U.S. EPA Environmental Technology Verification (ETV) Program
Advanced Monitoring Systems (AMS) Center

Air Stakeholder Committee Meeting
Thursday, February 22, 2007
Sacramento, CA

Meeting Minutes

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Attendees

Stakeholder Committee Members:
Jeff Cook, California Air Resources Board
Chuck Dene, EPRI
Rudy Eden, South Coast Air Quality Management District
Philip Galvin, New York State Department of Environmental Conservation
Tom Logan, EPA
Will Ollison, American Petroleum Institute
Roy Owens, Owens Corning
Lindene Patton, Zurich North America (phone-in)
Donald Stedman, University of Denver

Observers:
Jeff Wright, California Air Resources Board
Ahmed Mehadi, California Air Resources Board
Rebecca Neumann, California Air Resources Board

EPA/Battelle ETV Program Staff:
Bob Fuerst, EPA
Teresa Harten, EPA
Elizabeth Hunike, EPA
Amy Dindal, Battelle
Ryan James, Battelle
Gretchen Hund, Battelle
Tom Kelly, Battelle (phone-in)

Guest Speakers:
Kevin Cleary, California Air Resources Board
Larry Larsen, California Air Resources Board

Welcome, Agenda and Meeting Objectives

Gretchen Hund welcomed the stakeholders and observers to the meeting. Ms. Hund thanked Jeff Cook for hosting the meeting at the California Air Resources Board (CARB). She reviewed the agenda, and stated that the objectives for the meeting were similar to past meetings where the focus will be on verification testing progress and identifying priority technology categories for verification. Ms. Hund also noted that there will be two speakers from CARB, Kevin Cleary and Larry Larson, who will present on their respective programs.

Stakeholder Introductions

For the benefit of the observers, each stakeholder introduced him or her self and described his or her role within his or her organization and interest in air monitoring.

ETV Program Update and Sustainability Thoughts

Ms. Teresa Harten, Director of EPA's ETV program, provided an update on the ETV program. She began with a brief background on the ETV program and its successes, noting that it provides technology performance information that is critical to federal, state, and local agencies. Collaborations and vendor cost-sharing leverage ETV, generating approximately 40-50 percent of the total funds for the program. Ms. Harten further described that there have been 381 technology verifications and 85 generic protocols completed through the ETV program since 1995. Over 300 stakeholders are active in advisory groups and technical panels across the ETV program, and internet and worldwide interest in the program has resulted in greater than three million hits per year on the ETV web site, with interest continuing to grow.

Ms. Harten also stated that new case study booklets have been produced that document technology verifications and project future outcomes resulting from these verifications. She went on to describe a specific case study from one of the booklets, the verification testing of diesel retrofit technologies. Seven technologies were tested as part of this verification test, with six of them qualifying for EPA Office of Transportation and Air Quality (OTAQ) grant programs, such as the Clean School Bus Grant Program. As a result of the verification testing, at least 1,345 diesel retrofit technologies were sold. Ms. Harten pointed out that, over a seven-year period, because of these purchases, six to nine tons of particulate matter (PM) would be reduced and one life and $3-5 million would be saved, based on risk reduction extrapolations using EPA's regulatory analysis for the Highway Diesel Rule. Over seven years at 10 percent projected market penetration, 9,000 to 31,000 tons of PM will be reduced, $4-16 billion will be saved, and 683 to 2,380 people will avoid premature mortality.

Ms. Harten then proceeded to discuss graphical representations of statistics of the ETV program over the years. In a bar graph detailing ETV program verifications and funding sources, she showed how ETV base program funding has declined over the years, peaking in 1998 at just under $10 million and declining to approximately $2 million in 2006. The number of verifications has also decreased as base funding has declined, peaking at 57 verifications in 2000 and decreasing to 13 in 2006. Funding from other sources (not including in-kind contributions),

began contributing to ETV program funding in 1997 when the first verification tests were conducted and has continued in varying amounts over the next nine years. Ms. Harten then showed how the average time for completion of a verification test has increased over the years, taking from approximately 15 months in fiscal year 2002 to approximately 21 months in fiscal year 2006. Ms Harten stated that increased collaborations have likely increased the time for verification.

The average cost per verification test or protocol development has varied over the past eight years (1998-2006), ranging from $80,000 to $300,000. Funding outside of ETV base program funding has also varied over time, though outside funding has increased over the past few years. Cost-sharing, cash or in-kind support from outside groups, is also a significant source of support for the ETV program. Ms. Harten showed how cost-sharing contributions to verification tests have varied between fiscal years 2002 and 2006. Direct funding, or cash, from other organizations has accounted for 25 percent to 85 percent of the total cost-share on verification tests and totaled $840,000 in fiscal year 2006. In-kind support has consistently exceeded cash contributions, sometimes by as much as double (in fiscal year 2006). In-kind support has accounted for approximately 40 percent to 47 percent of the cost share in verification tests and ranged from $1.3 million to $2 million in estimated cash value.

Ms. Harten then turned her attention to the idea of sustainability. To better understand this area, she provided example sustainability metrics: recyclability, reusability, toxics use, resource (i.e., renewable or non-renewable), and life cycle analysis and impact analysis. Ms. Harten indicated that adding sustainability criteria to ETV verification tests would be ideal, but there are challenges. There would have to be agreement, through the use of the stakeholder process, on the appropriate sustainability criteria and how to measure and report these criteria. There would be additional costs associated with verification for these sustainability criteria. Also, the ETV program has been based on the fact that it provides third party testing data of a known quality. Ms. Harten indicated that sustainability criteria will rely largely on self-reporting by vendors, which means that the data for these criteria will be of an uncertain quality as they would not be a direct product of the ETV verification test. She pointed out that there would also be delays in reporting because of the likely challenges by vendors to presentation of the sustainability criteria results. It was pointed out that that AMS Center has often included sustainability criteria in its reports but has not called them “sustainability”. It was agreed that the AMS Center should increase its focus on specifically calling out sustainability criteria.

Current and Future Impact of the ETV Program

Due to time constraints, this session was delayed for discussion in conjunction with the “Developing Technology Categories” discussion in the afternoon. Ms. Amy Dindal, Battelle AMS Center program manager, asked the stakeholders to respond to the “homework” questions that were sent to the stakeholders before the meeting:

- What is one area in your field of expertise that has benefited from ETV tests? What direct results/benefits have you noted?

- In what other areas might ETV be able to make an impact? Where could an ETV test really be beneficial?

Ms. Dindal noted that the Lodi Truck Study (presented by Larry Larson) was a good example of the benefit of the ETV results from the ambient particulate monitoring (PM) test. Mr. Rudy Eden noted that his organization (South Coast Air Quality Management District (SCAQMD) benefited from the NOx reports that were completed under ETV. The stakeholders also noted that the verification of poor performance of technologies in general was a direct benefit. Others areas where ETV might make an impact were discussed in terms of future technology categories (see discussion on "Next Technology Categories").

AMS Center Update

Ms. Dindal provided an AMS Center update. She reported that, over its 10-year existence, 121 verification reports have been completed by the AMS Center. In addition, 22 test/QA plans have been completed, 37 stakeholder meetings have been held, and 84 AMS Center newsletters (*The Monitor*) have been published. She also said that seven technology verifications are currently in various stages of progress and numerous are under development. Ms. Dindal then listed the technology categories that the AMS Center has tested. Of the 121 verified technologies, 54 have been air monitoring technologies and 67 have been water monitoring technologies. Technologies verified by the AMS Center have ranged from ambient ammonia monitors to dioxin emissions monitors to atrazine ELISA test kits to on-line turbidimeters. Within each technology category, anywhere from one to 13 technologies have been verified by the AMS Center. There are six current, on-going AMS Center verification tests: mercury emission monitoring systems (four technologies), personal cascade impactor sampler (one technology), beach monitoring samplers (protocol development only), multi-parameter water sensors (one technology), ballast water exchange screening tools (one technology), and soil rapid toxicity technologies (protocol development only).

Ms. Dindal described recent outreach initiatives by the AMS Center: the November issue of *The Monitor* was distributed, AMS Center staff attended the February 7 Ohio Harmful Algal Bloom Focus Group Workshop as well as the February 11-14 National Air Quality Conference, and a manuscript to *Environmental Science and Technology* was in progress. Ms. Dindal also highlighted the support the AMS Center has received over its existence. This includes $685,000 in vendor contributions, $581,000 in cash co-funding from collaborators, and $3.68 million in in-kind support. Recent verification tests have been co-funded at or near 100 percent and vendor cost-share is increasing in certain market segments. Ms. Dindal noted that any new verification test must have funding support. She also indicated that stakeholders will be critical in the sustainability of the AMS Center. To this end, the stakeholders must continue to identify pressing environmental monitoring needs, identify and/or provide testing collaborations, and continue to take an interest in the AMS Center and its activities.

Verification Status: Mercury Emission Monitoring Systems

Ms. Dindal presented information on the verification test for mercury continuous emission monitoring (CEM) systems. She acknowledged the support of the Illinois Clean Coal Institute, the Northern Indiana Public Service Company, and EPA's Office of Research and Development for the mercury test. She started by providing a background on mercury monitoring requirements, indicating that the Clean Air Mercury Rule requires that all utility plants emitting more than a minimal amount of mercury begin reporting stack gas mercury levels by January 1, 2009. Only total vapor phase mercury is required to be monitored. Ms. Dindal also noted that a cap-and-trade system for mercury emissions is being implemented, but that states are free to choose other approaches for addressing mercury emissions. She then discussed the two different types of mercury monitoring systems that are acceptable for monitoring under 40 CFR Part 75: CEMs and sorbent systems. CEMs consist of a sample probe, umbilical line, gas conditioner analyzer, and a calibration source. As the name suggests, CEMs can monitor continuously (or nearly so) and can report elemental mercury, oxidized mercury, and total mercury. Sorbent systems collect mercury onto charcoal sorbent traps that are inserted directly into the stack. The traps are subjected to mercury analyses after collection and typically only measure total mercury.

The ETV verification test of mercury CEMs occurred June 12 to July 25, 2006 at Unit 17 of the R.M. Schahfer plant of NIPSCo, near Valparaiso, Indiana. Two CEMs, one from Tekran Instruments and one from Thermo Electron, participated in the test. Two sorbent sampling systems also participated in the verification test, one from Apex Instruments and one from Environmental Supply Company. Ms. Dindal said that Unit 17 of the R.M. Schahfer plant burns Illinois subbituminous coal, and has an electrostatic precipitator (ESP) and a wet flue gas desulfurization (FGD). Typical stack conditions at this unit are 130 F, 100 parts per million (ppm) NO_x, 200 ppm SO_x, and 15 percent water. The mercury emissions from the unit are approximately 1 $\mu g/m^3$ total mercury, with greater than 90 percent being elemental mercury.

Ms. Dindal then provided details on the verification test. She said that for the sorbent sample analysis, Environmental Supply purchased traps and analysis from Frontier Geosciences. The traps were pre-spiked with mercury, and the analysis was performed via extraction and laboratory cold vapor atomic adsorption (CVAA) spectroscopy analysis. Apex Instruments purchased traps and analysis from Ohio Lumex. The traps were pre-spiked with mercury and the analysis of the samples consisted of pyrolizing the charcoal to drive off the collected mercury into a Lumex RA-915+ mercury analyzer. Ms. Dindal indicated that a set of performance parameters were verified as part of the verification test. These parameters were accuracy, time response, seven-day calibration drift, linearity, data completeness, operational factors, and cost. Accuracy was measured with regards to the Ontario Hydro (OH) method. For this method, two sets of 12 two-hour runs were analyzed. Two separate OH method sampling periods were conducted, one from June 12-15 and the other from July 10-13. Ms. Dindal said that both relative accuracy and the absolute difference of the mean results were determined for the accuracy parameter and that linearity was only determined for the CEM samplers.

Ms. Dindal then provided some results from the mercury CEMs verification test. Because the ETV program does not compare technologies, the technologies for this category are referred to

as CEM A, CEM B, Sorbent C, and Sorbent D. Ms. Dindal said that CEM A operated throughout the six-week field period of testing, including both OH methods reference periods. CEM B arrived late in the field, had numerous problems that limited its period of operation, and only participated in the second OH method reference period. Sorbent C operated without problems in the first OH method reference period. Sorbent D had traps that were fragile and non-uniform with a heavy sampling probe. It only was operated during the second OH method reference period. (Sorbent C and Sorbent D each were operated during one reference sampling period due to limited sampling ports in the stack.) Ms. Dindal then provided the relative accuracy results. Relative accuracy for total mercury was 21.2 percent on average for the two CEM technologies and 28.1 percent for the two sorbent technologies. Average relative accuracies for elemental mercury were similar. Ms. Dindal then presented accuracy results as a difference of means for the four technologies. Results ranged from -0.264 to 0.108 $\mu g/m^3$ for the CEM samplers across all types of mercury monitored (total, elemental, and oxidized). Corrected total mercury sorbent sampler differences were 0.243 and 0.162 $\mu g/m^3$.

Ms. Dindal reported on other results for the CEM technologies. The time response was between 5 and 10 minutes for the two CEMs while the seven-day calibration shift was up to 1.3 percent and 3.1 percent of the 10 $\mu g/m^3$ scale. Linearity was similar for both CEMs, within approximately 7 percent. Data completeness ranged for all four technologies throughout the verification test. Completeness results were between 28 percent for valid CEM data and 100 percent for operating CEM data. Purchase prices were lower for the sorbent technologies ($10,000 to $19,000) and higher for the CEMs ($125,000 each).

Ms. Dindal said that final revisions have been made to all four technology verification reports in response to vendor, peer reviewers, EPA administrative reviewers, and EPA science policy reviewer comments. The verification reports and statements have been signed by a Battelle representative and were submitted to EPA in February 2007 for EPA's final approval.

CARB's Innovative Clean Air Technologies (ICAT) program

Mr. Kevin Cleary of CARB gave a presentation on CARB's Innovative Clean Air Technologies (ICAT) program. Mr. Cleary said that the purpose of ICAT is to promote emissions reductions, CARB initiatives, and the California economy by co-funding field demonstrations of new, beneficial technologies such as emissions control and emissions monitoring and measurement technologies. He then discussed capital availability as it relates to the development phase of a new technology. More specifically, as the phase of technology development progresses from idea to prototype, capital availability decreases but regains momentum through the demonstration and commercial sales phases.

Mr. Cleary listed the technology eligibility criteria for the ICAT program. The technology must be a new emissions control technology, show an increase in capability, be a new application of a control, or be a cost reduction of a useful control. The technology should be advanced in research and development but not be commercially available yet. It must reduce criteria, toxic, or greenhouse gases in California and must also be marketable and cost-competitive. He said that ICAT funds up to 50 percent of the projects costs for development of a technology. The grantee

pays for 10 percent of the project costs with cash while ICAT pays for the labor, fringe benefits, materials and supplies, subcontractor costs, and travel costs; however, ICAT does not pay for equipment or overhead, and there are conditions on the payment to the grantees.

When selecting grantees, Mr. Cleary indicated that there are various criteria that the ICAT program considers, including the stage of the technology's development, the potential air quality benefits, the applicant's credentials, the commercial potential of the technology, and the quality of the project. Grants have been awarded to 56 projects under the ICAT program since 1994, with an average grant amount of $203,000. In fact, 12 new projects are set to start this year. The 24 completed projects include electrically-regenerated diesel particulate filter for school buses, paint resin produced from vegetable oils, and a staged combustion low-NO_x boiler burner.

Mr. Cleary then detailed the overall ICAT program process, which he said begins with a public solicitation for ideas. Next, pre-proposals are screened; selected pre-proposal authors are invited to submit a full proposal. The proposals go through a review process, ending with Board approval of the selected grants. Once selected, a grantee has certain responsibilities under the ICAT program. The grantee must hold a kick-off meeting in California, submit quarterly progress reports, host site visits (as requested), submit a final report, and hold a post-project seminar in California. Mr. Cleary then provided an overview of the new ICAT grants in 2006, which include diesel particulate matter (DPM) measurement using electrostatic charging, laser induced incandescence for soot measurement, a solid NH_3 storage system for selective catalytic reduction, an acoustic sensor for filling liquefied petroleum gas storage tanks, and a closed-loop combustion control system for microturbines.

Mr. Cleary then discussed the possibility of an ICAT/ETV collaboration. He said that this was an opportunity to collaborate on worthy projects of mutual interest. Mr. Cleary said that the programs could leverage funding, allowing both programs to expand their understanding and pool of potential applicants. Candidates for this collaboration would go through the ICAT program process. Ms. Harten said that the announcement of the ICAT solicitation could be added to the ETV program's monthly listserv (ETVoice). Ms. Dindal said she would send the ICAT announcement to the AMS Center email database. To learn more about the ICAT program, interested parties can visit their web site at www.arb.ca.gov/research/icat/icat.htm.

Verification Status: Soil Rapid Toxicity Technologies

Ms. Dindal provided an overview on the status of the rapid soil toxicity verification test. As background, she said that soil toxicity testing helps to screen sites for areas of concern and monitor cleanup effectiveness. A broad range of screening technologies may respond to many toxic compounds as this is a non-selective technique. Traditional soil toxicity tests like seed germination, or earthworm survival, can take weeks to provide a result, unlike the rapid soil toxicity technologies which can provide screening results in hours.

Ms. Dindal then provided an update on the status of the verification test. She said that stakeholder concurrence has been received on this category. Co-funding for developing the testing protocol has been received from EPA's Office of Solid Waste and Emergency Response

and several vendors have expressed interest in participating in a verification test. However, co-funding is needed to proceed with testing. The level of co-funding needed for a test of these technologies would depend on the scale of the test. Ms. Dindal said that there are six interested vendors: Cybersense, Abraxis, Assure Controls, Fisher Scientific, Strathkelvin Instruments, and Crown Biosystems. These technologies range from luminescent bacteria to a respirometer.

Ms. Dindal said that a generic protocol was under development for the rapid soil toxicity technology category. Input has been received from external peer reviewers. Ms. Dindal then discussed some likely components of a rapid soil toxicity verification test. A major component of the test would be to determine what contaminants technologies are sensitive to and what the detection limits of each technology is. Also, environmental, "real world" samples would be used. Other possible components of testing would be to assess whether the technology can be used to estimate the extent to which the contaminants being tested for are bioavailable. Another potential component of testing would be to assess bacterial remediation approaches, that is, can the technology predict how well bacteria applied for site remediation are working. There are, however, pros and cons to including each of these factors as part of a verification test. Other considerations for the protocol include prioritizing the test to stay within the vendor/co-funding budget, determining what a standard application of the technology is for most vendors, and determining what end-users want evaluated the most. To the latter point, the stakeholders commented that the protocol should be focused on determining if the technologies can be used as a quick screen for toxic components and stay away from the bioavailability and bacterial remediation aspects which they viewed as separate protocols. Ms. Dindal said that the generic protocol will be ready for EPA and external reviewers in March. The AMS Center expects several vendors to sign up once the protocol is finalized. Test/QA plan development will begin at that time, after vendor co-funding has been received. Questions on the soil rapid toxicity test can be directed to Ms. Mary Schrock who is the Verification Test Coordinator (614-424-4976, schrock@battelle.org).

Lodi Truck Study Activities

Mr. Larry Larsen of CARB discussed activities from the Lodi Truck Study in a presentation titled "Freeway-based Diesel Signature Study: Pilot Study Results and Plans for Full-Scale Study." Mr. Larsen first gave a background on the study. He said that a substantial percent of statewide risk from toxic air contaminants is from DPM; however there is not a generally accepted method for quantifying ambient DPM concentrations. Mr. Larsen said that a relatively inexpensive approach using continuous instruments offers advantages and was successfully tested in a 30-day pilot study of this program. Preparation for a full-scale, freeway-based diesel signature study is almost complete, with sampling set to begin in October or November of 2007.

Mr. Larsen then discussed the freeway-based diesel signature study in more detail. He said that the approach for this study seeks to quantify DPM in California communities based on easily measurable air quality data. The study measures air quality near a freeway for which counts of diesel and gasoline vehicles are known by hour. Study data is then used to identify a diesel signature and develop a simplified source-apportionment method to determine DPM using air quality data only. Mr. Larsen said that the overall study is divided into several stages. First, lab

testing was conducted to gain additional familiarity with key instruments, specifically the aethalometers (for black carbon) and the PAS2000s (for particle-bound polycyclic aromatic hydrocarbons (PAH)). Next, a pilot study was conducted to answer basic technical questions. The results of the pilot study supported committing resources for a full-scale study. The full-scale study is the final stage in the overall study and, as Mr. Larsen indicated, should begin sampling late winter or early spring and continue sampling for 12 months.

Mr. Larsen then discussed the pilot study in more detail. The pilot study objective was to assess field performance of black carbon and PAH monitors, including determining limits of detection (LODs) and precision of the monitors (the Aethalometer and the PAS2000). Mr. Larsen noted that, according to the results of the pilot study, the LODs were well below all measured ambient contaminant concentrations while the signal for both monitors was approximately five times greater than the uncertainty. It was also clear from this study that traffic does indeed make enough black carbon and PAHs to be measured. Mr. Larsen said that the performance of the instruments in the pilot study supported their use for a full-scale study.

Finally, Mr. Larsen discussed additional insights that were gained from the pilot study. He said that the pilot study data suggest that PAH and black carbon ratios are significantly different for diesel vehicles compared to gasoline vehicles. The pilot study data further suggest that PAH-to-black carbon ratios for diesel and gasoline vehicles can be used to quantify diesel black carbon through a simplified source apportionment model. Mr. Larsen said that a full-scale field study is being planned. Equipment has been purchased and materials already committed to the effort; however site logistics still needed to be worked out. The study is expected to start around March 15, 2007 and on or after December 31, 2007 as data will be collected for the summer and winter seasons. The study is expected to be completed in April 2008 with reports and publications to follow. Mr. Stedman very strongly suggested adding CO_2 monitoring capability to that program in view of the fact that with the aid of CO_2 data one can directly compute emissions per unit of fuel burned.

Technology Categories under Development

Ms. Dindal discussed technology categories under development by the AMS Center. There are six current or developing air technology verifications including emission characterization system for semiconductor applications; continuous PM monitoring systems; ambient ozone monitors; selected ion flow tube mass spectrometry (SIFT-MS); remote leak detection devices; and radio frequency identification devices. Ms. Dindal went on to briefly discuss each technology category.

Applied Materials is the vendor for the emissions characterization system for semiconductor applications verification test. The technology is the Integrated Platform for Emissions Characterization (IPEC). It uses a Fourier Transform infrared (FTIR) and quadrupole MS for the detection of toxic emissions from semiconductor processing, such as HF, NF_3, and SF_6. The vendor is contributing nearly 100 percent of the funding for testing. Ms. Dindal indicated that this technology might be the subject of a joint verification with the Air Pollution Control

Technology Center of ETV, to address both monitoring and emission control components of the technology.

A request for continuous PM monitor vendors was issued in a recent AMS Center newsletter and through the ETV web site. Ms. Dindal said that a few mixed responses were received. Interested vendors include Thermo Electron, Land Instruments, and MSI. The stakeholders commented that the PM monitors category can be split into ambient PM monitors and source PM monitors. The ambient PM monitors should be portable hand-held units, while the source PM monitors should focus on utility industry applications.

For ambient ozone monitors, an ETV verification has been requested by Optec, Inc., a Russian company. This technology is for ambient monitoring and is based on solid-phase chemiluminescence. Ms. Dindal noted that, coincidentally, there is interest in further evaluation of ambient ozone monitors currently used in network applications, with possible potential collaborations available with the American Petroleum Institute. Stakeholders provided concurrence in proceeding with this category.

Syft Technologies of New Zealand is interested in verification of its selected ion flow tube mass spectrometry (SIFT-MS) technology, the Voice-100 SIFT-MS. Ms. Dindal said that the vendor described the technology as utilizing precisely controlled chemical ionization reactions to detect and quantify trace amounts of volatile organic compounds (VOC). Ms. Dindal then described the operation principles of the technology, which involves the generation of positive ions, ion selection, reaction of the ions with the introduced sample, and detection of the selected reaction products. The SIFT-MS claims sensitive, rapid analysis of whole air even in humid samples. It is applicable to alkane, alkene, and aromatic hydrocarbons, and oxygen-, sulfur-, and halogen-containing organics, as well as ammonia, hydrogen cyanide, hydrogen sulfide, nitrogen dioxide, and phosphine. The instrument has a continuous operation with a one-minute measurement time. Ms. Dindal said that the absolute concentrations of an analyte can be calculated for this technology. The instrument's linear response range is typically single-digit parts per billion by volume to tens of parts per million by volume. She said that the technology is applicable to stack emissions and to motor vehicle emissions. The vendor, Syft Technologies, is interested in some feedback from the stakeholder group on where to apply the technology. Stakeholders responded with many potential application areas including VOC speciation, odor complaint resolution, emergency response, human exposure (breath analysis), wood treatment sites, and evaluation of oxygenates. The stakeholders were highly in favor of proceeding with this technology category.

Ms. Dindal then moved on to remote leak detection devices. She said that these technologies are portable infrared video cameras that detect chemicals leaking from flanges, valves, fittings, etc., and are being proposed as an alternative to EPA Method 21. Battelle/ETV have participated in discussions with EPA, American Petroleum Institute, and industry representatives on these technologies.

Next Air Technology Categories

Ms. Hund discussed next air technology categories with the stakeholders. She said that the goal of this session was to determine verification priorities for discussed technology categories, provide new technology category recommendations, and gather information needed to proceed forward with a new technology category, such as vendor names and potential collaborators. In considering what technology categories to prioritize, Ms. Hund said that stakeholders should consider the feasibility of verifying such a technology, the number of commercially available technologies, and what outcomes might result from a verification test. She reminded the group of the collaboration needs for a verification test, which include co-funding, test site host, on-site staff, reference method sampling and analyses, and possibly the hosting and preparation of a technology field day.

To put current technology category recommendations into perspective, Ms. Hund reviewed previous stakeholder meeting minutes to discuss what technology categories have been suggested in the past. She indicated that the AMS Center was often able to connect stakeholder suggestions with collaborators and vendors for successful verification tests, such as with ambient PM monitors and mercury CEMs. Sometimes, however, all of the pieces don't come together, despite a great stakeholder suggestion, as with mold detection technologies. Some of the source monitoring technologies that have been suggested in the past include indoor air sensor arrays, monitors for emissions from vehicles, multi-gas emissions monitors, and ultrafine particulate monitors. For ambient air monitoring technologies, past suggestions include real-time carbonyl monitors, passive monitors, and continuous formaldehyde ambient monitors. Ms. Hund noted that over the years, 46 percent of the technology category suggestions by stakeholders have been for source monitors, while 54 percent have been for ambient monitors. However, in terms of actual verification tests, the split was 50/50. Ms. Hund then listed some recent technology category suggestions, which include vapor intrusion technologies, e-noses, and mass spectrometry technologies, as well as technologies discussed as "under development" previously.

Ms. Hund asked the stakeholders to consider some criteria for each new technology category that they suggest for testing. They should consider if the technology category is well-defined, whether it is still important to verify, if there are commercially available technologies on the market, who potential test collaborators could be, and which stakeholders have an interest in or experience with this technology.

This list of technology categories suggested by the stakeholders included the following. Those categories in **bold** received the stakeholders concurrence.

Source PM monitors (electric utility industry)
Ambient PM monitors (portable, battery-operated, hand-held)
Baghouse leak detectors
Ozone ambient monitors
SIFT-MS
Battery-powered sampling pumps (focusing on sustainability criteria)
Remote Leak Detection

Radio Frequency Identification Devices
Climate change technologies
Agricultural emissions technologies for VOCs or PM

Wrap up/Action Items

Ms. Hund closed the meeting by saying that the AMS Center would continue to conduct teleconferences with the stakeholders on a quarterly basis. The next air stakeholder call will be in late spring/early summer. Ms. Hund thanked the stakeholders for their active participation in the meeting. The meeting concluded and a tour of the facilities at CARB was conducted by Jeff Cook.