**THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM**

U.S. Environmental Protection Agency

Illinois Clean Coal Institute

Battelle
*The Business of Innovation*

# ETV Joint Verification Statement

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| **TECHNOLOGY TYPE:** | **Mercury Emissions Monitor** | |
| **APPLICATION:** | **Sorbent Trap Monitoring of Flue Gas Mercury** | |
| **TECHNOLOGY NAME:** | **Sorbent-Based Mercury Sampling System** | |
| **COMPANY:** | **Apex Instruments, Inc.** | |
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The U.S. Environmental Protection Agency (EPA) has established the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by accelerating the acceptance and use of improved and cost-effective technologies. ETV seeks to achieve this goal by providing high-quality, peer-reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies. Information and ETV documents are available at www.epa.gov/etv.

ETV works in partnership with recognized standards and testing organizations, with stakeholder groups (consisting of buyers, vendor organizations, and permitters), and with individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer-reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance (QA) protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

The Advanced Monitoring Systems (AMS) Center, one of six technology areas under ETV, is operated by Battelle in cooperation with EPA's National Exposure Research Laboratory. In collaboration with the Illinois Clean Coal Institute, and with assistance from the Northern Indiana Public Service Company, the AMS Center evaluated the performance of the Apex Instruments Sorbent-Based Mercury Sampling System for determining mercury in stack gas at a coal-fired power plant. This verification statement provides a summary of the test results.

## VERIFICATION TEST DESCRIPTION

The performance of the Apex system was evaluated in terms of relative accuracy (RA), data completeness, and operational factors (ease of use, maintenance and data output needs, power and other consumables use, reliability, and operational costs). RA was determined according to Equation A-10 of Chapter 40 of the Code of Federal Regulations Part 75 (40 CFR Part 75) Appendix A, by comparing the Apex vapor-phase total mercury ($Hg_T$) results to simultaneous results from American Society for Testing and Materials (ASTM) D 6784-02, the "Ontario Hydro" (OH) method. Data completeness was assessed as the percentage of maximum data return achieved by the Apex system over its test period. Operational factors were evaluated by means of observations during use and records of needed maintenance, vendor activities, and expendables use.

The Apex system was verified at Unit 17 of the R.M. Schahfer Generating Station, located near Wheatfield, Indiana, between July 9 and 13, 2006. Unit 17 burns pulverized Illinois sub-bituminous coal and has an electrostatic precipitator and a wet flue gas desulfurization unit. During this period, twelve successive OH method runs, each of 2 hours duration, were conducted on the Unit 17 stack using paired OH trains. Those reference samples were collected and analyzed to determine elemental mercury and oxidized mercury, the sum of which is $Hg_T$.

QA oversight of verification testing was provided by Battelle and EPA. Battelle QA staff conducted a technical systems audit, a performance evaluation audit, and a data quality audit of 10% of the test data.

This verification statement, the full report on which it is based, and the test/QA plan for this verification test are all available at www.epa.gov/etv/centers/center1.html.

## TECHNOLOGY DESCRIPTION

The following description of the Apex system is based on information provided by the vendor. The information provided below was not verified in this test.

The Apex system tested in this program was designed to sample mercury emissions from coal-fired sources as specified in Appendix K in 40 CFR Part 75. The system consisted of two Apex Instruments Model XC-60 Gas Sampling Consoles, an SGC 4000 Hg Stirling Gas Conditioner, and a 9-foot-long dual trap mercury sampling probe with a 25-foot-long heated sample line. Each XC-60 console incorporated a dry gas meter, rotameter flow meter, manual sample flow control valves, temperature indicators, vacuum gauge, and sampling pump. These consoles performed simultaneous sampling with two sorbent traps through the single probe, maintaining a constant sampling flow of about 500 cubic centimeters per minute through each trap. Pre- and post-run leak checks were conducted in each run. Sample gas drawn through the sorbent traps in the probe tip was transported through the heated sample line to the SGC 4000 Hg Stirling Gas Conditioner, where moisture was removed by condensation before the gas entered each XC-60 console. The Apex system operator recorded sampling data manually every 15 minutes during each run, including stack, probe, console, and Stirling chiller temperatures; sample flow rates; vacuum and pressure readings; and barometric pressure.

The sorbent traps used with the Apex system were prepared and analyzed for $Hg_T$ by Ohio Lumex. Consistent with Appendix K, each trap incorporated three sorbent sections: a sampling section, a breakthrough section, and a pre-spiked section to assess mercury spike recovery.

**VERIFICATION RESULTS**

The RA of the Apex system for determining $Hg_T$ was 26.6%, based on 11 OH runs, when the comparison was based on Apex results uncorrected for mercury spike recovery. For those 11 runs, the overall average $Hg_T$ value from the OH reference method was 1.008 micrograms per dry standard cubic meter (µg/dscm), whereas that from the Apex system was 1.171 µg/dscm, a difference of 0.162 µg/dscm. When comparing Apex results corrected for mercury spike recovery, the RA for 11 runs was 20.3%, and the OH and Apex average values were 1.008 µg/dscm and 1.132 µg/dscm, respectively, a difference of 0.124 µg/dscm.

The Apex sampler was operated during all 12 OH runs conducted over four days with no delays or sampling interruptions. However, the recovery of sorbent traps for analysis was incomplete due to breakage of traps. Both paired sorbent traps were recovered for seven of the 12 OH runs, one trap was recovered for four runs, and for the final run only one usable sorbent trap was available. Treating those five runs with only one trap recovered as one-half of a complete sampling run, the overall data completeness for the Apex sampler is calculated to be 79.2%.

The greatest limitation of the Apex system was the poor quality of the sorbent traps used. The traps were fragile, and the glass tubing used for the traps was of inconsistent diameter. This made installation and retrieval of the traps difficult and led to frequent breakage of the traps. It should be noted that this limitation due to the traps is not related to the Apex sampling technology itself, i.e., improvements in the quality of the sorbent traps should translate directly into improved performance of the entire system. An additional limitation of the Apex system was the relatively heavy sampling probe used with the system, which was very difficult for one operator to handle alone.

The approximate cost of the Apex system as tested (i.e., a manually operated dual system) is $10,000 to $15,000, depending on options. As used in this test, the cost per sorbent trap sample was $205, consisting of $55 for the trap, $60 for pre-spiking with mercury, and $90 for analysis of the three-section trap after sampling.

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