormwater products have undergone ETV testing and verification and are being used in the United States and overseas. Computational fluid dynamics (CFD), a computerized prediction of fluid flow patterns, is used to predict how devices will behave in practice. Navier-Stokes differential equations are the fundamental equations solved numerically in CFD. CFD and physical testing show that chamber configuration (e.g., simple vortex, advanced vortex) has a bearing on device efficacy. Robert Andoh showed several videos and still images to demonstrate how CFD is used and to illustrate the differences between several devices. The series of tests led to the following conclusions: (1) various approaches to sediment interception, storage, and retention are available; (2) internal components greatly affect flow profiles and hydrodynamic characteristics; (3) poorly designed systems are subject to pollutant washout; (4) well-designed systems incorporate isolated and protected storage zones; and (5) the poorest performers have no isolated storage zones and poor protection of the base region.

Robert Andoh described an SBIR-funded technology called the Up-Flo[®] Filter, which is an advanced, passive, high-capacity, proprietary upflow filtration system in a compact modular device. The outputs from SBIR Phase II field monitoring will be available in a published report, and verification is close to completion under the ETV Program. The SBIR process has been useful and instrumental in the development and marketing of this novel technology for stormwater treatment. ETV and related verification processes are needed and useful for the industry, and the right approach is being adopted.

SBIR Vendor: Balloon Platforms for Remote Sensing of Water Quality in Mixing Zones

Robert Doneker, MixZon, Inc.

Robert Doneker of MixZon, Inc., (based in Portland, Oregon) explained that National Pollutant Discharge Elimination System (NPDES) permits are written so that a mixing zone is allowed; a mixing zone is a limited area or volume of water where initial dilution of a discharge takes place, and water quality criteria apply at the boundary of this zone. EPA's SBIR Program solicited better methods for remote sensing of water quality at site scales with the goal of decreasing costs for environmental compliance monitoring.

Blimps are more cost-effective than helicopters and planes and can be used as a platform for remote sensing of mixing zones. The developed platform has a low cost potential, allows real-time measurement of the full mixing zone, is easy to deploy, can obtain georeferenced images for regulatory compliance monitoring, can be deployed for extended periods, and uses forward-looking infrared imagery. The MixZon Remote Sensing System uses a tethered helium balloon, remote sensing platform (including a pan/tilt camera), ground station laptop, wireless router, and ZoneView software.

A survey boat was used to groundtruth the model and verify predictions from aerial, remotely-sensed measurements. The goal was to obtain a georeferenced image of regulatory mixing zones. Field tests showed that the remote sensing platform was able to identify a subsurface leak that was not observable otherwise and identify that a diffuser was not behaving as designed at the test sites. The platform also may be of interest for outfall monitoring and design and can be applied in the areas of tile drain location, fish habitat/thermal refugia, and ground water recharge. Another advantage of the real-time aspect of the platform is that personnel in the boat receiving aerial data are directed to the most appropriate locations to collect ground data.

Region 2 Water Quality and Wastewater Treatment Technology Priorities

Karen O'Brien, EPA Region 2, Session Chair

Karen O'Brien explained that Region 2 issues NPDES permits in Puerto Rico and oversees the NPDES programs for New York, New Jersey, and the U.S. Virgin Islands. Because water quality-based effluent limits can be very stringent, new advanced technologies are needed to meet the low limits, and the region needs to understand what new developments are underway within the industry. NPDES permitting authorities need to know which technologies work and which do not and what performance the technologies are capable of to advise dischargers of what is achievable. The appropriateness of the technology and design must be verified. EPA's stormwater regulations usually are best management practices instead of numeric limitations, but with the Phase II Stormwater Rule, the next big challenge will be to meet nutrient limitations. Conventional technologies are not designed, and therefore are inadequate, for treating low levels of nutrients. Because dischargers will ask EPA for assistance with new technologies for removal, EPA must be aware of new developments and validated technologies in this area. This information also is necessary for developing compliance schedules. Wastewater treatment technologies typically are not effective at treating low levels of legacy pollutants (i.e., substances whose use has been banned or severely restricted by the EPA), so more innovations in this area are needed.

Discussion

In response to a suggestion that EPA provide guidance about whether certain technologies should or should not be used, Karen O'Brien explained that EPA does not endorse technologies but has data and guidance on what reductions are achieved.

In response to various questions, Karen O'Brien explained the following.

- ✧ One possible application for real-time data is dealing with impacts that affect wildlife.
- ✧ EPA regions and headquarters are aware and concerned about PPCPs and EDCs.
- ✧ There is a long process for implementation of formal effluent limits and water quality standards.

In response to a question, Robert Andoh of Hydro International, stated that testing had demonstrated Hydro's separation device's oil removal and efficacy. The device does not create high-energy cyclones or high-speed vortexes, so there is not much intermixing.

In response to several questions, Robert Doneker of MixZon, Inc., stated the following.

- ✧ The remote sensing technology is a temperature measurement technique, so there must be a change in temperature between the measured and ambient sources.
- ✧ The technology is eligible for ETV verification, and MixZon is interested in pursuing it.
- ✧ The technology can be applied in cases in which there is a temperature change as a result of a chemical spill in a river.

AIR SESSION 2C: AIR POLLUTION CONTROL TECHNOLOGIES

Region 2 Air Pollution Control Technology Priorities

Jehuda Menczel, EPA Region 2, Session Chair

Jehuda Menczel stated that Region 2 is responsible for the air compliance program that includes state implementation plans (SIPs), new source performance standards, national emissions standards for hazardous air pollutants, permitting, Asbestos Hazard Emergency Response Act (asbestos in schools), acid rain, stratospheric ozone protection, and compliance assistance. The technologies associated with these programs include reasonably available control technology, best available control technology (BACT), lowest achievable emission rates, and maximum achievable control technology (MACT). Most of New York and New Jersey are in nonattainment for ozone. In these areas, there are 800 major sources of ozone; 855 sources are covered under the MACT, which shows that Region 2 has a lot of work to do to become compliant. Inspectors go to the field to do visible emissions observations. He would like to see every inspector equipped with handheld instruments that could be aimed at stacks for speciation of hazardous air pollutants (HAPs) and sensing instruments for remote detection of leaks. There is a need for up-to-date information on efficiencies and comparisons of control equipment (e.g., baghouses versus electrostatic precipitators versus scrubbers). The region issues prevention of significant deterioration permits and there is a need to install BACT. Additional needs include substitutes for asbestos, mercury controls, and state assistance (e.g., for wood-fired boilers). There have been complaints from upstate New York that people are using wood-fired boilers and polluting the air.

SBIR Vendor: Membranes for Air Venting and Retaining VOCs in Gasoline Storage Tanks; Retrofitting Diesel Electric Generators for Emission Reduction ***Stuart Nemser, Compact Membrane Systems, Inc.***

Stuart Nemser stated that Compact Membrane Systems, Inc. (CMS) is a technology development company based in Wilmington, Delaware. He described the CMS air separation membranes, which can be used for: (1) VOC recovery at fuel storage tanks, and (2) NO_x emission reductions. In the first area, their goal was to develop a membrane-based vapor processor that will maintain fugitive emissions from retail gasoline stations below the new California Air Resources Board (CARB) limit of 0.38 pounds of gasoline lost per 1,000 gallons of station throughput. CMS developed a simple membrane gasoline vapor recovery system that exceeds the new CARB standards. The system has passed all requirements for certification by CARB and Underwriters Laboratories, Inc. CMS supplies the membrane element and Vapor Systems Technology supplies the processor. CMS is selling about 100 cartridges per month. During the SBIR Program, the following key improvements to the vapor processor were made: (1) introduction of Module Purge, which reduced emissions by a factor of two; and (2) development of a composite hollow fiber membrane with significantly improved separation capability, which reduced emissions by a further factor of two. The membranes reduce gasoline station emissions by greater than 98 percent.

In the second area, CMS generated nitrogen-enriched air (NEA) from cooled turbocharged air using an air separation membrane integrated into the diesel engine. It is sufficiently compact for use on-board diesel-powered trucks and mobile equipment. The field durability test program included five Caterpillar diesel-powered class 8 trucks outfitted with NEA membranes. There was no evidence of membrane fouling after more than 1 million miles. CMS plans to demonstrate and verify the NEA membrane on new engine platforms such as biodiesel and ethanol-diesel fueled engines and in combination with other technologies. The membranes reduce diesel NO_x emissions on many platforms by greater than 50 percent. This technology is ideal for high load opportunities (e.g., generators, ships, locomotives). The NO_x emissions reductions are a result of reducing oxygen concentration and combustion temperature in locomotive diesel engines. However, reduced oxygen concentration increases PM formation. Diesel NEA cartridges work best at high load, while exhaust gas recycle works worst at high load.

ETV Verification of Air Pollution Control Technologies

Jenia Tufts, ETV Air Pollution Control Technology Center, RTI International; Barry Liebowitz, Environmental Research, New York State Energy Research and Development Authority; and Ajay Joshi, Johnson Matthey

Jenia Tufts presented an overview of the Air Pollution Control Technology (APCT) Center. She recently took over as director of the APCT Center from Andrew Trenholm. The focus of the APCT Center is on technologies for controlling emissions of PM, NO_x, VOCs, and HAPs. Eight test protocols have been completed and are on the ETV Web Site. She discussed completed verifications for two technology categories: gas turbine technology for NO_x emissions reduction and dust suppressants. In collaboration with NYSERDA, a VOC control (biofilters) verification is in progress at a fiberglass parts manufacturing facility in New York. The technology uses a modular biofilter to control styrene emissions. There is potential interest from an Irish company to verify a biofilter for H₂S control for wastewater treatment plants. Fourteen verifications have expired for baghouse filtration products (BFPs) (verifications are good for three years), six unexpired verifications are on the ETV Web Site, and three additional verifications are in progress. A testing protocol was developed for BFPs; the initial focus was on verifying the penetration of PM_{2.5} through bag fabrics to determine the removal efficiency. The ETV procedure was adopted as ASTM Method D6830, Characterizing the Pressure Drop and Filtration Performance of Cleanable Filter Media. This procedure also is under review by an International Organization for Standardization (ISO) committee to adopt it as an ISO standard. In fall 2005, the South Coast Air Quality Management District (SCAQMD) issued a rule for the cement industry requiring that the frequency of compliance tests is reduced from once a year to once in five years when verified fabrics are used. The APCT Center completed a verification for Southern Filter Media as a direct result of the rule. Since fiscal year 2005, three verifications have been completed, and four verifications are in progress. Eleven verifications have been completed for mobile sources (diesel retrofits); this included 10 add-on devices and 1 alternative diesel fuel. One verification for an add-on device should be completed in early 2009. Two selective catalytic reduction (SCR) systems have signed-up for verification testing.

The APCT Center partnered with the EPA Office of Transportation and Air Quality (OTAQ) National Clean Diesel Campaign (NCDC) for diesel retrofit emissions control technologies. NCDC-listed technologies are associated with SIP credits and OTAQ grants. Three test protocols have been completed for mobile sources devices, fuels, and SCR. The APCT Center is coordinating with Texas, which has a grant program for NO_x control technologies and funds vendors to pay for verification testing, and with California, which has its own verification program. Diesel retrofit technology types include: devices (diesel exhaust catalysts, diesel particulate filters, engine modifications, and other devices), SCR, and fuels (alternative fuels, reformulations, fuel additives, and lubricants and lubricant additives). Nine verifications have been completed and two verifications are in progress. Jenia Tufts presented a slide depicting the various verification interactions between the different partners, including: the vendors, APCT Center, EPA OTAQ NCDC, CARB, EPA grant recipients, and other funded projects. She briefly

reviewed eight completed verifications and two verifications that are in process and under discussion.

Jenia Tufts described a new partnership for the APCT Center. EPA OAQPS developed a voluntary program for outdoor wood-fired hydronic heater (OWHH) technologies. The OWHH program encourages manufacturers to improve air quality through development and distribution of cleaner, more efficient OWHH technologies. A test method was developed by an ASTM work group and EPA. An ETV protocol was prepared, which incorporates EPA's test method and procedures. The APCT Center will verify the performance of these OWHHs, and the test results can be used by the vendors to participate in the OWHH Program. The Northeast States for Coordinated Air Use Management (NESCAUM) and several Northeast states were active stateholders in this effort.

Barry Liebowitz provided an overview of NYSERDA's environmental research and development programs. The Clean Energy Research and Market Development program has several subprogram areas including: renewable portfolio standards systems benefit change program; regional greenhouse gas initiative program; and research and development programs associated with power systems and transportation, renewable and indigenous resources, and environmental research. Environmental research, in turn, encompasses several subdivisions, including: an environmental monitoring, evaluation, and protection program (responsible for assessing the impacts of energy use on air quality, ecosystems, and climate change); a water and wastewater program; an agricultural waste management program; and an environmental technology program. In all cases, the goal is to improve current practices through the development and use of new technologies and processes. The environmental technology program has focused broadly on several applications (water and wastewater, solid waste/contaminated waste, air quality monitoring, air pollution control, and carbon capture). Recently, NYSERDA has released a solicitation for improved environmental performance for power generation, which is directed to owners and operators, and has focused on assessing the performance of retrofit emission control technologies for off-road diesel equipment, specifically construction equipment.

Many of NYSERDA's programs are oriented to product development, from conceptual design to verification. In the past, NYSERDA has promoted the use of the EPA ETV Program to verify the performance of products and processes produced or of interest in New York State.

One environmental technology project sponsored by NYSERDA is a biofiltration technology for styrene capture and control in collaboration with HAPcontrol, LLC, Triad Technology, and Cornell University. The Occupational Safety and Health Administration (OSHA) has regulated work exposure to 50 parts per million (ppm) 8-hour time-weighted average (TWA), and California OSHA has proposed 20 ppm TWA from its current 100 ppm TWA. EPA requires an air permit if styrene use is above 10 tons per year. The HAPcontrol biofiltration technology takes styrene, puts it through a biofilm to a microorganism that degrades it to CO₂ and water. The technology consists of a point of source capture, biological treatment (to ensure that toxic intermediate degradation products are not produced under aerobic conditions), and recycling of treated air. HAPcontrol's bioreactor system is installed inside of their engineered bio-furniture, which includes worktables, waste cans, cabinets, and modular wall units, to capture the styrene at the source of generation. Depending on the rate of flow through the biofilter, there can be a 70-90 percent removal of styrene to CO₂ and water vapor. The ETV Verification Protocol for Bioreaction System Control Technologies for Volatile Organic Compound Emissions is completed and the test/quality assurance plan is under development for HAPcontrol's bio-furniture applied to styrene capture and control. The APCT Center will conduct the verification test, collect data, and issue the verification report. The goal of the test will be to evaluate performance of the 8-module bioreactor worktable, evaluate possible adverse environmental impacts, and document the test conditions and results. The performance factors to be measured include styrene emissions, inlet/outlet volumetric flow rates, and styrene concentrations. The associated impacts to be assessed include wastewater styrene concentrations, microbe emissions in outlet gas stream, and microbe content of the sump. Other measurement parameters include

reactor volume, flow rates, temporary total enclosure conditions (air temperature, pressure, and humidity), and background styrene levels.

Barry Liebowitz stated that outdoor wood-fired boilers are a major problem in upstate New York. There are a lot of competing forces on the use of biomass. Some people are interested in it as a renewable resource that can reduce the cost of energy. However, equal attention must be paid to environmental impacts, health effects, and efficiency. NYSERDA has a review of the state-of-the-art on European wood heaters in terms of efficiency and pollution control. Barry Liebowitz will discuss this further in the breakout session.

Ajay Joshi stated that Johnson Matthey, based in Malvern, Pennsylvania, has emission control devices for mobile, on-road, off-road, and stationary sources. He presented on two diesel on-road retrofit technologies, one of which is going through the ETV verification process and the other one has already completed verification testing. The two technologies are the Selective Catalytic Reduction Technology (SCRT®) System and the Partial Continuous Regenerating Technology (PCRT®) System. The SCRT® System is a combination of Johnson Matthey's CRT® and SCR. Ajay Joshi stated that the SCRT® System reduces NO_x by 70 percent and PM, hydrocarbons, and CO by 90 percent. Low-temperature NO_x reduction is enhanced with nitrogen dioxide generated by the CRT® filter, and the aqueous urea added to the exhaust stream provides high NO_x reduction on the SCR catalyst. Fifty field trials have been conducted in the United States and a number of field trials have been conducted in the United Kingdom and France. The PCRT® System has an oxidation catalyst and a partial filter that provides greater than 50 percent PM reduction for "cold" applications. It can be applied to older, dirtier engines with high PM emissions. The PCRT® System verification test has been completed. He stated that ETV provided the following advantages for the device manufacturer. (1) Data quality is assured by a third-party so there is less question and answers after testing. (2) Coordination between test labs, EPA, and the manufacturer is managed by the APCT Center. (3) EPA recognizes the process. (4) ETV verification may be an additional selling point for certain customers. (5) The ETV process can reduce the total time required to obtain verification.

Barry Liebowitz stated that New York State has had a concern with wood-fired heaters for the past five years. There is a New York State Office of the Attorney General Report entitled "Smoke Gets Into Your Lungs" that can be accessed at http://www.oag.state.ny.us/media_center/2005/aug/August%202005.pdf. It is a good report that provides an overview of the growth and use of outdoor wood-fired heaters. The heaters are often run on partial load. These heaters have limited hydronic thermal storage capacity and, when heat is not called for, inlet air staves combustion, producing high levels of smoke. With low stack heights, smoke plumes rapidly cool and stay close to the ground, which enhances the opportunity for increased exposure to wood smoke.

NYSERDA recently issued a solicitation on Energy and Environmental Performance of Biomass-fired Heating Equipment. The solicitation emphasizes both energy efficiency and emissions (fine particles and gases), compares biomass-fired technology performance to fossil fuel-fired technology performance, includes local ambient air quality studies, and encourages New York State manufacturers to develop high efficiency and low emission technologies. Barry Liebowitz provided a brief overview of the seven projects that resulted from the solicitation. (1) NESCAUM, with the University of British Columbia, is conducting spatial modeling and monitoring of wood smoke in rural New York State. (2) NESCAUM also received funding for emissions characterization of small-scale commercial boilers. This project involves energy and emissions testing of two popular wood chip boiler models using EPA Methods 5 and 28, energy and emissions testing of a redundant oil-fired boiler onsite, and local wood smoke monitoring. (3) Another project is for a commercial wood pellet boiler demonstration using a 0.5 MMBtu pellet boiler developed by Advanced Climate Technologies. Energy and emissions testing will be conducted by Clarkson University's Center for Air Resources Engineering and Science. (4) Another similar system

using a commercial 0.5 MMBtu wood chip boiler will be demonstrated. Clarkson University will conduct the energy and emissions testing. They will be looking at energy efficiency and PM emissions. (5) One project is a split wood boiler developed by Alternative Fuel Boilers, Inc., that will be tested for energy efficiency and PM emissions. (6) Brookhaven National Laboratory was awarded funding for energy efficiency and emissions performance of residential biomass heating options. They will be testing a variety of wood combustion equipment including wood stoves, pellet stoves, wood boilers, and grass pellet stoves. (7) Two grass pellet demonstrations will be conducted. A grass pellet stove will be demonstrated at Cornell University and a grass pellet boiler will undergo testing at the State University of New York Canton.

NYSERDA is finalizing agreements to work with EPA NRMRL on two OWHH models, a two-stage split wood unit, and a two-stage wood pellet system. NRMRL will be looking at gases, fine particulates, and molecular markers. NRMRL will develop market penetration scenarios and conduct a toxicology study. He briefly reviewed a chart on the percent energy efficiency and fine particle emissions for a variety of commercial boilers that indicated how European wood heating technology can produce emissions comparable to oil-fired heaters. NYSERDA will be issuing a follow-up solicitation called Energy and Environmental Performance for Improving High Efficiency Wood-Fired Heating Equipment. Barry Liebowitz recommended that participants read “Biomass Combustion in Europe” (August 2003) by Thomas Nussbaumer to get an appreciation for the combustion and emission control technology advances that have been made to commercial and residential wood-fired heating appliances in the European Union. The report can be accessed on NYSERDA’s Web Site at <http://www.nyserdera.org/Programs/Environment/EMEP/Report%2008-03%20-%20Biomass%20Combustion%20in%20Europe-complete-after%20corrections.pdf>.

Discussion

In response to various questions, Stuart Nemser of Compact Membrane Systems, Inc., stated the following.

- ✧ In all cases with 79-81 percent nitrogen, a 50-60 percent NO_x reduction was achieved for locomotives, shipboard engines, caterpillars, and generators.
- ✧ If you go above 81 percent nitrogen, energy costs increase, PM increases significantly, it is not oxidizing well, and CO increases. If you use biodiesel, which is more combustible, then you have more NO_x issues, but the PM and CO decrease.

In response to a question, Ajay Joshi of Johnson Matthey, stated that the types of applications for the PCRT® System included trash trucks, school buses, and off-road equipment that do not operate at high temperature.

BREAKOUT DISCUSSION SESSIONS

Breakout Session 1C: Water Quality and Wastewater Treatment Technologies— Technology Verification Role in Region 2

Facilitators: *Karen O’Brien, EPA Region 2*
Tom Stevens, ETV Water Quality Protection Center, NSF International

EPA Region 2 issues NPDES Permits in Puerto Rico and oversees the NPDES programs in New York, New Jersey, and the U.S. Virgin Islands. Water quality-based effluent limitations can be very stringent

and require advanced technology to meet low limits. New standards and TMDL analyses can require treatment of parameters not traditionally addressed by conventional technology. Additionally, new regulations, such as EPA's Storm Water Phase II Rule, can require that other types of discharges be addressed. Permitting authorities want to know what works, what does not work, and what operation and maintenance to require in a permit. Dischargers will propose and ask EPA for assistance with new technologies for removal, so EPA needs to be aware of new developments and validated technologies. This breakout session focused on how the ETV WQP Center's verifications of stormwater treatment, decentralized wastewater treatment, watershed protection and ballast water treatment technologies can support the region's efforts.

Concerns were raised about complying with Phase II TMDLs for nutrients and pathogens. Information is needed on the performance of catch basin inserts—how well they perform, criteria for determining when or where they are appropriate. Vendors are aggressively marketing these technologies and decision-makers do not know much about their performance. Data are also needed on the performance of low impact/greener alternatives for development. Ray Frederick noted that EPA NRMRL's facility in Edison, New Jersey, is researching permeable pavements such as interlocking blocks and porous concrete and asphalt to increase stormwater infiltration. Other technologies being tested include engineered swales, green roof designs, and rain gardens.

Tom Stevens noted that ETV, the Technology Acceptance and Reciprocity Partnership, States of New Jersey and Wisconsin, and others are evaluating the performance of stormwater treatment/control technologies. Although there are some similarities on how they evaluate these technologies, there are a number of differences as well, reflecting regional issues and drivers, as well as technical perspectives. More coordination is needed to ensure decision-makers are supplied with data that are generated in a similar manner.

Improved sampling methods and real-time monitoring devices are needed to assess flow before, during, and after storm events at construction sites. Guidance is needed for selecting appropriate low- and high-tech alternatives for controlling point-source and non-point-source stormwater discharges.

Currently, ETV is focusing on sewer rehabilitation technologies (coatings, grouts, and liners), as well as condition assessment systems. Information needs were requested by the WQP Center. A participant noted that alternatives to rehabilitation are often absent from EPA grants for wastewater treatment plants, largely due to a general absence of information on these alternatives. Ray Frederick noted that NRMRL has developed a white paper on aging infrastructure that discusses the state-of-the-science for condition assessment and identifies emerging technologies that need to be evaluated. Decision-support tools are also needed to determine when to replace, repair, or leave a line alone.

Breakout Session 2C: Air Pollution Control Technologies—Outdoor Wood-Fired Hydronic Heaters

Facilitator: *Mike Kosusko, ETV Air Pollution Control Technology Center, EPA Office of Research and Development*

The ETV APCT Center has published a protocol for verification testing of emissions reductions provided by new OWHH technologies at <http://www.epa.gov/nrmrl/std/etv/pubs/600etv08014.pdf>. ETV-verified emissions data for OWHH technologies may be used as part of an overall process that leads to a product's qualification in EPA's voluntary OWHH program and also may be used for state programs. This breakout session focused on potential interactions with ETV in the area of OWHH technologies and other residential wood burning.

Mike Kosusko stated that OWHHs emit a nasty plume of wood smoke that contributes to health problems and PM nonattainment at the state and local level. On the regulatory side, NESCAUM and their member states that include New England and New York and New Jersey were very concerned about the emissions from these heaters and were in the process of developing a model rule to control these emissions for their member states. In 2006, OAQPS decided to develop a voluntary program to improve the emissions characteristics of the heaters. In July 2007, the program was formally announced and companies signed agreements to develop lower emitting heaters. To qualify as a cleaner unit under EPA's voluntary program, a unit should emit no more than 0.60 pounds of fine particulate per MMBtu of wood input. In Phase 1, 20 vendors signed up with the program; 10 devices were qualified by OAQPS without ETV involvement. More information can be obtained on these vendors and the program at <http://www.epa.gov/woodheaters/>. As part of Phase 2, EPA looked at NESCAUM's model rule, which is 0.32 pounds per MMBtu of PM as output from the heater. This provided significant improvement in burning of wood and emissions from the heaters. ETV got involved because the current process created a large backlog in reviewing test results at OAQPS. Also, ETV published the test protocol based on the EPA Method in June 2008. EPA is trying to develop relationships with qualified test laboratories throughout the United States. It is estimated that there could be 10 to 20 verifications per year in this area. It is anticipated that the first verification test will take place in early 2009.

Mike Kosusko stated that he has been involved with an initiative started by EPA Administrator Stephen Johnson in August 2007. Administrator Johnson had been in California and made an agreement with CARB recognizing that there was a serious nonattainment issue for PM and NO_x in California's SCAQMD that required innovative technology to address. A workgroup was established in EPA and a collaborative meeting was held with California EPA, CARB, SCAQMD, and the San Joaquin Valley Air Pollution Control District (SJVAPCD). A Memorandum of Agreement (MOA) was signed for Coordination and Collaboration on Research Projects Related to New Clean Air Technologies on July 9, 2008, at the California Emerging Clean Air Technology Forum. The MOA committed the agencies to develop and test new sustainable technologies to potentially accelerate progress in meeting current and future national air quality standards. The California Emerging Clean Air Technology Forum was a collaborative effort between EPA, CARB, SCAQMD, SJVQPCD, and the California EPA to accelerate the development and implementation of technologies to achieve air quality goals. These agencies sponsored the one-day public forum, which focused on a variety of mobile and stationary source technologies. Information on this forum is available on EPA Region 9's Web Site at <http://www.epa.gov/region09/air/cecat-forum/index.html>. The innovative technologies that could be considered include hybrid electric vehicles, use of agricultural and landfill biogases, distributed electrical generation systems, fuel cells, and monitoring devices. There is interest in working with Region 2 and New York State on their nonattainment problems.

Barry Liebowitz commented that he was surprised to learn that it would be an acceptable approach to have propane afterburners for some of the outdoor wood-fired boilers. If the wood boiler is sold with a full tank of propane, most homeowners would not fill the tank when it is empty. We need to introduce the new 80-90 percent efficient technologies and pollution control technologies that work and are reasonable to take advantage of a renewable resource.

In response to a question, Mike Kosusko responded that the cost for a wood heater was around \$10,000.

WASTE SESSION 3A: SOILS, SURFACES, AND SITE CHARACTERIZATION TECHNOLOGIES

Region 2 Waste Technology Priorities

Robert Runyon, EPA Region 2, Session Chair

Robert Runyon stated that, as there are many sites within Region 2 where vapor intrusion is known or suspected, this is a good area on which to focus technology needs. Monitoring program design (multiple building scenarios, geology, and ground water), subslab monitoring (representative samples and accuracy), vapor attenuation (real-time measurement and influencing factors), and high water table environments (sampling technology, attenuation, and representativeness) are factors that may have applications for technologies being developed. No standard protocol exists in this area. There currently is no mechanism for measuring subslab concentrations without an access agreement, and soil-gas concentrations are not reliable.

ETV Verification of Advanced Monitoring Systems for Soils, Surfaces, and Site Characterization

Amy Dindal, ETV Advanced Monitoring Systems Center, Battelle; Stuart Nagourney, New Jersey Department of Environmental Protection; and Michael Brody, EPA Office of the Chief Financial Officer

Amy Dindal explained that there are multiple approaches to site characterization, and knowing the available options are important to decisionmakers. Stuart Nagourney, a member of the AMS Center water stakeholder committee, explained that the traditional approach to environmental sampling has been in place for nearly 40 years, and there are many issues with this approach, including the fact that collected data are not spatially or temporally representative. Current options for expedited data collection are costly and/or have limited availability. Onsite analysis options include field-deployable technologies, *in situ* sensors, and remote measurement systems. Current tools in the toolbox that are amenable to field application include a variety of analytical, geophysical, and/or geological tools, but all of these tools require some adjustment to traditional data quality expectations. The quality of the conceptual site model determines the quality of remediation; therefore, anything that improves the model is beneficial. Additionally, real-time monitoring is beneficial in a number of applications, including septic system monitoring and long-term stewardship of landfills. A regulatory concern of onsite data collection is whether the data are legally defensible. The New Jersey Department of Environmental Protection (NJDEP) has a plan to gain support for real-time measurements by blending these measurements into the existing state laboratory certification program. This implementation plan includes real-time measurements in the Environmental Laboratory Certification Program and a limited number of methods for certification. Currently, 10 of the 16 facilities that have applied for certification have been certified, and more than 300 NJDEP staff members have been trained.

Michael Brody explained that a remarkable amount of technologies that apply to the environment can be harnessed, and it is necessary to be fiscally efficient because issues will increase even as budgets decrease. Smart sensors can serve as breakthroughs in efficiency for water infrastructures and other environmental process controls. They can help automate responses to threats to human health and the environment. He highlighted several types of sensors and their cost and field readiness. Utah State University is focusing on sensors, deployment of sensor networks, development of new modeling tools, and cyberinfrastructure. The University of Illinois at Urbana-Champaign is investigating the selective detection and removal of conventionally difficult-to-treat and emerging pollutants; these detection methods are linked directly to treatment methods and replace conventional, expensive, and/or incomplete sensing and destruction technologies. Additionally, the university has built a prototype for a multiconta-

minant sensor to be placed on a network device. Many problems are best understood with network sensors. Timeliness of data is important and needs to be a more explicit component of data quality.

Amy Dindal provided an overview of the 56 ETV verifications completed to date for site characterization. Two areas of verification that are of interest to Region 2 are soil rapid toxicity testing and passive ground water sampling devices. The AMS Center published a joint international protocol for verification of soil rapid toxicity technologies with ETV Canada and Environment Canada. Verification testing under this protocol can occur within either country or jointly with both countries. ETV is collaborating with the Nordic Water Technology Verification Center (NOWATECH) to internationally test a passive ground water sampling device developed by a Danish vendor. An existing ETV test/quality assurance plan is being utilized for the upcoming testing, which will include controlled bench-scale laboratory testing, simulated stand-pipe testing, and field testing in groundwater wells. Additionally, several verification tests are under development at the AMS Center, including vapor intrusion and monitoring of remediation processes.

ETV Verification of Materials Management and Remediation Technologies ***Teri Richardson, EPA Office of Research and Development***

Teri Richardson explained that the new ETV Materials Management and Remediation (MMR) Center is awaiting final approval and will be coming online by the end of 2008. The center will have support from EPA's Land Remediation and Pollution Control Division and Ground Water and Ecosystems Restoration Division. The MMR Center will fill the gap left following closure of the EPA Superfund Innovative Technology Evaluation (SITE) Program. The center will examine many of the same issues as the SITE Program (e.g., soil and Superfund remediation) and address new emerging issues (e.g., construction debris, nanotechnology). Regional input into areas of focus is being sought. Verification of materials management technologies and technologies to remediate contaminated land and ground water is important where industrial or commercial activities have resulted in a legacy of hazardous constituents that limit future use of the property.

Environmental and Sustainable Technology Evaluation of Qualitative Spot Test Kits for Lead in Paint ***Julius Enriquez, EPA Office of Research and Development***

Julius Enriquez stated that verification of these test kits is being done in collaboration with EPA's Office of Pollution Prevention and Toxics (OPPT). Acknowledgment was extended to Sam Brown and Jackie Mosby, both from OPPT, who attended the presentation.

Julius Enriquez explained the dangers of lead exposure, stating that an estimated 24 million U.S. homes have significant lead hazards. The Lead Renovation, Repair, and Painting Rule concerns lead-based paint hazards created by renovation and painting activities in target housing. Under this rule, EPA must promote the development of improved test kits for lead-based paint surfaces, with limited false negative and positive rates. Current tests do not meet all of the criteria; improved test kits must be easy to use, reliable, inexpensive, fast, and meet specific limits for false negative and positive rates. EPA has implemented a two-phase process for lead test kit evaluations. In Phase 1, which is being conducted currently, commercially available kits are being evaluated by OPPT. During Phase 2, which will begin in April 2009, ETV will verify the test kits based on the criteria for the false negative and positive standards. ETV will provide the data from this verification to OPPT for the second phase of EPA's recognition program. After September 1, 2010, all test kits must meet both of the required probability criteria to be recognized by EPA.

SBIR Vendor: Development of a Reliable, Low-Cost, and User-Friendly Spot Test Kit for Leaded Paint and Dust
David Kellner, DzymeTech, Inc.

David Kellner described the Lead Test Kit developed by DzymeTech, Inc. (based in Champaign, Illinois), which uses catalytic DNA to bind to lead as a specific target and fluorescence for detection. The approach has high selectivity for Pb(II) over other metal ions, and the detection limit is 0.2 parts per billion (ppb), much less than the EPA Maximum Contaminant Level of 15 ppb. DNA is placed in the sensor housing and the sample is run through the housing to resuspend the DNA before the test. The system provides an understandable read out with time-stamped data. The drawback is the need for an expensive fluorometer, so the company is attempting to develop a colorimetric test using DNA-functionalized gold nanoparticles. Colorimetric detection is quantifiable and can be monitored by the eye or a portable colorimeter. The key to meeting the ideal performance standard is to design a sensor with tunable dynamic range, and testing has determined that this assay can be tailored to a wide range of desired thresholds. The company also is developing fluorescent sensors for uranium dioxide, copper, mercury, and cocaine.

SBIR Vendor: Field Screening Detector for Metals in Soil
James Gallup, Director, EPA SBIR Program

James Gallup presented for Mickey Frish of Physical Sciences, Inc. (PSI) (based in Andover, Massachusetts), about a metal-in-soil analyzer developed with SBIR funding. The technology is an SBIR Phase I and II technology for soil analysis. The technology was funded in 2002, and the resulting detection is 20 milligrams per kilogram (mg/kg). It is a good field screening tool but is less useful for meeting regulatory limits. The spark-induced breakdown spectroscopy technology in soil allows for the sampling of contaminants such as lead, mercury, barium, and chromium. Following a high-voltage spark that initiates a discharge, which vaporizes and then ionizes air and aerosol particles, the plasma cools and atomic emission occurs. As the plasma cools, better sampling is obtained, and the contaminant can be seen much more specifically. Good results were achieved in terms of the ability to measure the appropriate analytes, but the 20 mg/kg limit achieved restricts what can be done with the technology. At this point, this technology is not being commercialized, but there has been recent promise regarding use for homeland security applications.

Discussion

In response to several questions, David Kellner of DzymeTech, Inc., stated the following.

- ✧ Commercially available fluorometers cost approximately \$2,500, and DzymeTech is attempting to build one for \$1,000.
- ✧ Commercially available colorimeters are approximately \$500.
- ✧ DzymeTech's instrument can handle thousands of samples.
- ✧ The housing has been tested for more than a year and, in terms of life expectancy, is expected to last several years.
- ✧ The assay is expected to cost less than \$25 per test.

In response to a question, Amy Dindal explained that the ground water passive sampler has not been verified for enforcement reliability and accuracy yet, but there is an opportunity for collaboration.

Breakout Session 3A: Soils, Surfaces, and Site Characterization Technologies— Vapor Intrusion

Facilitator: *Doug Grosse, ETV Advanced Monitoring Systems Center, EPA Office of Research and Development*
Diane Salkie, EPA Region 2

Indoor vapor intrusion is the migration of contaminants from the environment into indoor air. Generally, this occurs when volatile organics or inorganic compounds have been released to the soil and ground water, which eventually migrate to the subsurface beneath buildings. Vapor intrusion is an important environmental issue for regulators, industry, and the public. This breakout session focused on a brief description of local vapor intrusion experiences and whether there are near-term opportunities for ETV verification testing in this critical area.

Doug Grosse explained that EPA ORD technical support is involved with vapor intrusion issues, and a final draft of the EPA Office of Solid Waste and Emergency Response vapor intrusion guidance document will be published soon. EPA is working with the Interstate Technology and Regulatory Council, which has developed its own vapor intrusion guidance document. Soil gas and ground water sampling are analytical options for analyzing indoor vapor intrusion, and there are three types of vapor intrusion situations: basement, crawlspace, and slab-on-grade. Temporal and spatial variability impact vapor intrusion sampling. There have been several considerations taken into account in the guidance documents that have been put forth so far. It is important to note that sampling next to a basement instead of under a basement can produce very different results, and concentrations of contaminants can be an order of magnitude different within 100 feet. This significantly increases the number of false positives and negatives. There is current interest in verification testing of vapor intrusion technologies, and vendors will be solicited. The AMS Center is interested in soliciting stakeholder input and participation.

Diane Salkie informed participants that Region 2 would like information on better modeling for vapor intrusion sites, new field sampling technologies, measurement of water table fluctuation, and how to obtain more representative samples.

The participants discussed standard technologies currently used for vapor intrusion detection, which are expensive, have unsatisfactory detection limits, and take weeks for results. An ironic issue is that the cost of sampling and assessing often is greater than the cost of mitigation; therefore, this is a programmatic struggle. To address this, screening technologies are needed that allow certain homes to be discarded from sampling. Limited resources should be used in areas that need mitigation. The current lack of standards make homeowners unwilling to drill and sample for vapor intrusion because this devalues their home. Because of interferences, the method utilized for radon cannot be used for vapor intrusion. Determining which homes are at risk and who will pay for mitigation are two more issues. Screening and models are being used to determine areas that truly are affected by vapor intrusion and not other sources. Although passive sampling technologies are available to determine whether there is a risk-based problem, they are not sensitive enough in this case. The issue of vapor intrusion is on vendors' radars, because it has become a predominant issue for stakeholders; many vendors will be at the National Forum on Vapor Intrusion in Philadelphia on January 12–13, 2009. Vendors and regulators have the same questions regarding vapor intrusion; these groups can work together to find answers and solutions.

APPENDIX A

Breakout Sessions Participant Lists

Breakout Session 1A: Water Monitoring Technologies— Beach Water Quality Monitoring

Rich Chapas
Battelle

Amy Dindal
Battelle

Mitch Erickson
U.S. Department of Homeland Security

James Gallup
U.S. Environmental Protection Agency

Doug Grosse
U.S. Environmental Protection Agency

Evelyn Hartzell
U.S. Environmental Protection Agency

Michael Jones
Strategic Diagnostics Inc.

Tom Kelly
Battelle

Peter Kent
AlloCAS, Inc.

Ray Klicius
Environment Canada

John Kushware
U.S. Environmental Protection Agency

Robert Legenhausen
POLYCONTROLS USA Inc.

John McKernan
U.S. Environmental Protection Agency

Vito Minei
Suffolk County Department of Health Services,
Division of Environmental Quality

Richard Montagna
Innovative Biotechnologies International, Inc.

Tiago Oliveira
U.S. Environmental Protection Agency

Marie O'Shea
U.S. Environmental Protection Agency

Jeff Nystrom
Industrial Test Systems, Inc.

Douglas Pabst
U.S. Environmental Protection Agency

Eric Vowinkel
U.S. Geological Survey

Breakout Session 1B: Drinking Water Treatment Technologies

Jeff Adams

U.S. Environmental Protection Agency

Bob Andoh

Hydro International

C. Bruce Bartley

NSF International

Carolyn Esposito

U.S. Environmental Protection Agency

Ray Frederick

U.S. Environmental Protection Agency

Michael Lowy

U.S. Environmental Protection Agency

Ben Slote

Reactive Innovations, LLC

Tom Stevens

NSF International

**Breakout Session 2B: Greenhouse Gas and Energy Technologies—Greenhouse Gas
Technology Areas**

Lee Beck

U.S. Environmental Protection Agency

Rico Biasetti

Renewafuel, LLC

Thomas Cook

Ctech

Sarah Eckstein

Cornell Cooperative Extension

John Filippelli

U.S. Environmental Protection Agency

Jim Foster

New York State Energy Research and
Development Authority

Tim Hansen

Southern Research Institute

Teresa Harten

U.S. Environmental Protection Agency

Barry Liebowitz

New York State Energy Research and
Development Authority

Dana Levy

New York State Energy Research and
Development Authority

Jim Mennell

Renewafuel, LLC

Teri Richardson

U.S. Environmental Protection Agency

Maggie Theroux

U.S. Environmental Protection Agency

Laine Vignona

University of Wisconsin-River Falls

**Breakout Session 1C: Water Quality and Wastewater Treatment Technologies—
Technology Verification Role in Region 2**

Jeff Adams

U.S. Environmental Protection Agency

Rick Balla

U.S. Environmental Protection Agency

Maria Clark

U.S. Environmental Protection Agency

Carolyn Esposito

U.S. Environmental Protection Agency

Evelyn Hartzell

U.S. Environmental Protection Agency

Ray Frederick

U.S. Environmental Protection Agency

Karen O'Brien

U.S. Environmental Protection Agency

Tom Stevens

NSF International

Tsan-Liang Su

Stevens Institute of Technology

Stephen Venezia

U.S. Environmental Protection Agency

Eric Vowinkel

U.S. Geological Survey

**Breakout Session 2C: Air Pollution Control Technologies—
Outdoor Wood-Fired Hydronic Heaters**

Lee Beck

U.S. Environmental Protection Agency

Lew Daly

HAPcontrol, LLC

Tim Hansen

Southern Research Institute

Ajay Joshi

JohnsonMatthey

Mike Kosusko

U.S. Environmental Protection Agency

Gaetano LaVigna

U.S. Environmental Protection Agency

Barry Liebowitz

New York State Energy Research and
Development Authority

Karl Mangels

U.S. Environmental Protection Agency

Jehuda Menczel

U.S. Environmental Protection Agency

Stuart Nemser

Compact Membrane Systems, Inc.

Brian Parker

Donaldson Company Inc.

Jenia Tufts

RTI International

**Breakout Session 3A: Soils, Surface, and Site Characterization Technologies—
Vapor Intrusion**

Robert Andoh
Hydro International

Jahwu Chou
Stevens Institute of Technology

Amy Dindal
Battelle

Greg Drames
Hydro International

James Gallup
U.S. Environmental Protection Agency

Luz Garcia
U.S. Environmental Protection Agency

Doug Grosse
U.S. Environmental Protection Agency

Bill Hagel
U.S. Environmental Protection Agency

Evelyn Hartzell
U.S. Environmental Protection Agency

Tom Kelly
Battelle

Ray Klicius
Environment Canada

Richard Koustas
U.S. Environmental Protection Agency

Matt Kreiner
Oxford Instruments

Christina Leung
U.S. Environmental Protection Agency

John Marzilli
U.S. Environmental Protection Agency

John McKernan
U.S. Environmental Protection Agency

Jeff Nystrom
Industrial Test Systems, Inc.

Teri Richardson
U.S. Environmental Protection Agency

Robert Runyon
U.S. Environmental Protection Agency

Diane Salkie
U.S. Environmental Protection Agency

Dennis Santella
U.S. Environmental Protection Agency

Kathryn Seaver
U.S. Environmental Protection Agency

Tsan-Liang Su
Stevens Institute of Technology

Laine Vignona
University of Wisconsin-River Falls

Eric Vowinkel
U.S. Geological Survey

APPENDIX B

Workshop Participant List

Hamish Adam

Boreal Laser

Jeffrey Adams

U.S. Environmental Protection Agency

Robert Andoh

Hydro International

Richard Balla

U.S. Environmental Protection Agency

LaShunta Barrow

Tetracore

C. Bruce Bartley

NSF International

Raymond Bath

U.S. Department of Homeland Security

Lee Beck

U.S. Environmental Protection Agency

Andrew Bellina

U.S. Environmental Protection Agency

Rico Biasetti

Renewafuel, LLC

Daniel Birkett

U.S. Environmental Protection Agency

George Bowker

Pinks and BB

Kim Bowman

Harvard University

Michael Brody

U.S. Environmental Protection Agency

Samuel Brown

U.S. Environmental Protection Agency

Rich Brown

Altech Environment USA

Dave Campbell

RCC International Wastewater Systems, Inc.

Robert Carvalho

U.S. Environmental Protection Agency

Gordon Cassone

Moses Chang

U.S. Environmental Protection Agency

Richard Chapas

Battelle

Tahwu Chou

Stevens Institute of Technology

Maria Clark

U.S. Environmental Protection Agency

Thomas Cook

CTech

Elizabeth Cosgrove

U.S. Environmental Protection Agency

Ramón Cruz

Partnership for New York City

Lew Daly

HAPcontrol, LLC

Michael Daly

HAPcontrol, LLC

Umesh Dholakia

U.S. Environmental Protection Agency

Amy Dindal

Battelle

Paul Dobson

Engine Control Systems

Robert Doneker

MixZon Inc.

Kathleen Drake
U.S. Environmental Protection Agency

Gregg Drames
Hydro International

Sarah Eckstein
Cornell Cooperative Extension

Julius Enriquez
U.S. Environmental Protection Agency

Mitchell Erickson
U.S. Department of Homeland Security

Trish Erickson
U.S. Environmental Protection Agency

Carolyn Esposito
U.S. Environmental Protection Agency

Metodi Filipov
Centrex, Inc.

John Filippelli
U.S. Environmental Protection Agency

Brenda Fletcher
U.S. Environmental Protection Agency

James Foster
New York State Energy Research and
Development Authority

Ken Fradkin
U.S. Environmental Protection Agency

Ray Frederick
U.S. Environmental Protection Agency

Mickey Frish
Physical Sciences, Inc.

James Gallup
U.S. Environmental Protection Agency

Philip Galvin
New York State Department of
Environmental Conservation

Luz Garcia
U.S. Environmental Protection Agency

Mozafar Ghaffari
U.S. Environmental Protection Agency

Robert Goltz
CDM Federal Programs Corporation

James Goodrich
U.S. Environmental Protection Agency

Doug Grosse
U.S. Environmental Protection Agency

Sally Gutierrez
U.S. Environmental Protection Agency

William Hagel
U.S. Environmental Protection Agency

Jan Hagiwara
U.S. Environmental Protection Agency

Tim Hansen
Southern Research Institute

Teresa Harten
U.S. Environmental Protection Agency

Evelyn Hartzell
U.S. Environmental Protection Agency

Edward Heath
New Ideas and Innovations, LLC

Roland Hemmett
U.S. Environmental Protection Agency

Scott Herndon
Aerodyne Research, Inc.

Michael Jones
Strategic Diagnostics Inc.

Ajay Joshi
Johnson Matthey

Lawrence Kaelin
U.S. Environmental Protection Agency

David Kellner
DzymeTech

Thomas Kelly
Battelle

Peter Kent
AlloCAS, Inc.

Kangwook Kim
The City of New York Department of
Sanitation

Raymond Klicius
Environment Canada

Michael Kosusko
U.S. Environmental Protection Agency

Richard Koustas
U.S. Environmental Protection Agency

Shailendra Koya
New York City Department of
Environmental Protection

Matthew Kreiner
Oxford Instruments

John Kushwara
U.S. Environmental Protection Agency

Tara Laroche
Eichrom Technologies, LLC

Robert Legenhausen
POLYCONTROLS USA, Inc.

Barbara Leiterman

Christina Leung
U.S. Environmental Protection Agency

Dana Levy
New York State Energy Research and
Development Authority

Barry Liebowitz
New York State Energy Research and
Development Authority

Jeanne Litwin
CDM Federal Programs Corporation

Charles LoBue
U.S. Environmental Protection Agency

Michael Lowy
U.S. Environmental Protection Agency

John Marzilli
U.S. Food and Drug Administration

John McKernan
Centers for Disease Control and Prevention

Craig McKim
Testo, Inc.

Jehuda Menczel
U.S. Environmental Protection Agency

James Mennell
Renewafuel, LLC

Michael Meyer
Met One Instruments, Inc.

Vito Minei
Suffolk County Department of Health
Services

Richard Montagna
Innovative Biotechnologies International,
Inc.

Jacqueline Mosby
U.S. Environmental Protection Agency

Grace Musumeci
U.S. Environmental Protection Agency

Borys Mychajliw
Emerson Process Management/Rosemount
Analytical

Stuart Nagourney
New Jersey Department of Environmental
Protection

Ravi Narayan
Cemtrex, Inc.

Stuart Nemser
Compact Membrane Systems, Inc.

Gene Newton
RCC Holdings Corp.

Jeff Nystrom
Industrial Test Systems, Inc.

Karen O'Brien
U.S. Environmental Protection Agency

Marie O'Shea
U.S. Environmental Protection Agency

Douglas Pabst
U.S. Environmental Protection Agency

Brian Parker
Donaldson Company, Inc.

Patricia Pechko
U.S. Environmental Protection Agency

Frank Princiotta
U.S. Environmental Protection Agency

Jurgen Reinmann
Environnement S.A. Deutschland

Mark Reiss
U.S. Environmental Protection Agency

Teri Richardson
U.S. Environmental Protection Agency

John Rogan
New Jersey Department of Environmental
Protection

Lisa Rogers
Mycometer, Inc.

Robert Runyon
U.S. Environmental Protection Agency

Dennis Santella
U.S. Environmental Protection Agency

Edward Schlueter
U.S. Environmental Protection Agency

Walter Schoepf
U.S. Environmental Protection Agency

Tiago Seabra de Oliveira
U.S. Environmental Protection Agency

Kathryn Seaver
U.S. Environmental Protection Agency

Paul Shapiro
U.S. Environmental Protection Agency

Jon Shein
Thermo Fisher Scientific

Joseph Siegel
U.S. Environmental Protection Agency

Jeff Silver
E Global Solutions

Benjamin Slote
Reactive Innovations, LLC

Claude Smith
RCC International Wastewater Systems, Inc.

Donna Somboonlakana
U.S. Environmental Protection Agency

Alan Steinberg
U.S. Environmental Protection Agency

Tom Stevens
NSF International

Tsan-Liang Su
Stevens Institute of Technology

Avraham Teitz
U.S. Environmental Protection Agency

Maggie Theroux
U.S. Environmental Protection Agency

Ness Tirol
U.S. Environmental Protection Agency

Hiep Tran
U.S. Environmental Protection Agency

Darrell Trueman
Engine Control Systems

Jenia Tufts
RTI International

Laine Vignona
University of Wisconsin–River Falls

Eric Vowinkel
U.S. Geological Survey

Abby Waits
U.S. Environmental Protection Agency

Aida Yanni
U.S. Environmental Protection Agency

Contractor Support

Joan Cox
The Scientific Consulting Group, Inc.

Denise Hoffman
The Scientific Consulting Group, Inc.

Kristen LeBaron
The Scientific Consulting Group, Inc.

APPENDIX C

Exhibitor List

Boreal Laser

EPA Environmental Technology Verification (ETV) Program Vendor

Verified Technology Type: GasFinder 2.0 Tunable Diode Laser (TDL) Open-Path Air Quality Monitor (verified 2000¹)

Contact: Hamish Adam

#13, 51127 Range Road 255

Spruce Grove, Alberta

Canada T7Y 1A8

Phone: (403) 271-2007

E-mail: hadam@boreal-laser.com

Web Site: www.boreal-laser.com

Boreal Laser has developed the GasScanner for multiple open path monitoring. The GasScanner was developed under a Cooperative Research and Development Agreement (CRADA) between Boreal and the EPA National Risk Management Research Laboratory to enable rapid scanning of area sources to quantify fugitive emissions of CH₄ and CO₂.²

C Tech Development Corporation

EPA Environmental Technology Verification (ETV) Program Vendor

Verified Technology Type: Environmental Visualization System Pro (EVS-PRO) Decision Support Software (verified 2000)

Contact: Thomas J. Cook

PO Box 971

Laie, HI 96762-9871

Phone: (808) 447-9751

E-mail: tcook@ctech.com

Web Site: www.ctech.com

C Tech's EVS and MVS software unite advanced gridding, geostatistical analysis, and fully three-dimensional visualization tools into a software system developed to address the needs of all Earth science disciplines. The graphical user interface is integrated with modular analysis and graphics routines, which satisfy the analysis and visualization needs of any application. The software can be used to analyze all types of analytes and geophysical data in any environment (e.g., soil, groundwater, surface water, air, etc.). Integrated geostatistics provide quantitative appraisal of the quality of site assessments and identification of optimal new sample locations at sites that require additional investigation. This technology can dramatically cut site assessment costs. Our tools improve site assessment and enhance your ability to analyze and present data for assessments, remediation planning, litigation support, regulatory reporting, and public relations.²

¹ U.S. EPA ETV verification is based on the evaluation of a technology's performance under specific, pre-determined criteria, testing conditions, and quality assurance procedures. The performance data reported by ETV are only applicable to the specific technology and model tested at the time of verification. ETV verification data cannot be used to represent the performance of subsequent models or other technologies manufactured or marketed by the vendor/developer.

² Technology description was provided by the vendor/developer. The U.S. Environmental Protection Agency (EPA) does not endorse the purchase or sale of any of the products or services mentioned in this document. U.S. EPA ETV and its cooperative verification organizations make no expressed or implied warranties as to the performance of a technology, nor do they certify that a technology will always perform or operate as verified. The views expressed by these companies are their own and do not necessarily reflect the views of the U.S. EPA.

DzymeTech, Inc.

EPA Small Business Innovation Research (SBIR) Program Vendor
Technology Type: Lead Test Kit Based on a DNA Enzyme for the Detection of Lead in Paint, Dust, Soil, and Water
Contact: David Kellner
60 Hazelwood
Champaign, IL 61820
Phone: (217) 417-6445
E-mail: dkellner@dzymetech.com
Web Site: www.dzymetech.com

DzymeTech, Inc. has developed a simple-to-use, quick test for the detection and quantification of lead in a portable, field-ready package. This test kit is based on a DNA enzyme that specifically binds lead.²

Emerson Process Management, Rosemount Analytical Liquid

EPA Environmental Technology Verification (ETV) Program Vendor
Verified Technology Type: Model WQS Multi-Parameter Water Monitor for Drinking Water Distribution Systems (verified 2006¹)
Contact: Bonnie Brown
2400 Barranca Parkway
Irvine, CA 92606
Phone: (949) 757-8536
E-mail: bonnie.brown@emerson.com
Web Site: www.railhome.com/liquid

Water is a crucial element for human activity and as demand increases with population, the re-use and proper treatment of water becomes critical. The liquid analysis professionals at Emerson Process Management can evaluate your application and deliver an optimal, real-world solution for your requirements utilizing world-class Rosemount Analytical sensors and instrumentation for chlorine measurement, pH, conductivity and water quality monitoring.²

Engine Control Systems

EPA Environmental Technology Verification (ETV) Program Vendor (verified 2004¹)
Contact: Kavitha Moorthy
165 Pony Drive
Newmarket, Ontario
Canada L3Y7V1
Phone: (905) 952-2438
E-mail: kamy@enginecontrolsystems.com
Web Site: www.enginecontrolsystems.com

Engine Control Systems Limited is a leading environmental company specializing in the design and manufacturing of verified exhaust treatment solutions. Globally, we offer a full range of products for OEM, aftermarket and retrofit markets for the reduction of exhaust emissions of on-road, off-road and stationary diesel, gasoline and alternative fuel engines, including propane and natural gas.²

Environnement S.A. Deutschland (previously bm becker messtechnik gmbh)

EPA Environmental Technology Verification (ETV) Program Vendor
Verified Technology Type: AMESA® (Adsorption Method for Sampling Dioxins and Furans) Dioxin Emission Monitoring System for Incinerator Emissions (verified 2006¹)
Contact: Jurgen Reinmann

Koelner Strasse 6
Eschborn
Germany 65760
Phone: +49 6196 936 223
E-mail: j.reinmann@environnement-sa.com
Web Site: www.amesa.eu

Environnement S.A. Deutschland has developed the AMESA® system for long-term sampling of dioxins/furans, POPs. By the usage of the AMESA® system, authorities and operators get more accurate information on the POPs emissions of domestic and hazardous waste incinerators, cement and power plants, etc. With new options, the system is also suitable for sampling of other micro pollutants such as heavy metals, mercury, and fine dust.²

HAPcontrol, LLC

EPA Environmental Technology Verification (ETV) Program Vendor
Verified Technology Type: HAPcontrol Engineered Bio-Furniture System Volatile Organic Compounds Emission Control Technology (verification in-process¹)
Contact: Lew Daly
105 Spencer Street
Syracuse, NY 13204
Phone: (315) 422-7607 (Triad Technologies, Inc.)
E-mail: ldaly@triadtec.com
Web Site: www.hapcontrol.com (under construction)

The HAPcontrol Engineered Bio-Furniture System is an energy efficient and industrially suitable green remediation solution that eliminates the installation, control, variability, maintenance, and energy costs and problems associated with classic whole-building bio-filtration and thermal oxidation. The system is based on using multiple, small artificial media biofilter cartridges contained within plant floor furnishings in the form of Bio-Tables, Bio-Walls, and Bio-Panel enclosures located adjacent to the pollutant release point. The tabletop exhibit uses scale Bio-Furniture modules to illustrate a variety of configurations used for localized closed-loop remediation of typical process-generated airborne pollutants, such as from acetone, BTEX, formaldehyde, styrene, and other organic compounds.²

Hydro International

EPA Environmental Technology Verification (ETV) Program Vendor
EPA Small Business Innovation Research (SBIR) Program Vendor
Verified Technology Type: Up-Flo™ Filter with CPZ Mix™ Filter Media In-Drain Treatment Device; Downstream Defender®, 6-foot Diameter Stormwater Treatment Technology (verified 2007¹)
Contact: Gregg Drames
94 Hutchins Drive
Portland, ME 04102
Phone: (207) 756-6200
E-mail: stormwaterinquiry@hil-tech.com
Web Site: www.hydro-international.biz

The Downstream Defender® advanced vortex separator and Up-Flo™ Filter fluidized bed filtration system are used to manage stormwater runoff. With unique design features, these technologies deliver optimal performance in a small footprint.²

Industrial Test Systems, Inc. (ITS)

EPA Environmental Technology Verification (ETV) Program Vendor

Verified Technology Type: Quick™, Quick II™, Quick™ Low Range, Quick™ Low Range II, and Quick™ Ultra Low II Test Kits for Analysis of Arsenic in Water; Cyanide ReagentStrip™ Test Kit for Detecting Cyanide in Water (verified 2002, 2003, 2005¹)

Contact: Robin Locklair

1875 Langston Street

Rock Hill, SC 29730

Phone: (803) 329-9712

E-mail: rlocklair@sensafe.com

Web Site: www.sensafe.com

Industrial Test Systems, Inc. (ITS) features an array of ETV-verified arsenic and cyanide water tests that provide accurate results at affordable prices. As an innovator of environmental test products, ITS currently is involved in the development of safe, accurate, easy, and affordable lead in paint and soil tests.²

Met One Instruments, Inc.

EPA Environmental Technology Verification (ETV) Program Vendor

Verified Technology Type: BAM 1020 Continuous Ambient Fine Particulate Monitor (verified 2001¹)

Contact: Michael B. Meyer

1600 NW Washington Boulevard

Grants Pass, OR 97526

Phone: (541) 471-7111

E-mail: mbmeyer@metone.com

Web Site: www.metone.com

Met One Instruments, Inc. has developed the BAM-1020 Beta Attenuation PM-2.5 Mass Monitor. Met One Instruments, an ISO 9001:2000 registered company, designs and manufactures weather and particle measurement instrumentation and systems. Products include meteorological sensors/stations, handheld/portable aerosol monitors, and particulate matter (PM) regulatory air samplers/monitors. Our BAM-1020 Monitor is the first continuous PM-2.5 particulate monitor to receive U.S. EPA Class III Federal Equivalent Method (FEM) designation (EQPM-0308-170). The BAM-1020 Monitor is the only regulatory beta gauge manufactured in the United States.²

Physical Sciences, Inc.

EPA Small Business Innovation Research (SBIR) Program Vendor

Technology Type: Compact Laser-Based Sensors for Remote Detection of Gases and Vapors

Contact: Mickey Frish

20 New England Business Center

Andover, MA 01810

Phone: (978) 738-8252

E-mail: frish@psicorp.com

Web Site: www.psicorp.com

Physical Sciences, Inc. develops highly sensitive gas sensors based on Tunable Diode Laser Absorption Spectroscopy for environmental and other applications: (1) Remote Methane Leak Detector for natural gas pipeline leak surveying, and (2) Vapor-Phase Hydrogen Peroxide Sensor for building decontamination.²

Renewafuel, LLC

EPA Environmental Technology Verification (ETV) Program Vendor

Verified Technology Type: Renewafuel Pelletized Wood Fuel for Biomass Co-Firing with Coal in

Industrial Boilers (verified 2008¹)
Contact: James A. Mennell
1100 Superior Avenue
Cleveland, OH 44114-2544
Phone: (612) 623-2360
E-mail: jmennell@renewafuelllc.com
Web Site: www.renewafuelllc.com

Renewafuel, LLC develops innovative biomass fuel products for use as a “green supplement” in place of coal at the University of Iowa’s power plant. This exhibit highlights the ability of industrial and institutional facilities to use Renewafuel’s products to supplement or replace coal without capital modifications, and achieve significant environmental benefits while maintaining boiler efficiency. Demonstrated environmental benefits include significant creditable reductions of carbon dioxide, sulfur dioxide and acid gases compared to coal. The exhibit also highlights positive energy balance associated with production and use of Renewafuel’s products and significant life-cycle greenhouse gas reductions compared to fossil fuels.²

Strategic Diagnostics, Inc.

EPA Environmental Technology Verification (ETV) Program Vendor
Verified Technology Type: RaPID Assay® Kit for Analysis of Atrazine in Water; Deltatox®, Microtox®, and RAPIDTOXKIT Rapid Toxicity Testing Systems; and D Tech, EnviroGard, and RaPID Assay System for Measurement of Polychlorinated Biphenyls (PCBs) in Soils and Solvent Extracts (verified 1998, 2003, 2004, 2006¹)
111 Pencader Drive
Newark, DE 19702
Phone: (302) 456-6789
E-mail: sales@sdix.com
Web Site: www.sdix.com

Strategic Diagnostics, Inc. is a market leader in developing and manufacturing rapid and accurate testing technologies for both onsite and laboratory use in environmental, remediation, water quality, and industrial applications. Testing methodologies are available for toxicity, priority pollutants (including PCBs), pesticides, PAHs, petroleum hydrocarbons (BTEX/TPH), TNT/RDX, heavy metals, and many other common testing parameters. Many of Strategic Diagnostics’ products have been used in the Triad approach onsite assessment and remediation projects and are featured on the web site www.triadcentral.org. Customers benefit from being able to make smart decisions with rapid and accurate results, as well as from outstanding return on investment versus competing alternatives.²

Testo, Inc.

EPA Environmental Technology Verification (ETV) Program Vendor
Verified Technology Type: Model 350 Portable Emissions Analyzer for Determining Nitrogen Oxides and Combustion Emissions (verified 1999, 2003¹)
Contact: Craig McKim
40 White Lake Road
Sparta, NJ 07871
Phone: (862) 354-5001
E-mail: craig@testo.com
Web Site: www.testo350.com

Nitrogen Oxides (NOx) testing with the Testo 350 Portable Emission Analyzer is easier and more affordable than ever. Numerous options like Testo’s exclusive LOW NOx and LOW CO sensors,

patented CO dilution systems, on-board sample conditioning and powerful reporting software lets you configure the ideal emission analyzer for your specific testing requirements. Exclusive sensor design and over 40 years experience are among some of the reasons the Testo 350 is an excellent choice for your emission testing needs.²

Tetracore, Inc.

EPA Environmental Technology Verification (ETV) Program Vendor

Verified Technology Type: BioThreat Alert® Test Strips and Enzyme-Linked Immunosorbent Assay (ELISA) Test Kits for Biotoxins in Water (verified 2004¹)

Contact: Brian Kijowski

9901 Belward Campus Drive, Suite 300

Rockville, MD 20850

Phone: (240) 268-5400

E-mail: bkijowski@tetracore.com

Web Site: www.tetracore.com

Tetracore creates and develops highly innovative diagnostic reagents and assays for infectious diseases and bio-terrorism threat agents.²

Thermo Scientific NITON Analyzers

EPA Environmental Technology Verification (ETV) Program Vendor

EPA Small Business Innovation Research (SBIR) Program Vendor

Verified Technology Type: XL Spectrum Field-Portable Analyzer for Measurement of Metals in Soil; XL-300 Series, XL-700 Series, and XLt-700 Series X-Ray Fluorescence (XRF) Spectrum Analyzers for Measurement of Lead in Dust (verified 1998, 2002, 2003¹)

Contact: Jon Shein

900 Middlesex Turnpike, Building 8

Billerica, MA 01821

Phone: (978) 670-7460

E-mail: jon.shein@thermofisher.com

Web Site: www.niton.com

Handheld Thermo Scientific Niton XL3 Series environmental analyzers are the world's leading field-portable XRF instruments for nondestructive chemical analysis. The pre-set factory calibration provides simultaneous analysis of up to 25 elements, in any bulk material, with no requirements for onsite calibrations or standards. Niton® XRF analyzers were initially developed, in part, by two rounds of SBIR funding, have been verified in rounds of ETV testing, and have participated in the EPA Superfund Innovative Technology Evaluation (SITE) Program. They have been core components of two EPA EMPACT projects, the Region 1 Lead Safe Yard technology transfer, and the Region 2 Syracuse Lead Dust Outreach, Monitoring and Education Project. The instrument's software adjusts the electronics "on the fly" to produce maximum count rate, as well as correcting automatically for variations in soil-sample chemistry and density, reducing the need for site-specific calibrations. Niton® analyzers comply with EPA Method 6200 for in-situ soil testing, and contain wireless Bluetooth™ interface for connection with peripheral devices. The Niton® XL3 can test in virtually any substrate and provides instant results for air filter loading and dust wipe analysis.²

U.S. EPA Environmental Technology Verification (ETV) Program

Contact: Abby Waits

26 W. Martin Luther King Drive, MS 208A

Cincinnati, OH 45268

Phone: (513) 569-7884

E-mail: waits.abby@epa.gov

Web Site: www.epa.gov/etv

EPA's ETV Program was established in 1995 to speed the implementation of new, improved environmental technology to solve high-risk environmental problems. ETV develops testing protocols and verifies the performance of commercial-ready innovative technologies that have the potential to improve protection of human health and the environment. The goals of the ETV Program are to accelerate the entrance of new environmental technologies into the domestic and international marketplace, and to provide credible, high-quality data on the performance of promising environmental technologies for the benefit of purchasers, permittees, vendors, and the public.

U.S. EPA Small Business Innovation Research (SBIR) Program

Contact: James Gallup

Ariel Rios Building (8722F)

1200 Pennsylvania Avenue, NW

Washington, DC 20460

Phone: (202) 343-9703

E-mail: gallup.james@epa.gov

Web Site: www.epa.gov/ncer/sbir

EPA's SBIR Program is an important part of EPA's research and development efforts and helps the Agency achieve its mission to protect human health and safeguard the natural environment. Through the SBIR Program, EPA makes awards to small, high-tech firms to help develop and commercialize cutting-edge environmental technologies. SBIR is intended to support the development of environmental technologies that ultimately will be commercialized and improve our environment and quality of life, create jobs, increase productivity and economic growth, and improve the international competitiveness of the U.S. technology industry.