**Long-Term Carbon Injection Field Test for > 90%
Mercury Removal for a PRB Unit with a
Spray Dryer and Fabric Filter**

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TABLE OF CONTENTS

1. EXECUTIVE SUMMARY	1
2. INTRODUCTION AND BACKGROUND.....	3
3. APPROACH.....	6
3.1. Objectives.....	9
3.2. Scope.....	9
3.3. Tasks.....	10
3.3.1. Test Coordination, QA/QC, and Test Plan Development	10
3.3.2. Equipment Installation.....	11
3.3.3. Technology Transfer.....	13
4. RESULTS AND DISCUSSION	14
4.1. Field Testing	14
4.1.1. Silo and Hg-CEM Operation	14
4.1.2. Baseline Test.....	25
4.1.3. Co-Benefits Analysis	31
4.1.4. Parametric Test.....	39
4.1.5. Optimization Test.....	40
4.1.6. Long-Term Test	43
4.2. Coal and Coal Byproduct Sample Evaluation	54
4.2.1. SGLP Results.....	55
4.2.2. Ash Analysis With and Without PAC	57
4.2.3. Coal Properties.....	60
5. ECONOMIC ANALYSIS	62
5.1. System Description.....	63
5.2. Cost and Economic Methodology	64
5.3. Capital Costs.....	64
5.4. Operating and Levelized Costs.....	65
6. CONCLUSIONS	67
LIST OF ACRONYMS AND ABBREVIATIONS	69
APPENDIX A: PROJECT TEST PLAN.....	71
APPENDIX B: HG-CEM QA/QC PROTOCOLS.....	90
APPENDIX C: M30A RESULTS.....	94
APPENDIX D: MANUAL GAS SAMPLING RESULTS.....	100
APPENDIX E: COAL AND ASH ANALYSES	199
APPENDIX F: STANDARD CALCULATIONS.....	2320

LIST OF TABLES

Table 1.	Key Parameters of the Hardin Station.....	6
Table 2.	Hardin Project Timeline.....	8
Table 3.	Linearity Check Results.	16
Table 4.	Results of the First M30A RATA.	17
Table 5.	Results of the Second M30A RATA.	18
Table 6.	Results of the Third M30A RATA.	19
Table 7.	Manual Measurements Conducted during Baseline Testing.	27
Table 8.	Summary of First Set of Baseline Gas Measurements.	29
Table 9.	Summary of the Second Set of Baseline Gas Measurements.	30
Table 10.	Summary of Baseline PM₁₀/PM_{2.5} Measurements.	31
Table 11.	Summary of Coal Blending Runs.	33
Table 12.	Timeline for the Long-Term Test.....	44
Table 13.	Comparison of Baseline and Long-Term Gas Measurements at the SDA Inlet at Hardin.	52
Table 14.	Comparison of Baseline and Long Term Gas Measurements at the Stack at Hardin.....	53
Table 15.	Comparison of Baseline and Long-Term PM and SO₃ Measurements at the Stack at Hardin.	54
Table 16.	SGLP Results on Baseline and Long-Term Ash Samples.	56
Table 17.	Absaloka Coal Properties at Hardin.....	61
Table 18.	Design Criteria for the Mercury Control System at Hardin	62
Table 19.	Mercury Removal Efficiencies and Costs for Different APC Configurations, Coals, and Sorbents.....	63
Table 20.	Capital and O&M Cost Estimate for the ACI System at Hardin.....	65
Table 21.	Levelized Costs	66

LIST OF FIGURES

Figure 1.	Schematic of the Hardin Station with Sample Locations.....	6
Figure 2.	The ACI System and Stack Hg-CEM Probe Installed at Hardin.....	12
Figure 3.	The Hg-CEM, Probe, Sample Ports and New Platform Installed at the AH Outlet/SDA Inlet Location.....	13
Figure 4.	Effect of N ₂ as a Dilution Gas on Hg-CEM Noise.	20
Figure 5.	Humidifier and Nitrogen Generator Upgrades on the Stack Hg- CEM.	21
Figure 6.	Photo of the Mercuric Chloride Generator in the Stack Probe at Hardin.	22
Figure 7.	Mercury Control System Performance without Feedback Control.	24
Figure 8.	Mercury Control System Performance with Feedback Control.	25
Figure 9.	Baseline Mercury and Load Trends for Hardin Station, 2Q07.....	26
Figure 10.	Results from the First Set of Baseline Gas Measurements.	28
Figure 11.	Results of the Second Baseline Mercury Test.....	30
Figure 12.	Effect of Load on Hg Speciation and Native Removal.	32
Figure 13.	Portable Coal Conveying System at Hardin Station.	33
Figure 14.	Mercury Removal for the West Elk Coal Blend Test.....	34
Figure 15.	Mercury Removal for the Coal Additive Test.....	36
Figure 16.	Hg-CEM Trends for the Coal Additive Test.....	37
Figure 17.	Effect of Ammonia Flow on Mercury Removal, 09/16/08.....	38
Figure 18.	Effect of Ammonia Flow on Mercury Removal, 09/23/08.....	38
Figure 19.	Mercury Removal for the Parametric Test.	40
Figure 20.	Mercury Removal with Calgon FLUEPAC™-MC PLUS.	41
Figure 21.	Mercury Removal with DARCO® Hg-LH.....	42
Figure 22.	System Performance after the Start of the Long-Term Test.	45
Figure 23.	4Q07 Long-Term Mercury Removal with DARCO® Hg-LH.....	46
Figure 24.	1Q08 Long-Term Mercury Removal with DARCO® Hg-LH.....	47
Figure 25.	2Q08 Long-Term Mercury Removal with DARCO® Hg-LH.....	49
Figure 26.	3Q08 Mercury Removal with Hg-LH and MC PLUS.....	50
Figure 27.	4Q08 Mercury Removal with MC PLUS and ADA Power PAC <i>PREMIUM</i>	51
Figure 28.	Sampling Locations at Hardin.....	55

Figure 29.	Results of the SGLP Leaching Test on Ash Samples with and without Carbon Injection.....	57
Figure 30.	Comparison of LOI, Total, and Organic Carbon in Ash with SDA Solids.	58
Figure 31.	CEGRIT In-Situ Ash Analyses Downstream of the ACI Location.	59
Figure 32.	Mercury in FF Ash Samples during the Optimization Test.	59
Figure 33.	Hg and Br in FF Ash before and during the KNX Test.	60

1. EXECUTIVE SUMMARY

The power industry in the U.S. is faced with meeting regulations to reduce the emissions of mercury compounds from coal-fired plants. Injecting a sorbent such as powdered activated carbon (PAC) into the flue gas represents one of the simplest and most mature approaches to controlling mercury emissions from coal-fired boilers. The purpose of this test program was to evaluate the long-term mercury removal capability, long-term mercury emissions variability, and operating and maintenance (O&M) costs associated with sorbent injection on a configuration being considered for many new plants. Testing was conducted by ADA Environmental Solutions (ADA) at Rocky Mountain Power's (RMP) Hardin Station through funding provided by DOE/NETL, RMP, and other industry partners. The Hardin Station is a new plant rated at 121 MW gross that was first brought online in April of 2006. Hardin fires a Powder River Basin (PRB) coal and is configured with selective catalytic reduction (SCR) for NO_x control, a spray dryer absorber (SDA) for SO₂ control, and a fabric filter (FF) for particulate control. Based upon previous testing at PRB sites with SCRs, very little additional mercury oxidation from the SCR was expected at Hardin. In addition, based upon results from DOE/NETL Phase II Round I testing at Holcomb Station and results from similarly configured sites, low native mercury removal was expected across the SDA and FF.

The main goal of this project was met—sorbent injection was used to economically and effectively achieve 90% mercury control as measured from the air heater (AH) outlet to the stack for a period of ten months. This goal was achieved with DARCO[®] Hg-LH, Calgon FLUEPAC[®]-MC PLUS and ADA Power PAC *PREMIUM* brominated activated carbons at nominal loadings of 1.5–2.5 lb/MMacf. An economic analysis determined the twenty-year levelized cost to be 0.87 mills/kW-hr, or \$15,000/lb Hg removed. No detrimental effects on other equipment or plant operations were observed. The results of this project also filled a data gap for plants firing PRB coal and configured with an SCR, SDA, and FF, as many new plants are being designed today.

Another goal of the project was to evaluate, on a short-term basis, the mercury removal associated with coal additives and coal blending with western bituminous coal. The additive test showed that, at this site, the coal additive known as KNX was effective at increasing mercury removal while decreasing sorbent usage. Coal blending was conducted with two different western bituminous coals, and West Elk coal increased native capture from nominally 10% to 50%.

Two additional co-benefits were discovered at this site. First, it was found that native capture increased from nominally 10% at full load to 50% at low load. The effect is believed to be due to an increase in mercury oxidation across the SCR caused by a corresponding decrease in ammonia injection when the plant reduces load. Less ammonia means more active oxidation sites in the SCR for the mercury. The second co-benefit was the finding that high ammonia concentrations can have a negative impact on mercury removal by powdered activated carbon. For a period of time, the plant operated with a high excess of ammonia injection necessitated by the plugging of one-third of the SCR. Under these conditions and at high load, the mercury control system could not maintain 90% removal even at the maximum feed rate of 3.5 lb/MMacf (pounds of mercury per million actual cubic feet). The plant was able to demonstrate that mercury removal was directly related to the ammonia injection rate

in a series of tests where the ammonia rate was decreased, causing a corresponding increase in mercury removal. Also, after the SCR was refurbished and ammonia injection levels returned to normal, the mercury removal performance also returned to normal.

Another goal of the project was to install a commercial-grade activated carbon injection (ACI) system and integrate it with new-generation continuous emissions monitors for mercury (Hg-CEMs) to allow automatic feedback control on outlet mercury emissions. This was accomplished and the plant can now be operated to control carbon injection based on either the overall mercury removal or an outlet mercury emission rate. By integrating these systems, it was determined that the plant could reduce powdered activated carbon consumption, especially at low load, because, at Hardin, native mercury capture increases from less than 20% to about 50% at low load and the carbon injection rate can be decreased accordingly. Currently, the plant is operating to automatically control emissions to below 0.9 lb/TBtu (pounds of mercury per million British thermal units) at carbon loadings of 0.5 to 1.5 lb/MMacf. During the final phase of the Long-Term test, the ACI system was operated by plant personnel. The estimated O&M cost for a single Hg-CEM system is \$15,500/yr.

The Hg-CEMs performed well throughout the project. This project began shortly after Thermo Fisher first offered the Mercury Freedom System™ on a commercial basis and progressed through several iterations, improvements, and upgrades to the hardware and software. Indeed, there was a ten-fold increase in the precision and accuracy of the units during the course of the project due to several successful upgrades. In their present condition, the Hg-CEMs measure mercury to a precision of about $\pm 0.05 \mu\text{g/wscm}$ (micrograms of mercury per wet standard cubic meter of gas), and only require occasional fine-tuning of the calibration coefficients. The quality assurance/quality control (QA/QC) protocol required to keep the units operating at their optimal performance was also developed and perfected during the course of the project. ADA Environmental Solutions (ADA) developed a daily calibration procedure that surpasses the requirements specified in the Clean Air Mercury Rule (CAMR), and a weekly diagnostic program that ensures that the systems are operating properly and receive the necessary maintenance. For the most part, the systems passed the daily, weekly, and quarterly QA/QC requirements as well as four performance verification tests using the Ontario Hydro (O-H) and Sorbent Trap Methods (STM) for the first test and the EPA Method 30A (M30A) procedure for the remaining three. However, some improvements are still necessary before the system can meet all of the requirements. These involve tests that challenge the system with oxidized mercury (Hg+2). These tests could not be passed at Hardin in spite of trying several improvements suggested by ADA or Thermo Fisher.

2. INTRODUCTION AND BACKGROUND

Rocky Mountain Power, Inc. (RMP), a wholly owned subsidiary of Colorado Energy Management, brought a new plant on line in the spring of 2006 near Hardin, Montana. The plant, Hardin Generating Station, fires subbituminous Powder River Basin (PRB) coal and is configured with low-NO_x burners and selective catalytic reduction (SCR) for NO_x control, a spray dryer absorber (SDA) for SO₂ control, and a fabric filter (FF) for particulate control. RMP is working with the Montana Environmental Information Center (MEIC), the Montana Department of Environmental Quality (M-DEQ), and other interested parties to assess the costs and effectiveness of activated carbon injection (ACI) to optimize mercury emissions reduction. They partnered with the Department of Energy National Energy Technology Lab (DOE/NETL) and ADA Environmental Solutions (ADA) to determine whether 90% mercury control could be achieved for a 10-month period and to provide valuable long-term performance data on mercury control.

There was a twofold purpose to the program. First, this Phase III program provided the opportunity to assemble expertise from DOE, technology development companies, and power generators to assist in the transition from shorter-term, proof-of-concept tests conducted in DOE's Phase I and II programs to long-term performance testing of the most advanced mercury control technology for this configuration. Second, this program permitted the expansion of RMP's original scope of work for technology evaluation to include the evaluation of additional, promising, new technologies that have had limited field testing. This program provided the opportunity to:

1. Perform a co-benefit analysis to define the range of native mercury removal achievable by natural operational variations of the SCR and SDA.
2. Assess the extent to which native mercury removal can be increased using coal additives or coal blending.
3. Evaluate the effectiveness of enhanced or bromine-treated carbon injection for mercury control.
4. Evaluate the viability of automatic feedback control using a new generation of continuous emission monitors for mercury (Hg-CEMs) and a commercial ACI system to maintain mercury emissions at a set level and optimize activated carbon usage.
5. Provide DOE/NETL and industry with long-term operating and maintenance requirements for an ACI system for ten months of continuous operation. During the final months of the Long-Term test, the ACI system was operated by plant personnel.
6. Provide valuable information to RMP, DOE, and industry on the operating and maintenance requirements for Hg-CEMs using the QA/QC procedures outlined in the Clean Air Mercury Rule and compliance monitoring requirements included in 40 CFR Part 60.49a and Part 75.
7. Provide the necessary data for RMP, MEIC, and M-DEQ to make well-informed decisions on the level of mercury control economically possible with ACI.

On March 15, 2005, the U.S. Environmental Protection Agency (EPA) issued a final regulation to control mercury from coal-fired power plants known as the Clean Air Mercury

Rule (CAMR). Although this regulation was vacated by the courts in 2008, it was the guiding document throughout this program and many of the performance requirements for mercury measurement are still followed by the industry in lieu of new a new regulation. Congress is currently working on a maximum achievable control technology (MACT) regulation for mercury. Any new regulation will affect the existing fleet of nearly 1,100 boilers. These plants are relatively old with an average age of more than 40 years. Although most of these units are capable of operating for many additional years, there is a desire to minimize large capital expenditures because of the reduced (and unknown) remaining life of the plant to amortize the project. Therefore, the industry needs environmental control technologies that:

- Take advantage of existing equipment and minimize the need for installing new major capital equipment
- Effectively meet regulations on units firing coal with a wide range of characteristics
- Will not require additional manpower or specialized technical expertise
- Can be installed and operated without jeopardizing the reliability of the generating facility

The injection of powdered activated carbon (PAC) into the flue gas represents one of the simplest and most extensively tested technologies for controlling mercury emissions from coal-fired boilers. NETL sponsored full-scale field tests conducted by ADA and others have proven the effectiveness of ACI for reducing mercury emissions on a variety of coals and unit configurations. These tests have also shown that mercury removal across the particulate collection devices can vary significantly depending on coal type and flue gas properties.

Evaluating the most advanced mercury control technology for the configuration at Hardin, SCR-SDA-FF, was important to the industry because it is favored by the industry for the majority of new plants firing PRB coal. Testing at Hardin provided an opportunity to evaluate 90% mercury control with enhanced technologies and the associated operating and maintenance (O&M). Specifically, this program advanced the knowledge base in seven areas.

1. 90% Mercury Control on a PRB-SCR-SDA-FF Configuration – This program provided the opportunity to evaluate several advanced mercury control technologies such as coal additives and treated PAC.
2. Effect of SCRs on Mercury Control – As more SCRs are put into service it is important to gather information on how mercury control is affected by an SCR. At the beginning of this project, no ACI tests had been conducted on a unit firing PRB and configured with an SCR, SDA, and FF.
3. Commercial-Grade Equipment – The ACI system and Hg-CEMs installed at Hardin were commercial-grade systems that were integrated to achieve continuous mercury control with minimal operator interface.
4. Long-Term Testing (10 months) – Long-term performance testing was the critical next step in the commercialization process for mercury control technologies. The Long-Term test period of this program lasted ten months and progressed through all seasons and through several major operational issues at the plant.

5. Coal Blending – High mercury removal was achieved at Holcomb Station (PRB coal, SDA-FF) by blending West Elk western bituminous coal with PRB coal. Short-term blending tests with two western bituminous coals were conducted at Hardin.
6. Economic Analysis – This determined the costs of 90% mercury control for a site configured with PRB-SCR-SDA-FF.
7. Systems Integration – This project evaluated the integration of ACI systems with Hg-CEMs to simplify operation and reduce PAC usage. Long-term data were obtained on the operability, maintainability, and reliability of ACI systems and compliance Hg-CEMs. Plant personnel were trained in the operations and maintenance of the systems.

3. APPROACH

Sorbent injection was used to effectively achieve and maintain mercury control at 90% as measured from the air heater (AH) outlet to the stack for a period of ten months. A short-term evaluation included tests with coal additives, and coal blending with western bituminous coal. A commercial-grade ACI system was installed and integrated with Hg-CEMs to allow automatic feedback control based on mercury removal. The project test plan that includes a detailed description of the site and test equipment is reproduced in Appendix A. Figure 1 is a schematic of the Hardin Station showing the various sampling locations for ash, coal, slurry, and flue gas. The key parameters of Hardin are listed in Table 1.

Figure 1. Schematic of the Hardin Station with Sample Locations.

Table 1. Key Parameters of the Hardin Station.

Test Period	August 2006–November 2008
Unit	1
Unit Size	121 MW
Coal	PRB, Absaloka Mine
Particulate Control	Fabric Filter
Gas Flow Rate, full load (acfm)	550,000
Sulfur Dioxide (SO ₂) Control	Spray Dryer with Recycle
Nitrogen Oxides (NO _x) Control	Low-NO _x Burners and SCR
Ash Reuse	Disposal
Test Portion of Unit	121 MW
Typical Inlet Mercury Range (µg/wscm)	2–12
Typical Native Mercury Removal	< 20%

Table 2 is a project timeline to provide the reader with a better sense of the important events of a project that spanned nearly three years. Notably, three events are so important to the general understanding of the project that they are listed and discussed separately at this point.

1. **Hg-CEM Nitrogen Generators (NG)** – On September 5, 2007, nitrogen generators were installed on the Hg-CEMs as an upgrade offered by Thermo Fisher. The purpose of the NGs is to create an oxygen-free gas for use as a carrier gas for calibrations and as a sample dilution and carrier gas. This event is important because it significantly increased the reliability and precision of the Hg-CEM measurements. Up to this time, signal variation was on the order of $\pm 0.5 \mu\text{g/wscm}$. This made it difficult to perform accurate calibrations and to interpret results when the mercury concentration at the stack fell below $0.5 \mu\text{g/wscm}$, which was often the case during coal additive and parametric testing. The NGs reduced signal variation to nominally $\pm 0.05 \mu\text{g/wscm}$.
2. **Step-Up Transformer Failure** – The Long-Term test began on September 26, 2007. On December 15, 2007, the plant's step-up transformer failed. On February 5, 2008, this transformer was replaced with a temporary, smaller unit that limited operation to 106 MW out of 121 MW. This is important because at low load the native mercury capture and, therefore, overall mercury capture increases at Hardin. This was discussed with the project team and it was decided to continue the Long-Term test in spite of the consequence to the interpretation of results. The original transformer was repaired and reinstalled on July 22, 2008.
3. **SCR Deposition** – On March 13, 2008, shortly after the Long-Term test resumed with the temporary transformer, a tube leak caused $> 25\%$ of the SCR to be plugged with ash. To compensate for the reduced available SCR surface area, the plant increased ammonia flow to maintain NO_x emission levels. However, the ammonia flow meter was not functioning properly and this significant operational change went unnoticed by ADA until the original transformer was reinstalled on July 22, 2008. At this time, mercury capture performance decreased significantly and it was discovered that excess ammonia negatively affects capture at full load (121 MW). The SCR was refurbished and the unit returned to "normal" operation on October 26, 2008. The Long-Term test ended on November 17, 2008.

Taken in combination, these events reduced the time the unit was operating normally during the 12-month (total duration) Long-Term test to about two months. However, valuable information was gained about the effect of the SCR and excess ammonia on mercury capture.

Table 2. Hardin Project Timeline.

1 Q 06	Project awarded
2 Q 06	Site kickoff meeting at Hardin Signed Cooperative Agreement with DOE/NETL Signed Host Site Agreement
3 Q 06	DOE kickoff at DOE NETL (July 2006) Completed the Cost Share Agreement with RMP Platform installed at the SDA inlet Test Trailer installed SDA Inlet and Stack Hg-CEM installed
4 Q 06	Quality Assurance Project Plan completed Sample and Data Management Plan completed Site Safety Plan completed Poster presented at the DOE/NETL conference in Pittsburgh (December 2006) Baseline Source Test completed (December 2006) Coal Blending Tests completed (December 2006)
1 Q 07	KNX Licensing Agreement obtained to test KNX - B&W declined test of their additive Trained RMP personnel on Hg-CEM ops Gave tour to utility personnel interested in Thermo Hg-CEMs First quarterly Hg-CEM linearity check failed - Hg-CEMs repaired
2 Q 07	Baseline Ontario Hydro (O-H) and STM Tests repeated (April 2007) Coal additive test with ALSTOM's KNX (April 2007) Carbon silo, transport piping, and injection lance installed Parametric Test with DARCO® Hg-LH, Calgon FLUEPAC™-MC PLUS, and PAC+KNX (May, June 2007) Smaller screws installed on ACI system to facilitate lower feed rates
3 Q 07	Optimization Tests with Calgon FLUEPAC™-MC PLUS and NORIT DARCO® Hg-LH (August 2007) Baseline Stack Test for PM2.5, PM10, and Controlled Condensate (SO₃) (September 2007) 9/5/07: Nitrogen Generators installed on Hg-CEMs - performance significantly improved 9/26/07: Began Long Term Test with DARCO® Hg-LH Trained RMP operators on ACI system operation
4 Q 07	Presentation given at the DOE/NETL Conference (December 2007) 12/15/07: Step-up transformer failed causing 2-mo outage Upgraded ACI system logic for Hg-CEMs feedback control to automatically maintain 90% Hg removal Mercuric Chloride Generator installed on Stack Hg-CEM
1 Q 08	Presented paper at the EUEC Conference (January 2008) 2/5/08: Plant resumed operation at 106 MW of 121 MW 2/25/08: Resumed Long Term Tests with Hg-LH 3/13/08: Major tube leak plugged 25+% of SCR Periods of poor performance may have been due to a batch of PAC with low bromine levels
2 Q 08	Trained plant personnel on Hg-CEM and ACI system operations. 4/21/08: First Method 30A RATA Test
3 Q 08	Presented paper at the Mega Symposium (August 2008) Trained additional plant personnel in Hg-CEM operations 7/4/08-7/22/08: Outage to install refurbished step-up transformer. Could not maintain 90% removal w/excess ammonia and 121 MW. 8/19/08: Long Term Test concluded with DARCO® Hg-LH DARCO® Hg-LH was tested for 167 days during which 208,731 lb was fed 8/26/08: Began Calgon FLUEPAC™-MC PLUS for 2-mo test Could not maintain 90% removal at 2.75-3.0 lb/MMacf w/excess ammonia and 121 MW. 9/22/08: Long Term source sampling test and second M30A RATA. ACI system operation assumed by plant
4 Q 08	10/13/08: Final M30A RATA Test. Dynamic Spike Test. 10/19/08-10/26/08: Outage to refurbish SCR. 10/29/08: Resume test w/Calgon MC PLUS 11/17/08: Long Term Test completed Calgon FLUEPAC™-MC PLUS was tested for 60 days during which 110,431 lb was fed Began Test with ADA Power PAC Premium (not part of DOE Project)
1 Q 09	Presented paper at the EUEC Conference (February 2009) 1/14/08-.....: Running in auto with emissions control. Emissions under 0.9 lb/TBtu at 1.0-3.0 lb/MMacf Final Report issued

3.1. Objectives

The purpose of this test program was to evaluate the long-term mercury removal capability, long-term mercury emissions variability, and O&M costs associated with sorbent injection on a plant configuration being considered for many new plants. Hardin fires a PRB coal and is configured with an SCR and low-NO_x burners for NO_x control, an SDA for SO₂ control, and an FF for particulate control. Based upon previous tests at other PRB sites with SCRs, very little additional mercury oxidation was expected at Hardin. The primary objectives of this project were:

- Demonstrate that 90% mercury removal was sustainable with ACI.
- Integrate a commercial Hg-CEM with an ACI system to simplify operation and reduce carbon usage.
- Train plant personnel to operate the Hg-CEMs and ACI equipment.

Secondary objectives included:

- The evaluation of co-benefits (e.g., effect of the SCR).
- The evaluation of coal additives to enhance mercury removal.
- The evaluation of coal blending with western bituminous coal.
- The determination of the cost reduction potential of using automatic feedback control from the Hg-CEMs to control ACI rate and maintain a fixed mercury emission rate independent of plant operations and coal variations.
- The evaluation of the impact of enhanced carbons on ash disposal.
- Providing data to support RMP and M-DEQ in a BACT analysis of technology implementation.

3.2. Scope

To achieve the objectives stated above, ADA installed a mercury sorbent injection system and two Hg-CEM systems at the Hardin Generating Station. This equipment, described in Appendix A, provided the means to evaluate a series of co-benefit enhancements and to conduct baseline and parametric tests to assess the potential for reducing mercury emissions by 90%. The co-benefits analysis characterized the range of mercury removal achievable by studying the affects of the SCR, SDA, and FF under normal variations in operation. The effectiveness of coal additives to enhance mercury oxidation across the SCR and subsequent removal in the SDA-FF was also studied. During parametric testing, the effectiveness of sorbent injection for mercury control was evaluated with and without enhanced co-benefit mercury removal. Since sorbent injection demonstrated that 90% mercury control was feasible, DOE/NETL approved a 10-month, long-term test to establish steady-state operation and assess potential maintenance and operational problems.

3.3. Tasks

The program was accomplished by following a series of technical tasks.

Task 1. Site Coordination, Kickoff Meetings, Develop Test Plan and QA/QC Plan

Task 2. Design, Procure, and Install Equipment

Task 3. Field Testing

Task 3.1. Hg-CEM and Silo Operations

Task 3.2. Baseline Tests

Task 3.3. Co-Benefits Analysis

Task 3.3.1. Effect of Low Load on Hg Removal

Task 3.3.2. Coal Blending Test

Task 3.3.3. Coal Additive Test

Task 3.3.4. Effect of Ammonia on Hg Removal

Task 3.4. Parametric Tests

Task 3.5. Optimization Test

Task 3.6. Long-Term Test

Task 4. Coal, Ash, and By-Product Sample Evaluation

Task 5. Technology Transfer

Task 6. Management and Reporting/Economic Analysis

3.3.1. Test Coordination, QA/QC, and Test Plan Development

Efforts within this task included test planning with input from the host site, DOE/NETL, and other contributing team members. The planning process included meeting with plant, corporate, and environmental personnel to agree upon an overall scope of the program, the potential impact on plant equipment and operation, and to gather preliminary information necessary to develop a detailed test plan and scope of work. Efforts included developing a QA/QC plan, identifying potential mercury sorbents and coal additives, finalizing the scope for each of the team members, and putting subcontracts in place for manual measurement services. The list of accomplishments within this task is below.

- Signed Cooperative Agreement and Host Site Agreement (April 27, 2006)
- Kickoff meeting held at the Hardin Generating Station (June 26, 2006)
- Developed Site Sampling Plan and Installation Plan (June 26, 2006)
- Contract for Services Agreement with RMP
- DOE Kickoff meeting at DOE/NETL (July 18, 2006)
- Reaction Engineering completed a preliminary Modeling Study to determine potential mercury oxidation and removal at baseline conditions across the SCR, SDA, and FF, and the effects of coal additives and coal blending on mercury oxidation.
- Completed the Quality Assurance Project Plan including Hg-CEM operating procedures to follow CAMR requirements.

- Completed a Sample and Data Management Plan.
- Arranged to test two western bituminous coals during the coal blending tests.
- Obtained a Licensing Agreement to test KNX. B&W declined to participate in a test of their coal additive.

3.3.2. Equipment Installation

There were two main components to Task 2; the design, procurement, and installation of an ACI system as well as the procurement and installation of two Thermo Fisher Hg-CEMs. Figure 2 and Figure 3 **Error! Reference source not found.** show the ACI system, and Hg-CEMs installed at Hardin. Upon completion of the project, the ACI system and stack Hg-CEM will remain at the site and be operated by the plant as a compliance mercury removal system.

The ACI system included a refurbished carbon storage and feed system, piping to transport the carbon to the injection location, and an injection lance. The piping was standard carbon steel pipe but the elbows used were long-radius, and ceramic lined. The single injection lance consisted of an open-ended, stainless steel pipe with the discharge located in the center of the duct after the AH and before the SDA. A new platform was also installed at the injection location to facilitate lance and Hg-CEM maintenance and manual flue gas measurements.

The Hg-CEMs were commercial Thermo Fisher Mercury Freedom Systems™. However, since this project began shortly after these systems became commercially available, several upgrades were made during the course of the project. These upgrades increased the reliability and accuracy of the Hg-CEMs and will be described more completely below.

An important component of Task 2 was to integrate the ACI and Hg-CEM systems to produce a system capable of automatically controlling mercury emissions to a specified set point. This was accomplished in the fall of 2007 and, afterwards, the integrated system was able to automatically achieve and maintain 90% mercury removal during normal operating conditions. Carbon injection concentrations ranging from 1.5 to 3.5 lb/MMacf were used to maintain mercury removal between 89–91% during periods of constant full load.

Figure 2. The ACI System and Stack Hg-CEM Probe Installed at Hardin.

Figure 3. The Hg-CEM, Probe, Sample Ports and New Platform Installed at the AH Outlet/SDA Inlet Location.

3.3.3. Technology Transfer

Transferring the information and observation from the research completed under this project to coal-fired utility customers was an important part of the program. Presentations were given at selected conferences to increase exposure of the test results and receive comments on the applicability of mercury removal with ACI from industry. The ultimate goal of technology transfer was to make results available to the public as quickly, comprehensively and accurately as possible.

- Connie Senior of Reaction Engineering presented a paper at the Electric Power Conference held in May 2007 concerning a model to predict the speciation and removal at Hardin and associated actual emissions measurements.
- ADA presented a poster at the DOE/NETL Mercury Control Technology Meeting in December 2006.
- At the request of RMP, ADA gave a tour to utility personnel interested in Thermo Hg-CEMs.
- ADA met with the new president of Colorado Energy Management to present an overview of the Hardin project.
- ADA presented a paper at the DOE/NETL conference in December 2007.
- ADA presented a paper at the EUEC Conference in January 2008.
- ADA presented a paper at the Mega Symposium in August 2008.
- ADA presented a paper at the EUEC Conference in February 2009.

4. RESULTS AND DISCUSSION

4.1. Field Testing

Field testing was conducted from September 2006 to November 2008, and included baseline measurements, co-benefits analysis with coal additives and coal blending, parametric tests with different carbons, and Long-Term testing. Mercury removal performance and balance-of-plant impacts were quantified by analyzing plant operating data, Hg-CEM measurements, collection, and analysis of solid samples (i.e., coal and ash), and through independent flue gas measurements. Operating parameters included flow rates, temperatures, pressures, and the emission values of all measured gases. The following sections discuss the results of all testing.

Please note that the units used flue gas mercury concentration throughout this report are micrograms of mercury per wet standard (1 atm, 68 °F) cubic meter of flue gas ($\mu\text{g}/\text{wscm}$) at the oxygen concentration of the raw flue gas. This was necessary because there were no oxygen or carbon dioxide monitors at the inlet location to allow conversion to lb/MBtu. Also, most of the graphs in the following sections show mercury values for both the inlet and outlet locations and it would have been awkward to present them in different units. However, unit conversion calculations at the stack indicate that the difference between $\mu\text{g}/\text{wscm}$ and lb/TBtu at this site is less than 0.1. Therefore, given the uncertainty in such measurements and the variability in coal composition and plant operations, the units can be considered to be interchangeable for the Hg-CEM mercury measurements at the stack. Examples of the standard calculations used in this section are included in Appendix B.

4.1.1. Silo and Hg-CEM Operation

Since the story of this project is closely connected with the story of the Hg-CEM and ACI systems, a separate section is included that discusses the successes, improvements, and maintenance issues that were gradually developed over the course of this project. The QA/QC protocol developed by ADA for the Hg-CEMs is included in Appendix C.

4.1.1.1. *Hg-CEM Quarterly Linearity Checks*

Linearity checks were performed to assess the response of the system with the low-, mid-, and high-level reference gas injected ahead of the inertial filter in non-repetitive, triplicate runs. Part 75 states that the CEM is required to meet a performance specification of 10.0% of reference or a difference of $\pm 1.0 \mu\text{g}/\text{m}^3$, whichever is less restrictive. Linearity checks are required each quarter and at least 30 days apart and must be completed within 24 unit operating hours. Linearity checks were performed manually by changing the span concentration of the calibrator.

Table 3 shows the results of all linearity checks performed during the project. The first linearity check performed at Hardin was in January 2007. This linearity check failed, but an investigation found problems with the configuration of the CEMs and performance of the calibrators; these problems were corrected and a subsequent linearity test passed. Some linearity checks were not performed in a quarter-year because there was uncertainty regarding specific federal QA/QC requirements (2007) and/or because of plant outages that

disrupted the test schedule (2008). The stack CEM failed a few linearity checks in the ten quarters spanned by the project. These can be attributed to the use equipment that was later upgraded (June 2007), the use of incorrect calibration concentrations (the test was initiated with incorrect settings in the calibrator and could not be stopped as per the rule), and calibrator maintenance activities (early in the project, the calibrators were found to be non-linear due to degradation of the mercury reservoir in the calibrator that was later corrected by use of nitrogen as the calibration carrier gas).

Table 3. Linearity Check Results.

HARDIN Hg-CEM LINEARITY CHECK – SDA INLET			
Quarter	Data	High Error	Result
1Q07	03/17/07	1.6 / 9.1%	PASS
2Q07	N/A	N/A	N/A
3Q07	09/19/07	0.50 / 4.1%	PASS
4Q07	N/A	N/A	N/A
1Q08	N/A	N/A	N/A
2Q08	04/04/08	0.31 / 3.8%	PASS
	04/28/08	0.31 / 4.0%	PASS
3Q08	07/25/08	0.45 / 7.2%	PASS
	09/17/08	0.39 / 4.7%	PASS
4Q08	11/18/08	0.15 / 2.0%	PASS

HARDIN Hg-CEM LINEARITY CHECK – STACK			
Quarter	Data	High Error	Result
1Q07	03/17/07	4.48 / 47.0%	FAIL *
	03/25/07	0.25 / 2.0%	PASS
2Q07	N/A	N/A	N/A
3Q07	07/20/07	1.48 / 24.0%	FAIL *
	09/19/07	1.71 / 9.3%	PASS
4Q07	N/A	N/A	N/A
1Q08	N/A	N/A	N/A
2Q08	04/04/08	4.81 / 35.4%	FAIL *
	04/28/08	0.32 / 10.7%	PASS
3Q08	07/25/08	0.77 / 8.5%	PASS
3Q08	09/18/08	0.38 / 8.7%	PASS
4Q08	11/18/08	0.40 / 5.0%	PASS

* Failed tests that were repeated after corrections were made.

4.1.1.2. Hg-CEM RATA Results (M30A)

ADA conducted three sets of Relative Accuracy Test Audit (RATA) tests on the Hg-CEMs using regulations outlined in 40 CFR Part 75.20. Method 30A was the instrumental reference method (IRM) employed to conduct the RATA on the stack Hg-CEM, and a modified Method 30A was used for the RATA on the AH outlet Hg-CEM. A full accounting of each RATA is presented in Appendix D.

The first RATA was conducted during the week of April 21, 2008. The stack Hg-CEMs passed the RATA and all performance tests conducted during this evaluation except the 3-Level System Integrity Check and the Bias Test. The AH outlet CEMs passed the RATA and all applicable performance tests except the Bias Test. The IRM analyzer passed all of the system checks except the Dynamic Spiking Test. A summary of these results is presented in Table 4. It should be noted that the results in Tables 4, 5, and 6 refer to both the IRM CEM (indented in the table) and the Hg-CEMs installed at Hardin (not indented).

Table 4. Results of the First M30A RATA.

Test	Stack Hg-CEMs (downstream of ACI)	Air Heater Outlet Hg-CEMs (upstream of ACI)
Linearity Check	PASS	PASS
7-Day Calibration Error Test	PASS	PASS
Cycle Time Test	PASS	PASS
3-Level System Integrity Check	FAIL	N/A
Relative Accuracy Test Audit	PASS	PASS
<u>IRM System Performance Tests</u>		
Interference Check (Optional)	-	-
3-Point System Calibration Error Test	PASS	-
System Integrity Check	PASS	-
Measurement System Response	PASS	-
Dynamic Spiking Test	FAIL	-
Bias Test	FAIL	FAIL

Note: The 3-Level System Integrity Check is not applicable to the AH outlet CEM because there is no mercuric chloride generator on this unit.

The failure of the 3-Level System Integrity Check on the stack Hg-CEM was attributed to improper insulation of the mercuric chloride generator. This unit was upgraded and tested before the second RATA but continued to fail the integrity check. The failure of the Bias Tests was attributed to a flaw in the design of the heating ventilation and air conditioning system on the IRM that made it difficult to maintain constant temperature within the housing. This flaw was repaired and the Bias Test was repeated during the next RATA test. No Bias Adjustment Factor was implemented at this time.

A Linearity Check performed on the Stack Hg-CEM prior to first M30A test failed due to calibrator non-linearity. As a result, the IRM calibrator was used to calibrate the stack Hg-CEM for the test period, and was later installed into the stack system after the RATA so the non-linear unit could be serviced.

The Dynamic Spiking Test failure was attributed to difficulties in maintaining vapor-phase oxidized mercury in the sample gas stream. Recovery of the oxidized mercury proved unsuccessful as evident in failure of both mean percentage recovery and absolute difference criteria. This test was further evaluated during the final RATA.

The second M30A RATA test was conducted during the week of September 24, 2008. Method 30A requires an Initial Measurement System Performance Test described in Section 8.2 [Method 30A] in order to ascertain proper function of the IRM analyzer. A summary of these tests (indented) and the RATA tests are presented in Table 5.

The Dynamic Spiking Test was not performed because it was not required until January 1, 2009. Also, the Dynamic Spiking Test failed during the previous test of April 20, 2008. Its merit will be reevaluated, with direction from the EPA, at a later date.

Both the stack and the AH outlet Hg-CEMs successfully met performance criteria for RATA testing. Bias was evaluated as out of specification; however, adjustment factors were not implemented because the bias was likely in the IRM unit. The Hg-CEMs installed at Hardin were subject to the scrutiny of a well-developed QA/QC program, described in Appendix C, which included daily calibration checks, and, as such, implementation of any correction from this Bias Test was deemed unnecessary.

Table 5. Results of the Second M30A RATA.

Test	Stack Hg-CEMs (downstream of ACI)	Air Heater Outlet Hg-CEMs (upstream of ACI)
Relative Accuracy Test Audit (RATA)	PASS	PASS
Interference Check (Optional)	-	-
3-Point System Calibration Error Test	PASS	PASS
System Integrity Check	PASS	PASS
Measurement System Response	PASS	PASS
Dynamic Spiking Test	Not Performed	Not Performed

Note: The System Integrity Check on the CEM installed at the AH outlet was performed with elemental mercury in lieu of oxidized because there is no mercuric chloride generator on this unit.

The Final M30A RATA Test was conducted on the Hg-CEMs during the week of October 15, 2008. Challenges with successful completion of oxidized calibrations during System Integrity Tests on the IRM analyzer necessitated substituting elemental mercury standards. Again, since the Dynamic Spiking Test was not required until January 1, 2009, it was not performed as part of this RATA. A summary of the tests performed is presented in Table 6.

Both the stack and the AH outlet Hg-CEMs successfully met performance criteria for RATA testing. Bias was evaluated as out of specification for the AH outlet CEM; however, bias adjustment factors were not implemented as stated before.

Table 6. Results of the Third M30A RATA.

Test	Stack Hg-CEMs (downstream of ACI)	Air Heater Outlet Hg-CEMs (upstream of ACI)
Relative Accuracy Test Audit (RATA)	PASS	PASS
Interference Check (Optional)	-	-
3-Point System Calibration Error Test	PASS	PASS
System Integrity Check	PASS	PASS
Measurement System Response	PASS	PASS
Dynamic Spiking Test	Not Performed	Not Performed

Note: The System Integrity Check on the CEMS installed at the AH outlet was performed with elemental mercury in lieu of oxidized because there is no mercuric chloride generator on this unit.

4.1.1.3. Hg-CEM Maintenance/Advancements

During the course of this project, several advancements were made to the Hg-CEM hardware and software that significantly improved their performance. Several issues also arose that required troubleshooting and/or on-site or factory maintenance. The following timeline discusses some of the more important issues and improvements.

1Q07

The first set of quarterly linearity checks performed on the Hg-CEMs failed. Upon further investigation and fine-tuning, the inlet system was repaired, but the calibrator on the stack CEM continued to be non-linear. A new calibrator was installed and was found to be linear at all ranges.

ADA was on site February 27–28, 2007, to investigate the cause of periodic spikes in the HgT value on the stack CEM. It was found that a unique combination of two, periodic, small leaks in the probe allowed undiluted flue gas into the system.

2Q07

In June 2007, a test was conducted using nitrogen, instead of air, for a calibration carrier gas and as the dilution gas on the stack Hg-CEM. This greatly improved measurement precision and calibration performance as compared to the AH outlet CEM. Figure 4 shows the mercury concentrations measured by the two Hg-CEMs. The two traces in the upper portion of the graph represent the AH outlet Hg-CEM values of HgT and Hg0. The traces fall on top of each other and are indistinguishable indicating that all mercury was in the elemental form. These concentrations were measured using air as the carrier and dilution gas and have a typical “noise” range of about ± 0.5 $\mu\text{g/wscm}$. The two traces below the inlet traces represent the stack Hg-CEM values of HgT and Hg0. Again, these traces fall on top of each other and are indistinguishable. These stack measurements were recorded using nitrogen as the carrier and dilution gas and show that the “noise” range was reduced to approximately ± 0.1 $\mu\text{g/wscm}$. A permanent nitrogen generation system was ordered for both units.

The dilution orifices in the sample probes were replaced to lower the dilution ratio from 60 to 40. This further decreased the noise at the low mercury concentrations ($< 0.5 \mu\text{g/wscm}$) measured during carbon injection.

Figure 4. Effect of N_2 as a Dilution Gas on Hg-CEM Noise.

3Q07

The inlet and stack Hg-CEMs were fully upgraded with all of the latest innovations from Thermo Fisher, including:

- A nitrogen generator, shown in Figure 5, to supply the dilution and calibration gas.
- A lamp heater to maintain consistent mercury vapor bulb temperature. It was found that small changes in ambient temperature could affect mercury measurements. The lamp heater significantly reduced this effect.
- A humidifier to add moisture to the calibration gas to maintain a consistent humidity level across the inertial filter. In previous testing at other sites, it was found that performance could be affected when calibrating with a dry gas and then measuring a moist gas. This innovation maintained a consistent humidity from calibration to sampling.
- A new motherboard in the probe controller with a noise dampening circuit for the probe TCs and the programming required to operate a mercuric chloride generator (MCG).

Figure 5. Humidifier and Nitrogen Generator Upgrades on the Stack Hg-CEM.

4Q07

The stack Hg-CEM was upgraded with the addition of a mercuric chloride generator so that the performance of the converter could be verified as required by the CAMR. The MCG was installed in December, but problems with the stack CEM and an unexpected outage prevented shakedown and testing of this system until April 2008. A photo of the MCG is included as Figure 6.

Figure 6. Photo of the Mercuric Chloride Generator in the Stack Probe at Hardin.

1Q08

Repairs and maintenance included:

- A new power distribution board for the probe controller in the inlet CEM that failed because of a short in the probe that was caused when a heater wire in the probe fused to, and shorted out on, a heating rod that had vibrated out of the heating block.
- A new thermostat in the inlet probe.
- Replacement of the inlet probe converter core.
- Replacement of the I/O board in the stack CEM that failed during an electrical overload.
- Replacement of the stack probe converter core.

2Q08

The MCG was tested and found to achieve only 82% recovery even though it showed 100% conversion of the oxidized mercury back to elemental mercury. This problem was investigated over several months with help from Thermo Fisher and, although improvements were made, 90% conversion was never achieved with the MCG.

4.1.1.4. ACI System Performance

The activated carbon injection system performed well throughout the project. Some routine maintenance was required as exemplified by issues such as a failed speed sensor, a blower motor that locked up, and debris that caused a false reading on a level sensor. Overall, the injection system performed as expected.

At the conclusion of the Long-Term test, the total actual operating time and amount of carbon fed were:

DARCO® Hg-LH

a) Operating Time	167 days
b) Carbon Fed	208,731 lb
c) Average Feed Rate	52 lb/hr

Calgon FLUEPAC®-MC PLUS

a) Operating Time	60 days
b) Carbon Fed	110,431 lb
c) Average Feed Rate	77 lb/hr

One of the goals of the project was to investigate the potential savings of using feedback control from the Hg-CEMs to control the carbon loading. In the fall of 2007, the feeder control system was integrated with feedback from the Hg-CEMs to automatically maintain mercury removal at 90%. Prior to this, the carbon feed rate was maintained at a constant value and only updated a few times a week. Figure 7 and Figure 8 show the performance of the mercury control system with and without feedback control, respectively. The top graph in each figure shows the data from the Hg-CEMs including the total gaseous mercury (HgT) and elemental gaseous mercury (Hg0) in micrograms per wet standard (at 68 °F) cubic meters (µg/wscm) measured at the AH outlet and stack. The difference in the two values is the oxidized mercury (Hg+2). The graph in the middle shows the plant load in gross MW. The bottom graph shows the carbon loading in the gas stream in pounds per million actual cubic feet (lb/MMacf) and the percent mercury removal calculated as:

$$\% \text{ Hg Removal} = 100 * (\text{HgT In} - \text{HgT Out}) / \text{HgT In}$$

A comparison of Figure 7 and Figure 8 leads to the conclusion that linking the Hg-CEM readings to the carbon injection rate can help optimize mercury removal and reduce carbon usage. For example, Figure 7 shows that during periods when the inlet mercury changed significantly, and during low load operation, the carbon loading was not at the optimal rate to achieve 90% removal. At low load, removal increased to 95%, indicating that there was a potential to save carbon at these conditions. Figure 8 shows that under normal conditions mercury removal was maintained in a tight band around 90% removal. More importantly, it shows that at low load, carbon loading was reduced from 1.5 to 0.75 lb/MMacf, a 50% savings in carbon usage.

Figure 7. Mercury Control System Performance without Feedback Control.

Figure 8. Mercury Control System Performance with Feedback Control.

4.1.2. Baseline Test

After installation of the Hg-CEMs, baseline measurements were made over the next several months to establish the native mercury removal during typical plant operating conditions. During this time, no sorbent injection or other chemical additives were used. Baseline testing also provided the opportunity to determine if there were any co-benefits that could be utilized during the normal and variable operation of the boiler and pollution control equipment.

Baseline testing also included one full set of manual flue gas measurements and solid sample collection. Flue gas measurements included AH outlet and stack Hg-CEM measurements and manual sampling by an independent contractor for particulate, mercury, halogens, condensables, and ammonia. Solid samples included coal, ash from all six of the FF hoppers, and slurry from the SDA. The accuracy of the Hg-CEMs was verified with the Ontario Hydro method (O-H) and the sorbent trap method (STM).

4.1.2.1. Baseline Hg-CEM Data

Figure 9 presents typical baseline Hg-CEM data for Hardin. It shows that native mercury capture at high load is less than 20% (lower trace in the bottom graph), and that most of the mercury is in the elemental form (i.e., $HgT=Hg0$). However, at low load, the native mercury

removal can be as high as 40%, with a corresponding amount of oxidized mercury at the AH outlet. This was one of the most significant co-benefit findings for the project. It is believed that, at low load, the plant reduces the amount of ammonia to the SCR and, consequently, the mercury is more able to successfully compete for active sites in the SCR and, therefore, a larger portion of the mercury is oxidized. The oxidized mercury is then adsorbed by unburned carbon in the fly ash.

Figure 9. Baseline Mercury and Load Trends for Hardin Station, 2Q07.

4.1.2.2. Baseline Manual Source Testing

The first set of baseline flue gas measurements was collected from November 30 through December 2, 2007. Test methods are shown in Table 7. Some testing difficulties and delays were encountered due to inclement weather (-15 °F) that impacted both plant operation and sampling efforts. Initial results from ASTM D6784 (Ontario Hydro) measurements suggest < 10% native mercury removal across the SDA-FF.

Table 7. Manual Measurements Conducted during Baseline Testing.

Method	Description	Location
EPA M5/17	Total Particulate	SDA Inlet, Stack
EPA M26A	Halogens and Halides	SDA Inlet, Stack
CTM027	Ammonia	SDA Inlet
ASTM D6784	Speciated Mercury	SDA Inlet, Stack
STM	Total Mercury	SDA Inlet, Stack
NCASI 8A	Sulfur Trioxide	SDA Inlet

Figure 10 is a comparison of the mercury data collected during the first baseline test. The O-H data are presented as stacked bars showing the various mercury species separately. The STM and CEM data are shown as single points representing total vapor-phase mercury. Several conclusions can be drawn from the data given in Figure 10. In general, the CEM data were higher than the STM and O-H data, although the stack CEM data agree much better than the inlet CEM data. This difference was investigated and found to be caused by problems in calibration routine and non-linear calibration modules. After correcting these issues, the inlet and stack CEM values agreed more closely. Because of the poor agreement between the three test methods, this test was repeated in April 2007 (see section 4.3.2.3).

Notably, both the STM and O-H had data pairs that indicated that the stack mercury was higher than the inlet mercury, especially if discounting the contribution of the particulate-phase mercury that would have been removed in the FF. The inlet O-H also shows a higher concentration of Hg+2 that was not measured by the CEM. If this amount of oxidized mercury actually existed in the flue gas, it would likely be scrubbed in the SDA-FF (as is seen at low load), and the stack concentration would be correspondingly lower. It is more likely that both the particulate and oxidized fractions of the inlet O-H measurements are due to a sampling artifact of the O-H method. In the O-H method, the gas is sampled through a particulate filter and the filter cake that builds up can alter the speciation and particulate fraction of the mercury.

Figure 10. Results from the First Set of Baseline Gas Measurements.

Table 8 is a summary of the source testing results for the first set of baseline gas measurements. In general, good agreement was observed between the flow and moisture data measured by the different methods. Particulate measurements indicate that the baghouse is 99.8% efficient. The only halogen detected at either the SDA inlet or stack was chlorine (no HCl, HBr, HF, Br) and it was present in concentrations just above the detection limit. The ammonia concentration at the SDA inlet was 3.2 ppm. The sulfur trioxide reported at the stack was 3.5 ppm. However, the method used reports all sulphate species as sulfur trioxide and it is likely that the sulfur was in the form of an ammonia salt due to the ammonia introduced into the flue gas to control NO_x in the SCR.

Table 8. Summary of First Set of Baseline Gas Measurements.

	SDA Inlet	Stack
EPA 5B		
Moisture (%)		14.8
Flow Rate (DSCFM)		294,956
Particulate Matter (lbs/hr)		32.22
EPA 5/17/26A/CTM027		
Moisture (%)	10.69	15.07
Flow Rate (DSCFM)	292,800	293,809
Particulate Matter (lbs/hr – front half)	10,640.09	22.09
Chlorine (mg/dscm)	0.263	0.384
Ammonia (ppm)	3.2	
EPA 5/17/ASTM D6784-02		
Moisture (%)	10.18	14.72
Flow Rate (DSCFM)	291,987	295,482
Particulate Matter (lbs/hr – front half)	8,837.89	20.49
Total Mercury (lbs/TBtu)	3.965	3.745
NCASI 8A		
Moisture (%)	10.47	
Sulfur Trioxide (ppm)*	3.5	

*SO₃ was likely in the form of an ammonia salt

4.1.2.3. Repeat of Baseline Flue Gas Measurements

The Baseline Source Test was repeated in April 2007 and the results are shown in Figure 11. In general, there is much better agreement between the CEM, STM, and O-H data than during the first test. Curiously, although the CEMs and STM data showed that the SDA inlet and stack concentrations were nearly equal, the O-H data showed slightly higher concentrations at the stack for each run.

Figure 11. Results of the Second Baseline Mercury Test.

Table 9 is a compilation of both sets of baseline gas measurements. Again, good agreement was observed between different testing methods. The stack flue gas concentrations of halogens and SO₃ were similar to the first test.

Table 9. Summary of the Second Set of Baseline Gas Measurements.

Sampling Trains - Parameters	November '06		April '07	
	SDA Inlet Average	Stack Average	SDA Inlet Average	Stack Average
EPA 5B				
- Moisture (%)		14.80		
- Flow Rate (DSCFM)		294956		
- Particulate Matter (lbs/hr-total)		32.22		
EPA 5 / 17 / 26A / CTM027				
- Moisture (%)	10.69	15.07		14.74
- Flow Rate (DSCFM)	292,800	293,809		295,494
- Particulate Matter (lbs/hr-front half)	10,640	22.09		18.34
- Chlorine (mg/dscm)	0.263	0.384		<0.393
- Ammonia (ppm)	3.2	NA		NA
EPA 5 / 17 / ASTM D6784-02				
- Moisture (%)	10.18	14.72	10.85	15.21
- Flow Rate (DSCFM)	291,987	295,482	305,317	310,113
- Particulate Matter (lbs/hr-front half)	8,837	20.49	9,184	28.29
- Total Mercury (lbs/TBtu)	3.965	3.745	2.944	3.926
NCASI 8A				
- Moisture (%)	10.47			
- Sulfur Trioxide (ppm)	3.5			

*SO₃ was likely in the form of an ammonia salt

*

4.1.2.4. Results of Additional Baseline Testing ($PM_{10}/PM_{2.5}$)

Additional gas measurements were made in September 2007 at the request of a new project partner. Triplicate measurements were made at the stack for PM_{10} , $PM_{2.5}$, and controlled condensate (SO_3). Table 10 is a summary of the results showing that the particulate and SO_3 concentrations were very low. These tests were repeated during the Long-Term test to determine the effect of carbon addition.

Table 10. Summary of Baseline $PM_{10}/PM_{2.5}$ Measurements.

Parameter	Results Average	Units
Particulate ($> PM_{10}$)	0.0030	gr/dscf
	7.90	lbs/hr
Particulate ($< PM_{10}$, $> PM_{2.5}$)	0.0030	gr/dscf
	7.90	lbs/hr
Particulate ($PM_{2.5}$)	0.0023	gr/dscf
	6.31	lbs/hr
Particulate (Total Catch)	0.0494	gr/dscf
	131.10	lbs/hr
Sulfur Trioxide	1.10	ppm

4.1.3. Co-Benefits Analysis

The co-benefit analysis involved studying how mercury removal was affected by normal variations in plant operations or by the use of coal additives or different blends of coal. Normal variations in the plant operations provided an opportunity to investigate how native mercury capture was affected by changes to the SCR, SDA, and FF. Coal additives, to increase the oxidation across the SCR and, subsequently, the mercury capture in the SDA-FF, were also studied. A short test was also conducted to determine the potential of blending western bituminous coal with the PRB coal used by the plant for enhanced mercury removal.

4.1.3.1. Effect of Low Load on Hg Removal

One of the focus areas for these tests was to determine whether any co-benefits to mercury removal could be achieved by varying operation of the other air pollution control devices. Early in the project, data from periods at low boiler load showed that the fraction of oxidized mercury at the inlet to the SDA increased, and, correspondingly, higher mercury removal was achieved across the SDA-FF. This was one of the most significant co-benefit discoveries of the project since little oxidation was expected across the SCR given the low halogen content of PRB coal.

Native mercury removal trends (no carbon injection) for the week of September 11, 2007, are presented in Figure 12. The increased mercury removal at low load can be clearly seen during times when the plant reduced load. Native capture increased from less than 20% to near 50% during these periods. At low load, the fraction of oxidized mercury at the SDA inlet increases significantly and higher mercury removal is achieved across the SDA-FF. It is theorized that, at low load, the plant reduces ammonia flow to the SCR and, consequently, more active sites are available to oxidize mercury.

Figure 12. Effect of Load on Hg Speciation and Native Removal.

4.1.3.2. Coal Blending Tests

Coal blending tests were conducted from December 4 through December 7, 2007. Two companies provided approximately 250 tons of western bituminous coal. Arch Coal provided coal from their West Elk mine near Gunnison, Colorado, and Roundup Trading International provided coal from the Bull Mountain mine near Roundup, Montana. The test matrix included evaluating each coal at 7% and 14% western bituminous mixed with a balance of PRB from the Absaloka mine. Each blend test was scheduled for nominally 16 hours with 8 hours of system recovery time between tests.

Hardin receives all its coal by truck from the nearby Absaloka mine. Coal from the truck unloading station is conveyed into a large storage silo (there is no coal pile at Hardin). The storage silo feeds the main coal belt, which is directed to discharge into one of three bunkers at a time. Each bunker feeds one of three coal mills. For the coal blending tests, the bunkers were emptied until approximately 16 hours of storage was available for the blended coal. Since only one bunker can be filled at a time, it is difficult for the plant to maintain the same level in each bunker. Consequently, for the coal blending tests, it is likely that the blended coal from each bunker reached the boiler at different times and was depleted at different times. This made it difficult to clearly define the beginning and end of each test.

A portable belt conveyor, supplied by the plant, was operated to feed the blend coal onto the main coal belt. A photograph of the portable belt conveyor is shown in Figure 13. The portable conveyor included an adjustable gate at the bottom of the hopper to control coal flow, a weigh scale, and a panel with feed rate and totalizer readouts.

Figure 13. Portable Coal Conveying System at Hardin Station.

Table 11 shows the weights of the various coals blended for each test. The goal was to blend enough coal to test for 16 hours (~ 1200 tons) with an 8-hour period between tests to allow conditions to recover. The target blend percentages were 7% and 14%.

Table 11. Summary of Coal Blending Runs.

Test Date	Absaloka Ton	West Elk Ton	Bull Mtn. Ton	Blended Ton	Blend %	Est. Time in Unit, hr.
12/04/06	928	72		1000	7.2	13.9
12/05/06	1141	174		1315	13.2	18.3
12/06/06	1039		174	1213	14.3	16.8
12/07/06	1036		86	1122	7.7	15.6

Mercury removal during coal blending tests was calculated several ways using values from the Hg-CEMs, coal flow rate, ash mercury content, and estimated vapor-phase mercury concentration calculated from coal mercury values. In most cases, it was possible to determine when the blend coal was being fired based on a decrease in the coal feed rate (western bituminous has a higher Btu content). The mercury content in the coal was

calculated from coal samples taken from the two conveyors at the beginning of each blend run. However, no samples were taken during the first run, so the mercury value is based on samples from the blend coal pile and from the main conveyor several hours after the run was complete.

For the first blend test (West Elk at 7.2%), there was a significant decrease in both the SDA inlet and stack mercury concentrations at the beginning of the test. However, there was no increase in Hg+2, which would suggest that if this decrease was due solely to the coal blend, mercury removal occurred in the particulate phase before reaching the SDA inlet sampling location. Based on this assumption, the mercury removal for the first test was about 50%, calculated using the mercury concentration at the beginning of the test and at its lowest point during the test. If removal is calculated strictly based on inlet and outlet mercury concentrations (i.e., assuming that the drop in the SDA inlet and stack concentrations was due to a change in the coal mercury), then removal increased from 10% to 27% due to coal blending. This was considered the more likely of the two scenarios since between the first and second tests, the mercury concentration did not recover to pretest levels, but coal measurements indicated that there was a drop in coal mercury at this time.

During the second test (West Elk at 13.2%), the stack mercury levels gradually decreased, but the inlet did not. Also, a mill trip halfway through the test caused a large upset and made the results for the second half of the test difficult to interpret. Based on the inlet and outlet concentrations, the mercury removal for the second test increased from 15% to 51%. Figure 14 shows mercury removal as a function of blend percentage for the West Elk tests, calculated from the SDA inlet and stack mercury CEM values. The value of 0% blend percentage is an average of the mercury removal before the blended coal reached the boiler.

Figure 14. Mercury Removal for the West Elk Coal Blend Test.

During the third test (Bull Mountain at 14.3%), the mercury concentration rose steadily throughout the entire run (from 4 to 12 µg/wscm) so it is difficult to estimate removal based on a starting background mercury level. However, based on the inlet and outlet concentrations at the beginning and near the end of the run, the mercury removal for this test only changed from 19% to 22%. The carbon monoxide values during this test were also higher than the other tests, indicating a change in combustion characteristics.

During the final test (Bull Mountain at 7.7%), the mercury removal remained relatively constant throughout the test at about 17%. However, it was difficult to determine exactly when this blend was fired because the coal feed rate did not show the pronounced drop as with the other tests.

Another way in which the native mercury capture was determined for the coal blending was to analyze for mercury in baseline and blending test ash samples from the FF. It should be stressed, however, that it was very difficult to obtain a representative ash sample at Hardin because the FF ash system had difficulty keeping up with the ash loading from the SDA, so the hoppers were often full. And since ash samples were drawn from a port at the bottom of the hopper, it was not possible to judge how long a sample had been in the hopper, or to correlate it to any particular set of operating conditions.

Two sets of baseline hopper samples were collected prior to the blend tests and compared with samples from Hopper B collected during coal blending. A comparison of ash mercury indicates that the mercury removal increased from 5% to 58% during the West Elk tests, which compares well to the CEM data. Unfortunately, during the Bull Mountain tests, the native coal mercury content increased significantly during the test and there is no ash sample that can be used as a reliable baseline indicator. However, if 5% is used for a typical value for native removal, the ash mercury measured during the Bull Mountain tests corresponds to a mercury removal increase from 5 to 14%.

4.1.3.3 Coal Additive Test

Coal Additive Testing was conducted during the week of April 23, 2007. KNX was added directly to each of the three coal feeders just ahead of the pulverizers. Testing began at the vendor's recommended KNX rate. However, it quickly became apparent that this rate was too high for this site so the flow was reduced in stages. Figure 15 shows the mercury removal for several KNX rates. The maximum mercury removal shown was 85% at a KNX rate of 0.5x of the vendor recommended rate.

Figure 15. Mercury Removal for the Coal Additive Test.

Figure 16 shows the mercury trends during a four-hour period in which four different KNX injection rates were tested. The figure shows that it only took a few minutes for the effects of KNX addition to register on the Hg-CEMs. The system also recovered very quickly after stopping KNX flow. The trends also show that the KNX affected the SDA inlet mercury concentration as well as the stack concentration, indicating the mercury removal was occurring in the SCR, AH, or on the fly ash before the SDA inlet. This result indicates that the fly ash at Hardin, which contains about 0.5% unburned carbon, has an affinity for oxidized mercury. Finally, the figure shows that the oxidized mercury formed by KNX addition is completely scrubbed in the SDA-FF. Based upon these results, KNX was later tested in combination with carbon injection during the Parametric test.

Figure 16. Hg-CEM Trends for the Coal Additive Test.

4.1.3.4. Effect of Ammonia on Hg Removal

The Hardin Station spent much of 2008 operating at 105 MW out of 121 MW due to a failure of the step-up transformer and its subsequent, temporary replacement with a smaller unit. When the plant returned to full-load operation, however, the mercury removal was often less than the targeted 90% even though the activated carbon injection rate was at maximum for screw size installed in the injection system. A larger screw was installed on one feed train to increase the maximum feed rate, but maintaining 90% mercury control was still a challenge.

It is believed that atypically high ammonia concentration at the SCR outlet was impacting the performance of the PAC because:

- Plant personnel reported that during a tube leak in March 2008, more than 25% of the SCR was plugged with ash. Consequently, it became necessary to increase ammonia injection to the SCR to maintain NO_x levels.
- On September 16, 2008, an operator noticed that the amount of ammonia being fed to the SCR affected mercury control performance. Figure 17 shows that when the ammonia flow was reduced, mercury removal increased.
- During the source tests in September 2007, a characterization of ammonia feed rate versus mercury control was conducted by measuring ammonia concentration at the AH outlet. During three tests, the plant changed the position of the ammonia control valve from 67% open to 55% open and to 45% open, and the ammonia concentration at the AH outlet decreased proportionally. Figure 18 clearly shows that ammonia affects mercury control performance. It should be noted the ammonia flow rate could not be

measured directly because the flow meter installed for this purpose was found to be over-ranged and not indicating properly.

- After the SCR was refurbished, mercury control performance returned to normal levels.

The mechanism for the ammonia interference may simply be that the ammonia competes with the mercury for sites on the activated carbon. Mercury is present in ppb concentrations while ammonia was measured at ppm levels. The effect ammonia can have on mercury control performance was another significant finding of the co-benefit analysis.

Figure 17. Effect of Ammonia Flow on Mercury Removal, 09/16/08.

Figure 18. Effect of Ammonia Flow on Mercury Removal, 09/23/08.

4.1.4. Parametric Test

The goal of the Parametric test was to evaluate the best candidate sorbents under various operating conditions. Parametric tests involved injecting sorbents into the flue gas upstream of the SDA for short periods (four hours) or until the stack Hg-CEM indicated steady performance. The Hg-CEMs were the basis for all Parametric test results. Parameters that were studied included:

- Sorbent type
- Sorbent injection concentration
- Unit combustion parameters
- Co-benefit enhancement additives

Parametric testing was conducted during the weeks of May 21, May 28, and June 18, 2007. Tests included three activated carbons: DARCO[®] Hg, DARCO[®] Hg-LH, and Calgon FLUEPAC[™]-MC PLUS, as well as one test combining PAC with KNX injection. MC PLUS and Hg-LH are brominated carbons while DARCO[®] Hg is not treated. Unfortunately, due to a super sack malfunction while loading MC PLUS, the results with DARCO[®] Hg were actually a mixture of MC PLUS and DARCO[®] Hg and had to be discounted. Also, the tests combining PAC injection with KNX coal additive are identified only as PAC+KNX because this PAC was also a mixture of the two carbons.

Figure 19 shows very similar performance between the two brominated carbons. Both Hg-LH and MC PLUS removed 90% of mercury at an injection concentration slightly below 1.0 lb/MMacf, which agrees well with results collected in the DOE Cooperative Agreement DE-FC26-03NT41986 at Sunflower Electric's Holcomb Station in 2004, as reported in Topical Report No. 41986R07, June 28, 2005.

When combining the mixed PAC and KNX addition, mercury removal levels were nearly 90% at a PAC loading of only 0.14 lb/MMacf and a relatively low KNX rate. Nearly 100% removal was obtained at a higher KNX rate and 0.14 lb/MMacf of the PAC mix.

Figure 19. Mercury Removal for the Parametric Test.

4.1.5. Optimization Test

Upon completion of the Parametric tests, ADA reviewed results with the project team and identified the most promising options to achieve 90% mercury removal. Each option was then tested for a two-day period to verify performance. Following these tests, ADA compiled an informal report summarizing the results to guide the project team and DOE in choosing the system parameters for the Long-Term activated carbon injection test.

The Optimization test was conducted August 6–9, 2007. Two brominated sorbents were tested: Calgon FLUEPAC™-MC PLUS and NORIT DARCO® Hg-LH. Figure 20 and Figure 21 show that the sorbents performed about the same and achieved 90% mercury removal at a loading of 2.0 lb/MMacf during the two-day tests. When analyzing these figures, it is important to take boiler load into consideration. At low load (90 MW), the sorbents performed better because of the higher amount of oxidized mercury formed at this plant at low load.

Figure 20. Mercury Removal with Calgon FLUEPAC™-MC PLUS.

Figure 21. Mercury Removal with DARCO[®] Hg-LH.

4.1.6. Long-Term Test

After approval from the DOE project officer, the selected sorbent identified in Task 3.4, Hg-LH, was continuously injected into the flue gas over a period eight months. A second sorbent, MC PLUS, was then tested for a two-month period. The Long-Term test was designed to collect the data necessary to evaluate whether sorbent injection created any long-term operational problems, whether 90% mercury control was sustainable, and to ascertain O&M costs.

Long-Term test measurements included a second full suite of manual flue gas measurements (presented in 4.1.6.2) at the SDA inlet and stack involving Hg-CEM measurements, particulate, halogens, sulfur trioxide, and ammonia measurements. The accuracy of the Hg-CEM was verified via a Method 30A RATA, in lieu of O-H measurements, using a mercury analyzer approved as an instrumental reference method (IRM) under 40 CFR Part 75.22.

Notably, three events are so important to the general understanding of the project they are listed and discussed separately at this point.

1. **Hg-CEM Nitrogen Generators (NG)** – On September 5, 2007, nitrogen generators were installed on the Hg-CEMs as an upgrade offered by Thermo Fisher. The purpose of the NGs is to create an oxygen-free gas for use as a carrier gas for calibrations and as a sample dilution and carrier gas. This event is important because it significantly increased the reliability and precision of the Hg-CEM measurements. Up to this time, signal variation was on the order of $\pm 0.5 \mu\text{g/wscm}$. This made it difficult to perform accurate calibrations and to interpret results when the mercury concentration at the stack fell below $0.5 \mu\text{g/wscm}$, which was often the case during coal additive and Parametric testing. The NGs reduced signal variation to nominally $\pm 0.05 \mu\text{g/wscm}$.
2. **Step-Up Transformer Failure** – The Long-Term test began on September 26, 2007. On December 15, 2007, the plant's step-up transformer failed. On February 5, 2008, this transformer was replaced with a temporary, smaller unit that limited operation to 106 MW out of 121 MW. This is important because at low load the native mercury capture and, therefore, overall mercury capture increases at Hardin. This was discussed with the project team and it was decided to continue the Long-Term test in spite of the consequence to the interpretation of results. The original transformer was repaired and re-installed on July 22, 2008.
3. **SCR Deposition** – On March 13, 2008, shortly after the Long-Term test resumed with the temporary transformer, a tube leak caused $> 25\%$ of the SCR to be plugged with ash. To compensate for the reduced available SCR surface area, the plant increased ammonia flow to maintain NO_x emission levels. However, the ammonia flow meter was not functioning properly and this significant operational change went unnoticed by ADA until the original transformer was reinstalled on July 22, 2008. At this time, mercury capture performance decreased significantly and it was discovered that excess ammonia negatively affects capture at full load (121 MW). The SCR was refurbished and the unit returned to "normal" operation on October 26, 2008. The Long-Term test ended on November 17, 2008.

Taken in combination, these events reduced the time at which the unit was operating normally during the 12-month (total duration) Long-Term test to about two months. However, valuable information was gained about the effect of the SCR and excess ammonia on mercury capture.

The section below presents the long-term data from shortly after start-up and for every quarter thereafter. Operating data for the quarterly results are presented as bulleted highlights for each quarter. Some important information is given in these highlights such as when outages occurred and when upgrades to the Hg-CEMs were implemented, etc. Table 12 presents the entire timeline for the Long-Term test.

Table 12. Timeline for the Long-Term Test.

3 Q 07	9/5/07: Nitrogen Generators installed on Hg-CEMs - performance significantly improved 9/26/07: Began Long Term Test with DARCO® Hg-LH 90% removal at AC of 1.5-2.75 lb/MMacf and 121 MW.
4 Q 07	12/6/07: Mercuric Chloride Generator installed on Stack Hg-CEM 12/15/07: Step-up transformer failed causing 2-mo outage
1 Q 08	2/5/08: Plant resumed operation at 106 MW of 121 MW 2/25/08: Resumed Long Term Tests with Hg-LH 90% removal at AC of 1.0-2.5 lb/MMacf and 106 MW 3/6/08: New Carbon w/low Br - 90% removal at AC of 2.0-2.75(max) lb/MMacf and 106 MW. 3/13/08: Major tube leak plugged 25+% of SCR Cannot maintain 90% with low Br carbon and and high NH3 slip
2 Q 08	4/7/08: New Carbon - 90% removal at AC of 1.75-2.5 lb/MMacf and 106 MW. 4/21/08: First Method 30A RATA Tests 5/14/08: New Carbon - 90% removal at AC of 1.0-1.75 lb/MMacf and 106 MW. 5/26/08-6/16/08: Dispatch Outage.
3 Q 08	7/4/08-7/22/08: Outage to install new step-up transformer. Could not maintain 90% removal w/high NH3 slip and 121 MW. 8/19/08: Long Term Test concluded with DARCO® Hg-LH DARCO® Hg-LH was tested for 167 days during which 208,731 lb were fed 8/26/08: Began Calgon FLUEPAC®-MC PLUS for 2-mo test Could not maintain 90% removal at 2.75-3.0 lb/MMacf w/high NH3 slip and 121 MW. 9/22/08: Manual Sampling for Long Term and second M30A RATAs.
4 Q 08	10/13/08: Final M30A RATA Test. Dynamic Spike Test. 10/19/08-10/26/08: Outage to refurbish SCR. 10/29/08: Resume test w/Calgon MC PLUS 90% removal at 2.0-3.0 lb/MMacf and 116 MW. 11/17/08: Long Term Test completed Calgon FLUEPAC®-MC PLUS was tested for 60 days during which 110,431 lb were fed Began Test with ADA Power PAC Premium (not part of DOE Project) 90% removal at 2.0-3.0 lb/MMacf and 121 MW.
1 Q 09	1/14/08-.....: Running in auto with emissions control. Emissions under 0.9 lb/TBtu at 1.0-3.0 lb/MMacf

4.1.6.1. Long-Term Test Data

The first phase of the Long-Term test began on September 26, 2007. Shortly after start-up using DARCO® Hg-LH, 90% mercury removal was consistently achieved at a carbon loading of 1.5 lb/MMacf as shown in Figure 22. Removal increased to 95% at low load even though the carbon feed rate was automatically reduced by a ratio of the current load to full load.

Figure 22. System Performance after the Start of the Long-Term Test.

4Q07 Performance trends are presented in Figure 23.

- The goal of 90% mercury removal was achieved and often exceeded with DARCO[®] Hg-LH. At full load (121 MW), 90% removal was maintained at ACI of 2.0–2.5 lb/MMacf.
- Inlet mercury concentration varied from 2–10 µg/wscm.
- **12/17/07: The plant's step-up transformer failed, leading to a 2-month outage.**

Figure 23. 4Q07 Long-Term Mercury Removal with DARCO[®] Hg-LH.

1Q08 Performance trends are presented in Figure 24.

- **Outage:** 12/15/07–02/05/08: step-up transformer failure. A temporary, smaller transformer installed that **limited load to 106 MW out of 121 MW**.
- 02/25/08: Resumed Long-Term tests with Hg-LH.
- At “full” load (106 MW), achieved 90% removal at ACI of 1.5–2.75 lb/MMacf.
- 03/06/08: A new batch of PAC was received with low Br concentration; could not always achieve 90% removal with this PAC.
- **03/13/08: Tube leak plugged 25+% of the SCR.**
- Inlet mercury concentration varied from 2–12 $\mu\text{g/wscm}$.

Figure 24. 1Q08 Long-Term Mercury Removal with DARCO® Hg-LH.

There were several instances during 1Q08 when the system could not maintain 90% removal at the maximum feed rate of the screw feeder (about 3.75 lb/MMacf). This was normally not an issue. Three theories were developed as to the cause of the poor performance. The first two were checked and discounted as discussed below.

1. Higher Baghouse Temperature – There was no significant difference in the baghouse temperature during this period compared to previous periods.
2. Poor inlet Hg-CEM Measurements – The inlet CEM was operating well during this period according to the daily QA checks. An ADA representative inspected the system to assure proper operation and noted that the inlet stinger heater had failed. This was repaired but did not change the relative mercury measurements.
3. Inconsistent Batch of PAC – The poor performance appeared to correlate with the receipt of a new truckload of activated carbon. During a routine comparison of feed rates calculated by a) the loss in weight of the silo as determined by load cells, and b) the screw speed and a typical value for sorbent density, the difference in feed rate was found to be about 10% when, historically, the difference was less than 1%. Further analyses of samples from the suspect batch and batches that performed well indicated leachable bromine content for the suspect batch of 2.5% when, historically, this value is around 5.5%.

Later in the project, it was discovered that during this quarter, a tube leak in March plugged 25⁺% of the SCR with ash. This resulted in higher ammonia injection rates to maintain permitted NO_x levels. The high ammonia levels were later determined to affect PAC performance (see section 4.1.3.4). However, because the boiler was de-rated to 106 MW and the ammonia flow meter was not operating properly, the full effects of the compromised SCR were not realized until the original transformer was reinstalled and 121 MW operations resumed. It is possible that the high ammonia rates, combined with the lower bromine content of one batch, resulted in the relatively poor performance observed during the latter part of this quarter.

2Q08 Performance trends are presented in Figure 25.

- 04/21/08: The first Method 30A RATA test was performed on the Hg-CEMs.
- 05/14/08: A new batch of PAC gave 90% removal at 1.0–1.75 lb/MMacf.
- **Upgrade:** Feedback control was implemented into the ACI control logic. The system was able to maintain 90% mercury removal in automatic.
- Inlet mercury concentration varied from 1–8 $\mu\text{g/wscm}$.
- **Outage:** 05/26–06/16/08 due to dispatch.

Figure 25. 2Q08 Long-Term Mercury Removal with DARCO® Hg-LH

3Q08 Performance trends are presented in Figure 26.

- **07/04–22/08: Outage to reinstall the 121 MW step-up transformer.**
- 90% removal was not achieved at 121 MW due to excess ammonia (see 4.1.3.4).
- 08/19/08: Long-Term test concluded with DARCO® Hg-LH. It was injected for 167 days during which 208,731 lb were fed.
- 08/26/08: Began injecting Calgon FLUEPAC™-MC PLUS for a two-month test.
- Could not maintain 90% removal due to excess ammonia when operating at 121 MW.
- 09/22/08: Completed the manual sampling tests with ACI and the second M30A RATA.
- Inlet mercury concentration varied from 2–9 µg/wscm.

Figure 26. 3Q08 Mercury Removal with Hg-LH and MC PLUS.

4Q08 Performance trends are presented in Figure 27.

- 10/13/08: Completed the final M30A RATA Test including a Dynamic Spike Test.
- 10/19–26/08: Outage to refurbish the SCR.
- **10/29/08: Resume test with Calgon MC PLUS.**
- Achieved 90% removal at 2.0–3.0 lb/MMacf (116 MW).
- **11/17/08: Completed the Long-Term test. Calgon FLUEPAC™-MC PLUS was tested for 60 days, during which 110,431 lb were fed.**
- Began a test with ADA's Power PAC *PREMIUM* carbon (not part of the DOE project). Initial results showed 90% mercury removal at ACI of 1.0–2.0 lb/MMacf.
- Inlet mercury concentration varied from 2.5–8.5 µg/wscm.

Figure 27. 4Q08 Mercury Removal with MC PLUS and ADA Power PAC *PREMIUM*.

4.1.6.2. Comparison of Baseline and Long-Term Source Testing

Manual gas measurements were collected during baseline testing and after several months of ACI to determine the effects of ACI on emissions. Sampling was conducted at the AH outlet ahead of the ACI location and at the stack. Measurements at the AH Outlet included particulates, condensables (SO₃), halogens (Cl, HCl, Br, HBr, and F), and ammonia. Measurements at the stack included particulates (including PM₁₀/PM_{2.5}), condensables (SO₃), and halogens (Cl, HCl, Br, HBr, and F). Complete tables of all the sampling results are included in Appendix E.

Table 13 lists the sampling results at the AH Outlet/SDA Inlet. There was generally good agreement between the two test dates except that the Cl and SO₃ values were slightly higher during the Long-Term tests, but this is likely caused by a difference in boiler operation and coal properties than as a result of PAC injection. It should be noted that the high ammonia value for the Long-Term test is unrepresentative of normal operations. The plant was injecting at high ammonia rates during this period because the SCR was more than 25% plugged with ash and the high rates were needed to maintain permitted NO_x levels. After the SCR was refurbished, ammonia usage dropped significantly.

Table 13. Comparison of Baseline and Long-Term Gas Measurements at the SDA Inlet at Hardin.

Particulate, Ammonia, Halogens, SO ₃	Baseline	Long Term
Test Date	12/2006	9/2008
Flow Rate – DSCFM (STP=29.92"Hg, 68°F)	292,800	293,196
Gas Temp. - °F	319	333
O ₂ - %Vol. (dry)	5.6	5.6
CO ₂ - %Vol. (dry)	13.8	13.9
Moisture Content - %	10.69	11.12
Particulate – gr/dscf (Front Half)	4.2394	4.6874
– lbs/hr (Front Half)	10640	11786
Ammonia - ppm	3.2	57.34
Chlorine – mg	0.175	0.611
– mg/dscm	0.263	0.836
Hydrogen Chloride – mg	ND	0.676
– mg/dscm	ND	0.914
Bromine – mg	ND	<0.080
– mg/dscm	ND	<0.110
Hydrogen Bromide – mg	ND	<0.024
– mg/dscm	ND	<0.034
Hydrogen Fluoride – mg	ND	<0.027
– mg/dscm	ND	<0.038
Sulfur Trioxide		
- Moisture Content - %	0.555	0.514
- Sample Volume – DSCM	10.48	10.50
- ppm	3.50	5.99

Table 14 lists the particulate and halogen values measured at the stack. The table shows that there was no significant difference in the particulate concentration at the stack during Baseline (22.1 and 18.9 lb/hr) and ACI testing (20.1 lb/hr). It also shows that there was no measurable amount of halogens, including bromine, in the stack gas except for some Cl measured during the final tests in concentrations just above the detection limit.

Table 14. Comparison of Baseline and Long Term Gas Measurements at the Stack at Hardin.

Particulate and Halogens		Baseline and Repeat		Long Term
Test Date		12/2006	4/2007	9/2008
Flow Rate – dscfm (STP=29.92"Hg, 68°F)		293,809	295,494	303,428
Stack Temp. - °F		209	224	207
O ₂ - %Vol. (dry)		6.9	6.7	6.1
CO ₂ - %Vol. (dry)		12.5	12.6	13.6
Moisture Content - %		15.07	14.74	15.52
Particulate				
- gr/dscf (Front Half)		0.0088	0.0072	0.0082
- lbs/hr (Front Half)		22.09	18.34	20.07
Chlorine	– mg	<0.468	<0.467	0.495
	– mg/dscm	<0.384	<0.393	0.474
Hydrogen Chloride	– mg	ND	<0.272	<0.303
	– mg/dscm	ND	<0.229	<0.285
Bromine	– mg	ND	<0.950	<0.082
	– mg/dscm	ND	<0.799	<0.079
Hydrogen Bromide	– mg	ND	<0.930	<0.032
	– mg/dscm	ND	<0.779	<0.030
Hydrogen Fluoride	– mg	ND	<0.286	<0.017
	– mg/dscm	ND	<0.241	<0.017

Table 15 lists the results of PM₁₀/PM_{2.5} and SO₃ measurements. The table shows a slight increase in the >PM₁₀ level and slight decreases in the <PM₁₀>PM_{2.5} and PM_{2.5} levels. These results indicate the ACI had no significant effect on fine particulate emissions.

Table 15. Comparison of Baseline and Long-Term PM and SO₃ Measurements at the Stack at Hardin.

Particulate PM₁₀/PM_{2.5} and SO₃	Baseline	Long Term
Test Date	09/2007	9/2008
Flow Rate – dscfm (STP=29.92"Hg, 68°F)	311,182	285,972
Stack Temp. - °F	220	212
O2 - %Vol. (dry)	6.7	6.2
CO2 - %Vol. (dry)	12.8	13.4
Percent Excess Air	46.1	41
Moisture Content - %	15.18	15.24
Particulate (>PM10) - gr/dscf	0.0030	0.0044
- lbs/hr	7.90	10.76
Particulate (<PM10>PM2.5) - gr/dscf	0.0030	0.0031
- lbs/hr	7.90	7.70
Particulate (PM2.5) - gr/dscf	0.0023	0.0022
- lbs/hr	6.31	5.27
Particulate Total - gr/dscf	0.0083	0.0097
- lbs/hr	22.11	23.73
Sulfur Trioxide		
- Moisture Content - %	14.88	15.66
- Sample Volume – DSCM	0.508	0.518
- ppm	1.10	1.22

4.2. Coal and Coal Byproduct Sample Evaluation

Samples of coal and ash were collected and analyzed in conjunction with the baseline and Long-Term tests. Sample locations at Hardin are shown in Figure 28. Ultimate, proximate, and calorific analyses were performed on select coal samples as well as determinations for mercury and halogen content. Fly ash, bottom ash, and SDA slurry samples were analyzed for mercury content, LOI carbon, total carbon, and organic carbon. Ash sample from Baseline and Long-Term tests were analyzed by the synthetic groundwater leaching procedure (SGLP) for mercury and other trace constituent stability. Several large FF ash samples (five gallon) were also collected in accordance with DOE/NETL requirements from the Baseline and Long-Term tests and sent to DOE. A complete accounting of all chemical analyses is included in Appendix F.

Figure 28. Sampling Locations at Hardin.

4.2.1. SGLP Results

The synthetic groundwater leaching procedure (SGLP) was developed at the University of North Dakota Energy and Environmental Research Center (EERC). It was designed to simulate the leaching of coal combustion byproducts (CCB) under more realistic conditions than the toxicity characteristic leaching procedure (TCLP). SGLP is modeled after TCLP, but uses deionized water for leaching, instead of an acidic solution, to more closely simulate the conditions found in a sanitary landfill. In the SGLP, samples are diluted 20:1 (liquid to solid ratio) and then agitated end-over-end. Samples are extracted after 18 hours and 20 days and analyzed for trace constituents. Hydration reactions that can take days or weeks to complete often incorporate trace toxins so that the 30-day concentration of these species is often lower than the 18-hour concentration.

An SGLP was conducted on a baseline (no ACI) ash sample and a sample collected after months of ACI with a brominated PAC. Trace materials, including bromide, chloride, fluoride, arsenic, selenium, and mercury, were measured after 18 hours and 30 days of agitation. The concentrations of these species were also measured in the raw samples to determine a maximum possible concentration for the leachate. These values are represented by “Max” in the following table and figure.

Table 16 and Figure 29 show the results of the SGLP. The leachate concentrations in the six figures are compared to EPA’s maximum containment level (MCL) for drinking water for all species except chloride and bromide that have no MCL. MCL levels are much stricter than the RCRA leaching values for sanitary landfills. In all cases, the leachate concentrations are below the MCL and decrease over time due to slow reactions with other ash constituents. The figures also show that, although the use of a brominated PAC increases the mercury concentration in the waste ash, the mercury does not leach from the sample. The table also gives the percentage of total constituent (Max) that was measured in the leachate.

Table 16. SGLP Results on Baseline and Long-Term Ash Samples.

Arsenic mg/L	FF-B Ash			
	Baseline	% Leach	Long Term	% Leach
Max	0.25		0.35	
18-hr	<0.01	#N/A	<0.01	#N/A
30-day	<0.01	#N/A	<0.01	#N/A

Bromide mg/L	FF-B Ash			
	Baseline	% Leach	Long Term	% Leach
Max	1.00		6.5	
18-hr	1.33	133	5.35	82
30-day	0.29	29	3.26	50

Chloride mg/L	FF-B Ash			
	Baseline	% Leach	Long Term	% Leach
Max	31		27	
18-hr	24	77	17	63
30-day	23	74	16	59

Fluoride mg/L	FF-B Ash			
	Baseline	% Leach	Long Term	% Leach
Max	16.5		19.5	
18-hr	2.33	14	2.33	12
30-day	0.05	0	0.12	1

Selenium mg/L	FF-B Ash			
	Baseline	% Leach	Long Term	% Leach
Max	0.25		0.2	
18-hr	0.01	4	<0.01	#N/A
30-day	<0.01	#N/A	<0.01	#N/A

Mercury mg/L	FF-B Ash			
	Baseline	% Leach	Long Term	% Leach
Max	0.00373		0.0133	
18-hr	0.000113	3	3.37E-05	0
30-day	5.4E-07	0	9.9E-07	0

Figure 29. Results of the SGLP Leaching Test on Ash Samples with and without Carbon Injection.

4.2.2. Ash Analysis With and Without PAC

Ash samples were collected from the six FF hoppers on several occasions and from the B hopper on a regular basis. The samples were analyzed for moisture, carbon, and mercury. Samples of bottom ash and SDA slurry were also analyzed for mercury and found to contain less than the detection limit.

Early in the test, the values obtained for carbon concentration in the ash were uncharacteristically high. The method used to determine the carbon levels was the loss on ignition (LOI) test. This test involves weighing, drying, weighing, and then heating the sample to drive off carbon, followed by a final weighing. However, it is known that for ash containing SDA solids, this method produces falsely high values probably because the heating process also drives off waters of hydration bound to the calcium sulphite and sulphate formed in the SDA. Therefore, the test procedure was changed to one that determines total carbon. However, these values also seemed high and the reason was traced to the fact that SDA solids contain a small amount of calcium carbonate from the lime used in the scrubbing process. Finally, a test was chosen that measures only organic carbon, not carbon tied up with other species like carbonates. This test produced results consistent with LOI values obtained from ash samples collected upstream of the SDA. Figure 30 shows the results of three analyses performed on the same ash samples.

Figure 30. Comparison of LOI, Total, and Organic Carbon in Ash with SDA Solids.

Figure 31 shows the results of analyses performed on ash samples taken in-situ from the duct upstream of the SDA and downstream of the ACI location. The ash was collected with a device known as a CEGRT. The figure shows that both carbon and mercury concentration increases as carbon loading increases. The carbon increase was expected, however the increase in ash mercury indicates that mercury was being absorbed onto the carbon even before the SDA and FF.

Figure 31. CEGRIT In-Situ Ash Analyses Downstream of the ACI Location.

Figure 32 is included to demonstrate the time required for the mercury concentration in the FF ash to reach a steady value. A large portion of the ash at Hardin is re-slurried and reinjected into the SDA to increase lime utilization and to increase the solids concentration of the lime/ash slurry mixture. The large hold-up of material in the ash slurry tanks increases the time required for the mercury in the ash to reach a steady level. It also makes it difficult to obtain a representative sample of ash from the hoppers for any short-term test. The figure shows that it takes at least several days for the ash mercury to reach a steady value.

Figure 32. Mercury in FF Ash Samples during the Optimization Test.

Figure 33 shows how the mercury and bromine concentration in the ash increased during the coal additive test with KNX. Mercury concentration increased from an average of 53 to 158 ppb and bromine increased from 4 to 181 ppm.

Figure 33. Hg and Br in FF Ash before and during the KNX Test.

4.2.3. Coal Properties

Hardin burns a PRB coal from the local Absaloka mine. Coal samples were collected from the main feed belt leading to the three coal bunkers. The coal bunkers have a nominal 16-hour capacity at full load. Table 17 shows the average, minimum, maximum, standard deviation, and sample size for all of analyses completed on Absaloka coal. For the samples taken, mercury averaged 46 ppm with a high of 94 ppm and a low of 14 ppm. This corresponds well to minimum and maximum mercury concentrations measured at the SDA inlet, nominally 2–10 $\mu\text{g/wscm}$ (as a general rule of thumb for Hardin, and as confirmed by combustion calculations, the mercury concentration of the gas can be estimated by dividing the coal mercury, in ppm, by 10 to give the gas concentration in $\mu\text{g/wscm}$). The coal table in Appendix F also shows that coal mercury was variable from sample to sample, which accounts for the day-to-day variations recorded by the Hg-CEMs.

Table 17. Absaloka Coal Properties at Hardin.

Absaloka Coal	% H ₂ O	Hg as rec (ng/g)	Hg dry (ng/g)	% Ash (as rec)	% FC (as rec)	% H ₂ O (as rec)	% S (as rec)	% Vol (as rec)	Btu/lb (as rec)	MAF (Btu/lb)
Average	11.73	40.82	46.16	8.22	37.84	24.38	0.55	29.55	8807	13066
Min	7.80	12.00	13.60	5.85	35.37	23.29	0.40	27.04	8533	12695
Max	16.10	84.31	94.10	10.04	39.81	26.55	0.70	31.82	9231	13268
Std Dev	2.31	17.12	18.99	1.14	1.36	0.76	0.08	1.15	192	142
No. of Samples	32	32	32	19	19	19	19	19	19	19

Absaloka Coal	Br (ug/g)	Cl (ug/g)	F (ug/g)	% Ash (as rec)	% C (as rec)	% H (as rec)	% H ₂ O (as rec)	% N (as rec)	% O (as rec)	% S (as rec)
Average	1.72	30.75	42.50	8.22	51.12	3.46	24.38	0.66	11.61	0.55
Min	1.20	6.00	25.00	5.85	49.73	3.22	23.29	0.48	10.68	0.40
Max	2.80	77.00	60.00	10.04	53.40	3.61	26.55	0.74	13.48	0.70
Std Dev	0.67	22.64	24.75	1.14	0.91	0.11	0.76	0.07	0.55	0.08
No. of Samples	5	8	2	19	19	19	19	19	19	19

5. ECONOMIC ANALYSIS

After completion of testing and analysis of the data, the requirements and costs for full-scale, permanent commercial implementation of the necessary equipment for mercury control using sorbent injection at the 121-MW Hardin Generating Station were determined. The related process equipment was sized and designed based on the Long-Term test results for 90% mercury control. Plant-specific requirements (sorbent storage capacity, plant arrangement, retrofit issues, winterization, controls interface, etc.) were also considered when determining the final cost. The system design was based on the criteria listed in Table 18.

Table 18. Design Criteria for the Mercury Control System at Hardin (50 lb/hr PAC Injection, 90% Mercury Control).

Parameter	Activated Carbon
Number of silos	1
Number of injection trains	2
Design feed capacity/train (lb/hr)	100
Operating feed capacity/train (lb/hr)	50
Sorbent storage capacity (lbs)	40,000
Conveying distance (ft)	250
Sorbent	DARCO [®] Hg-LH
Aerated density (lb/ft ³)	18
Settled density (lb/ft ³)	28
Particle MMD (microns)	18

The estimated uninstalled cost for an activated carbon injection system and storage silo for the 121-MW unit is \$781,000. Costs were estimated based on a long-term activated carbon injection concentration of 1.75 lb/MMacf. For Hardin, this would require an injection rate of nominally 50 lbs/hr of activated carbon at full load. Assuming a unit capacity factor of 81% and a delivered cost of \$1.00/lb for DARCO[®] Hg-LH sorbent, the annual sorbent cost for injecting upstream of the existing SDA and FF would be about \$355,000. This corresponds to a nominal sorbent cost of \$7,250 per pound of mercury removed.

Results from the field tests conducted to date indicate different levels of mercury removal can be achieved depending on the air pollution control equipment and different flue gas conditions. Data collected from the Phase I DOE tests at Gaston indicate mercury removal levels of up to 90% were obtained with COHPAC[®] (a baghouse installed downstream of an ESP) and DARCO[®] Hg sorbent injection. At Pleasant Prairie, 50–70% removal while injecting DARCO[®] Hg was the maximum achievable mercury control, with the configuration of an ESP collecting PRB ash. At Brayton Point, mercury removal levels of up to 90% were obtained with an ESP collecting bituminous ash with DARCO[®] Hg sorbent injection. DOE Phase II testing at Holcomb showed mercury removal levels of 90% were obtained with an SDA and FF while injecting DARCO[®] Hg-LH. Data from Hardin and seven other sites are summarized in Table 19.

Table 19. Mercury Removal Efficiencies and Costs for Different APC Configurations, Coals, and Sorbents.

Plant	APC Equipment	Coal	Sorbent	Removal %	Sorbent Cost (mills/kWh)
Gaston	COHPAC [®]	Bituminous	DARCO [®] Hg	90	0.43
Pleasant Prairie	ESP	PRB	DARCO [®] Hg	67	1.2
Brayton Point	ESP	Bituminous	DARCO [®] Hg	90	2.4
Holcomb	SDA-FF	PRB	DARCO [®] Hg-LH	90	0.44
Meramec	ESP	PRB	DARCO [®] Hg-LH	90	0.74
Independence	TOXECON II [™]	PRB	DARCO [®] Hg-LH	80	1.14
Merrimack	ESP	Bituminous	DARCO [®] Hg-LH with trona	70	1.31
Hardin	SDA-FF	PRB	DARCO [®] Hg-LH	90	0.41

The results from Hardin indicate that using DARCO[®] Hg-LH would result in similar mercury removal (90%) at less cost than at Holcomb. Both units have an SDA and FF and fire PRB coals; however, Hardin uses ash recycle to the SDA whereas Holcomb does not. A critical difference in the sorbent costs is the improved effectiveness of brominated carbon over unbrominated carbon, the only sorbent available during testing at Brayton Point. These results are presented as mills/kWh in Table 20 and as \$/kWh in Table 21. The use of DARCO[®] Hg-LH at Hardin resulted in mercury removal at projected costs similar to what would be expected at sites using an SDA and FF for emissions control combusting PRB coal.

5.1. System Description

For this cost estimate, the permanent PAC injection system for Hardin will consist of one bulk storage silo and two dilute-phase pneumatic conveying systems. DARCO[®] Hg-LH sorbent will be received in 40,000-pound batches delivered by pneumatic bulk tanker trucks. The silo is equipped with a pulse jet type bin vent filter to contain dust during the loading process. The silo is a shop-built, dry-welded tank with two mass flow discharge cones. Point level probes and weigh cells monitor sorbent level and inventory. Silo sizing was based on the capacity to hold approximately one truckload of DARCO[®] Hg-LH sorbent, sufficient for 33 days of operation at the design injection rate.

The sorbent is fed from the discharge cone by a rotary valve into feeder hoppers. From the hoppers the sorbent is metered into the conveying lines by volumetric feeders. Conveying air

supplied by regenerative blowers passes through an eductor, which provides suction to draw the sorbent into the conveying piping and carry it to the injection lance. The blowers and feeder trains are contained beneath the silo.

A Programmable Logic Controller (PLC) is used to control all aspects of system operation. The PLC and other control components will be mounted in a NEMA4 control panel. The control panel, motor control centers (MCCs), and disconnects will be housed in a prefabricated power and control building located adjacent to the silo.

5.2. Cost and Economic Methodology

Costs for the sorbent storage and injection equipment were provided by ADA based on the design requirements in Table 18. ADA has built and installed many similar systems at coal-fired power plants for mercury control. Estimated costs for the distribution manifold, piping and injection lances, installation man-hour and crane-hour estimates, and an estimate for foundations including pilings are also included. As construction costs are rising rapidly, these costs are tentative and very dependent upon local labor conditions as well as current national demand for related equipment.

EPRI Technical Assessment Guide (TAG) methodology was used to determine the indirect costs. A project contingency of 15% was used. Since the technology is relatively simple and well proven on similar scale, the process contingency was set at 5%. Based upon requested guarantee language, that contingency may increase to cover anticipated risks for a newer technology. ACI equipment can be installed in a few months; therefore, no adjustment was made for interest during construction, a significant cost factor for large construction projects lasting several years.

Operating costs include sorbent costs, electric power, operating labor, maintenance (labor and materials), and spare parts. An average incremental operating labor requirement of one hour per day per injection system was estimated to cover the incremental labor to operate and monitor the ACI injection system. The annual maintenance costs were based on 5% of the uninstalled equipment cost.

Levelized costs were developed based on a twenty-year book life and are presented in constant dollars.

5.3. Capital Costs

The uninstalled activated carbon storage and feed equipment costs are estimated at \$781,000. The estimated cost for the sorbent injection system and storage silo installed at the 121-MW unit is \$1,574,000 and includes all process equipment, foundations, support steel, plant modifications utility interfaces, engineering, taxes, overhead, and contingencies. The capital and O&M costs are summarized in Table 20.

Table 20. Capital and O&M Cost Estimate for the ACI System at Hardin. Annual Basis 2008.

Capital Costs Summary	
Equipment, FOB Hardin	\$781,000
Site Integration (materials and labor)	\$95,000
Installation (ACI silo and process equipment, foundations)	\$250,000
Taxes (6%)	\$56,000
Indirects/Contingencies	\$393,000
Total Capital Required	\$1,574,000
\$/kW	\$13.01

Operating and Maintenance Costs Summary	
Sorbent @ \$1.00/lb, DARCO [®] Hg-LH	\$355,000
Power, labor, maintenance	\$85,000
Variable O&M for 2008 (\$/kW)	\$3.64
Variable Mills/kW-hr	0.51

5.4. Operating and Levelized Costs

The most significant operational cost of sorbent injection for mercury control is the DARCO[®] Hg-LH sorbent. Sorbent costs were estimated for 90% mercury control based on the long-term sorbent injection concentration of 1.75 lbs/MMacf for activated carbon. For Hardin, this would require an injection rate of nominally 50 lbs/hr of activated carbon at full load. Assuming a unit capacity factor of 81% and a delivered activated carbon cost of \$1.00/lb, the twenty-year levelized annual cost of injecting sorbent at the SDA and FF inlet would be \$744,000. Included in this is other annual operating levelized costs including electric power, operating labor, and maintenance.

Based on the test program results and assuming that sorbent injection at the SDA inlet for mercury control is sustainable, an average of 90% mercury control can be attained at Hardin for an initial capital investment of \$1,574,000 with first year operating costs of \$5.68/kW, or annual twenty-year constant-dollar levelized costs of \$6.15/kW. This information is summarized in Table 21.

Table 21. Levelized Costs

Twenty-Year Levelized Costs Summary—\$ Constant	
Fixed Twenty-Year Levelized Costs	\$184,000
Variable O&M Twenty-Year Levelized Costs	\$560,000
Total Twenty-Year Levelized Costs	\$744,000
Fixed Levelized Costs \$/kW	\$1.52
First-Year Operating Levelized Costs \$/kW	\$3.64
Total Twenty-Year Levelized Costs \$/kW	\$6.15
First-Year Operating Levelized Costs mills/kW-hr	0.51
Total Twenty-Year Levelized Costs mills/kW-hr	0.87
Total Twenty-Year Levelized Cost \$/lb Hg removed	\$15,000

6. CONCLUSIONS

The main project objective of 90% mercury removal was achieved with two brominated PACs, DARCO® Hg-LH and Calgon FLUEPAC™-MC Plus. Shorter-term results with ADA Power PAC *PREMIUM* also indicate that it is capable of 90% mercury removal at similar ACI rates. At full load (121 MW) and under normal operating conditions, 90% mercury removal was maintained at carbon loadings of 1.5 to 2.5 lb/MMacf depending on the inlet mercury flue gas concentration. Much less carbon is needed at lower loads due to the higher mercury oxidation across the SCR. The twenty-year levelized cost was determined to be 0.87 mills/kW-hr or \$15,000/lb mercury removed.

- Manual Gas Measurements
 - The only halogen detected at either the SDA Inlet or Stack was chlorine and it was present in low concentrations (no HCl, HBr, HF, Br, or F). The ammonia concentration at the SDA Inlet was 3.2 ppm and the sulfur trioxide was 3.5–6.0 ppm (all sulphates are reported as SO₃ but were likely ammonia salts). The sulfur trioxide measured at the Stack was 1.2 ppm (also likely that SO₃ was present as ammonia salts). The particulate measurements at the stack, including PM₁₀/PM_{2.5} were not impacted by ACI.
 - Baseline Ontario Hydro and STM measurements agreed well with the Hg-CEMs.
- Co-Benefit Analysis
 - Mercury removal trends show that mercury removal increases at low load from less than 20% to as high as 50% due to the increased oxidation across the SCR. All of the oxidized mercury is scrubbed in the SDA-FF. It is theorized that the increase in mercury oxidation at low load results from the corresponding decrease in ammonia flow. With less ammonia in the SCR, mercury is able to more successfully compete for oxidation sites on the catalyst.
 - High levels of ammonia were found to negatively impact mercury removal during ACI. It is believed that the ammonia competes with mercury for active sites on the PAC. Ammonia is present in ppm quantities whereas mercury is at ppb levels.
- Coal Blending Tests – Blends with West Elk coal increased native mercury capture from 10 to 27% at a 7% blend, and from 15 to 51 % at a 14% blend. Blends with Bull Mountain coal showed only marginal increases in mercury removal.
- Coal Additive Test – KNX achieved a maximum mercury capture of 85% with no ACI.
- Parametric Test
 - Both DARCO® Hg-LH and Calgon FLUEPAC™-MC Plus achieved 90% mercury capture at a carbon loading of about 1.0 lb/MMacf.
 - The test combining KNX addition with PAC injection achieved 90% removal at a carbon loading of 0.14 lb/MMacf and a low KNX rate. When the KNX was increased, >95% mercury removal was achieved.

- Hg-CEM Upgrades – The addition of Nitrogen Generators on the Hg-CEMs increased the precision from nominally ± 0.5 $\mu\text{g/wscm}$ to less than ± 0.1 $\mu\text{g/wscm}$.
- Integration of PAC Silo Control and Hg-CEMs – The control scheme for the PAC silo was successfully integrated with feedback from Hg-CEMs. As much as a 50% reduction in carbon usage was realized at low load. Plant personnel were successfully trained in the operations of the Hg-CEMs and ACI systems. Plant personnel operated the ACI system during the last portion of the Long-Term test.
- Method 30A RATA – The Hg-CEMs installed at Hardin passed three RATA tests conducted by the EPA Method 30A.

LIST OF ACRONYMS AND ABBREVIATIONS

ACI	Activated carbon injection
AH	Air heater
CAMR	Clean Air Mercury Rule
CCB	Coal combustion byproducts
CEM	Continuous emission monitor
DOE	Department of Energy
EPA	Environmental Protection Agency
FF	Fabric filter
Hg+2	Oxidized gaseous mercury
Hg0	Elemental gaseous mercury
Hg-CEM	Mercury continuous emission monitor
HgT	Total gaseous mercury
IRM	Instrumental Reference Method
LOI	Loss on ignition
M30A	EPA Method 30A
MACT	Maximum Achievable Control Technology
MCC	Motor control center
MCG	Mercury chloride generator
MCL	Maximum containment level
MW	Megawatt
NETL	National Energy Technology Laboratory
NG	Nitrogen generator
NOx	Nitrogen Oxide
O-H	Ontario Hydro Method
O&M	Operating and Maintenance
PAC	Powdered activated carbon
PLC	Programmable logic controller
PRB	Powder River Basin
QA/QC	Quality Assurance/Quality Control
RATA	Relative Accuracy Test Audit
RMP	Rocky Mountain Power

SCR	Selective catalytic reduction
SDA	Spray dryer absorber
SGLP	Synthetic Groundwater Leaching Procedure
SO ₂	Sulfur Dioxide
STM	Sorbent Trap Method
TAG	Technical Assessment Guide
TCLP	Toxicity Characteristic Leaching Procedure

APPENDIX A: PROJECT TEST PLAN

PHASE III MERCURY CONTROL TECHNOLOGY FIELD TESTING AND RELATED MERCURY CONTROL RESEARCH AND DEVELOPMENT

***Long-Term Carbon Injection Field Test for >90% Mercury Removal for
a PRB Unit with a Spray Dryer and Fabric Filter***

Test Plan

Prepared for:
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DOE NETL (DE-FC26-06NT42774)
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Table of Contents

Project Overview	4
Host Site Description	5
General Technical Approach	5
Task 1. Site Coordination, Kick-Off Meetings, Develop Test Plan and QA/QC Plan	5
Task 2. Design, Procure and Install Equipment	6
Task 2.1. System Design and Procurement	6
Task 2.2. Installation	7
Task 3. Field Testing	8
Task 3.1. Baseline Tests	10
Task 3.2. Co-Benefits Analysis	10
Task 3.3. Parametric Tests	11
Task 3.4. Choose Long-Term Test Parameters	11
Task 3.5. Long-Term Test	12
Task 4. Coal, Ash, and By-Product Sample Evaluation	12
Task 5. Technology Transfer	13
Task 6. Management and Reporting	14
Schedule	15
Key Personnel and Contact Information	15
Appendix A – Equipment Descriptions	17
Sorbent Injection System Description	17
Mercury CEM Description	17

List of Tables and Figures

Table 1: Key Parameters of the Hardin Power Plant	5
Figure 1. Sorbent Injection Silo w/Outline of Proposed Shelter	7
Table 2. Work Breakdown Between RMP and ADA-ES	8
Table 3. Proposed Test Sequence for Hardin.....	9
Table 4. Sample Schedule for Hardin Testing	10
Figure 2. Sampling Locations for Hardin	13
Table 5. Project Schedule	15
Table 6. Key Project Personnel for Hardin Project.....	15
Figure 3. Thermo Electron Mercury Freedom System™	18

Project Overview

Hardin Generating Station was chosen to be included in Phase III of DOE's mercury control evaluation program. The overall objective for the Phase III program is to achieve 90% mercury control in excess of native removal. The goal of the testing at Hardin is to demonstrate >90% mercury removal for a period of 10 to 12 months using sorbent injection. This will allow an evaluation of long-term mercury removal capability, emissions variability, and the O&M costs associated with sorbent injection at a power plant with a configuration representative of many new plants. The project will also access the potential benefits of coal additives and coal blending with Western bituminous coal to increase mercury removal. During this project, a commercial-grade activated carbon injection system will be integrated with a new-generation mercury analyzer to allow automated feedback control of the outlet mercury emissions. The cost savings associated with feedback control will be assessed. Testing will be conducted at Rocky Mountain Power's Hardin Station that burns a PRB coal and is configured with an SCR (selective catalytic reduction) for NO_x control, an SDA (spray dryer absorber) for SO₂ control, and a FF (fabric filter) for particulate control. The unit was brought on line in January 2005.

Based upon previous results at PRB sites with SCRs, very little additional mercury oxidation is expected across the SCR at Hardin. In addition, results from DOE/NETL Phase II Round 1 at the Holcomb Station and similar sites, showed low native mercury removal across the SDA and FF. However, there is little data on the synergistic effects at PRB sites configured with an SCR, SDA and FF. However, it is possible that the use coal blending or coal additives will increase mercury oxidation across the SCR and enhance the subsequent mercury capture in the SDA and FF.

ADA-ES will design and procure a mercury sorbent injection system and mercury CEM for the Hardin Generating Station. This equipment, along with other portable equipment, will be used to conduct a series of tests to evaluate various combinations of potential mercury removal technologies including:

- Baseline Test – Perform speciated baseline mercury measurements across the SCR, SDA and FF,
- Co-Benefit Analysis - Characterize the range of mercury removal achievable by varying the operation of the SCR and SDA, and access the effectiveness of coal additives and coal blending to enhance mercury oxidation across the SCR and subsequent removal in the SDA and FF,
- Parametric Test - Evaluate the effectiveness of sorbent injection for mercury control with and without co-benefit enhancements.

The Parametric Test may be followed by an 11-month, Long-Term Test, with approval from DOE/NETL, if a technology is identified that meets the goal of >90% mercury removal. Upon completion of testing, ADA-ES will submit a comprehensive final report and participate in all functions required by DOE/NETL, including technology transfer to the industry.

Host Site Description

Hardin is a 116 MW, pulverized coal boiler that burns PRB coal from the nearby Absaloka Mine. The coal contains approximately 0.65% sulfur, 0.04 ppm mercury and <20 ppm chlorine. The unit is configured with low NO_x burners and an SCR for NO_x control, an SDA for SO₂ control and a FF for particulate control. Key characteristics of the configuration at Hardin are included in Table 1.

Table 1: Key Parameters of the Hardin Power Plant

Size (MW _{gross})	116
Coal (typical)	PRB, Absaloka Mine
Boiler Type	PC Boiler Opposing wall-fired
Sulfur Control	Spray Dryer with Recycle
Nitrogen Oxide Control	Low NO _x Burners/SCR
Particulate Control	Fabric Filter
Gas Flow Rate, full load (acfm) at injection location	~ 550,000
Flue Gas Temperature, Injection Location (°F)	260-320

General Technical Approach

A series of six tasks are planned to accomplish the objectives of this project. These tasks provide the outline for the test plan. A brief description of each task is provided below.

Task 1. Site Coordination, Kick-Off Meetings, Develop Test Plan and QA/QC Plan

The purpose of this task is to develop a detailed test plan agreed upon by contributing team members, personnel from the host site, environmental agencies and DOE/NETL. The planning process includes meetings with the appropriate personnel to gather the information necessary to develop the test plan and define the potential impact on plant equipment and operation. Efforts include identifying any permit requirements, developing a QA/QC plan, identifying potential mercury sorbents and coal additives, finalizing the scope for each of the team members, and putting subcontracts in place for manual measurement services.

As part of the proposed scope, QA/QC will be documented and specific procedures adhered to. The primary objectives of the QA/QC effort will be to control, evaluate, and document data quality to ensure that data generated are of sufficient quality to meet program objectives. Specific key parts of the QA/QC plan will include:

- QA/QC in sample collection, analytical and data analysis
- Integral performance evaluation and verification of mercury removal
- Procedural remedies for identified data deficiencies

- Oversight and documentation of all QA/QC

ADA-ES has developed and implemented successful QA/QC plans for other DOE/NETL projects. These shall serve as a general framework for this project's plan.

This task began upon award of the contract and the progress to date includes:

- Requesting a quote for the mercury Continuous Emissions Monitors (CEM)s,
- Scheduling a Site Visit/Meeting for June 26, 2006,
- Developing a preliminary equipment installation package based on previous projects,
- Writing the initial draft of the Test Plan.

Task 2. Design, Procure and Install Equipment

There are two major systems associated needed for this project, a mercury CEM system and a sorbent injection system (SIS). Descriptions of these systems are included in the appendix.

Two Thermo Electron CEMs will be used during this program. One CEM will be installed downstream of the air preheater with a secondary extraction location downstream of the SDA. The second CEM will be installed downstream of the FF at the stack.

The SIS will include a silo for sorbent storage, a metering system, sorbent distributor, injection grid in the duct upstream of the SDA, and the interconnecting piping. The output of both mercury CEMs will be interfaced with the silo control system for automatic control of the sorbent feed rate. The stack CEM will be interfaced with the plant data handling system (DHS) to allow real-time monitoring of mercury concentration by plant personnel.

Another system that will be required at Hardin is a coal additive injection skid for the introduction of additives upstream of the pulverizers. For liquid additives, this will be a simple pump arrangement. For dry additives, a small volumetric feeder will be used.

Coal blending will be achieved either by using a secondary coal storage silo.

Task 2.1. System Design and Procurement

The purpose of this task is to acquire and install the necessary equipment to complete the project. Some equipment will be site-specific and, by necessity, will be designed for Hardin. Examples may include the sorbent storage silo, sorbent distribution manifold, and injection lances. Figure 1 shows a typical activated carbon storage silo and feeding system with an outline of a proposed shelter around the bottom of the silo to protect the controls from the harsh Montana winters. ADA-ES engineers will work with plant engineers to develop an installation and contractor bid package for installation activities. ADA-ES will also oversee the work by contractors to ensure all installation is done properly and efficiently. Hardin will be responsible for all permitting and any variance requirements.

ADA-ES will also oversee installation and system checkout of the mercury measurement equipment. Procedures followed in this task will be similar to those used in previous full-scale mercury control programs that ADA-ES conducted for DOE. The actual equipment installation, not including preparation tasks, is estimated to take three weeks.

Figure 1. Sorbent Injection Silo w/Outline of Proposed Shelter

Task 2.2. Installation

A scope of work will be developed that includes a division of responsibilities between ADA-ES and RMP. A typical work split is shown in Table 2. Required site support may include the pouring of a cement platform for the silo, installation of injection and sampling ports (if not available), erection of any needed platforms and scaffolding to access the ports, supplying compressed air, electrical power, and the appropriate plant signals, including boiler load, to the injection skid and control trailer, and balance of plant engineering.

Table 2. Work Breakdown Between RMP and ADA-ES

RMP/Hardin	ADA-ES
Unload and store the injection silo until installation	Prepare installation document
Install the injection silo foundation	Oversee installation of SIS
Install the injection system	Install mercury analyzers
Erect a shelter around the base of the silo	Provide oversight to integrate stack Hg CEM into plant DHS
Install and/or inspect Sampling Ports	Install office trailers
Provide utilities such as power, instrument quality air and water to testing locations and office trailers	Develop Plan to integrate stack Hg CEM into plant DAS
Arrange for safe access to sorbent injection and mercury sampling locations	Provide the coal additives system
Provide access to plant data	Provide portable Hg measurement systems such as STMs (Sorbent Trap Method)
Provide cable and support to integrate stack Hg CEM into plant DHS (additional support from Monitor Labs)	

Task 3. Field Testing

Field testing shall cover a period of 20 months, and will include the Baseline Test, Co-Benefit Analysis, Parametric Test, and Long-Term Test. The current test schedule is shown in Table 3. The test matrix will be developed following the Site Kickoff Meeting and included in the final test plan.

Table 4 presents the frequency of manual emissions measurements and a summary of coal and byproduct samples that will be collected during the program. Additionally, comprehensive plant data will be logged through the plant DCS system. Such data will include combustion parameters, back-end parameters, and stack CEMs data (NO_x, SO₂, CO₂, flow). Operating parameters will include, at a minimum, flow rates, temperatures, pressures, and emission levels. A comprehensive list will be included in the final version of the test plan which will be completed following the site kickoff meeting.

The composition of all sorbents and chemical additives to be tested under this project must be provided to the DOE Project Officer prior to testing. The proprietary nature of such data will be protected by DOE/NETL. All sorbents and chemical additives must receive prior approval by the DOE Project Officer prior to testing.

Table 3. Proposed Test Sequence for Hardin

Test Description	Start Date	Comments/Duration
Baseline	10/06	1-month Manual Sampling ^a
Co-benefits	11/06 – 2/07	Vary System Performance (4-months) Coal Additives (1 to 2 weeks) Coal Blending (1-week)
Parametric Testing	4/07	1 to 2-weeks
Verify Optimum Performance	4/07	1 to 2 days field testing
Break	4/07	Review Results Request DOE Approval for Long-Term Tests
Long-term tests	5/07 - 3/08	Control to maximum emission rate 24 hours a day, 10 to 12 months. Conduct Manual Sampling ^a tests at least twice. .

^a Manual Sampling includes: ASTM M6784-02 (mercury), STM (modified 40 CFR, pt. 75 app.K, mercury), EPA M5 or 17 (particulate), EPA M26a (halogens), CTM-027 (Ammonnia)

Table 4. Sample Schedule for Hardin Testing

Task Description	Flue Gas Measurements									Solid Sampling			
	Inlet Hg (CEM)	Outlet Hg (CEM)	SDA Inlet Hg (Ontario Hydro ^A)	SDA Outlet Hg (Ontario Hydro ^A)	SDA Inlet Hg (Sorbent Traps)	SDA Outlet Hg (Sorbent Traps)	NH ₃ (CTM-027) ^C	Halogens (Method 26A)	Particulate (Method 5 or 17)	Coal	Bottom Ash ^B	Fly Ash, FF ^B	Sample Storage for DOE/NETL
3.1 Baseline Tests	X	X	1	1	TBD	TBD	1	1	1	D	D	D	3
3.2 Co-Benefits Analysis	X	X	0	0	TBD	TBD	0	0	0	W	0	W	0
3.3 Parametric Tests	X	X	0	0	TBD	TBD	0	0	0	D	0	D	0
3.4 Choose Long Term Test Parameters	X	X	0	0	TBD	TBD	0	0	0	0	0	0	0
3.5 Long Term Test	X	X	3	3	TBD	TBD	1	1	1	W	W	W	3

D = Daily

W = Weekly Composite

Notes:

A Each set of Ontario Hydro measurements shall consist of three runs

If a mercury CEM is approved as an instrumental reference method under 40 CFR Part 75.22 by the EPA Administrator, such instrumental method may be substituted for the Ontario Hydro measurements in this project with permission of DOE and team members.

B Samples of Fly Ash will be stored for independent analysis per DOE NETL requirements

C Ammonia in flue gas measurements will only be taken if ammonia injection is ongoing

Plant data available through the DCS will be recorded for all tests, including combustion and back-end parameters

Equipment to conduct sorbent trap measurements shall be on site for the entire duration of the field testing.

Measurements shall be taken at the discretion of the field team.

Task 3.1. Baseline Tests

After installation of the Hg CEMS, a series of baseline tests will be conducted to establish the mercury removal during typical plant operating conditions. There will be no addition of mercury sorbent or any other chemical additive during this period.

Baseline measurements will include one complete set of flue gas measurements and sample analyses. These will include Hg CEM measurements and the appropriate gas analyses, performed by an independent contractor, at the SDA inlet and FF outlet. The independent contractor will perform, at a minimum, particulate, mercury, halogen, and ammonia measurements. The accuracy of the Hg CEM will be verified with an appropriate reference method, such as the Ontario Hydro Method. If a mercury CEM is approved as a reference method under 40 CFR Part 75.22 prior to this test, it may be used in place of Ontario Hydros with permission from DOE and other team members.

Task 3.2. Co-Benefits Analysis

The purpose of this task is to determine if mercury capture across the SDA and FF can be enhanced by changes in plant operations or by the use of coal additives or coal blending. The first test series in this task include changes to plant operating practices and use of coal additives to determine if mercury oxidation can be increased across the SCR and, if so, if this increases the

subsequent mercury capture in the SDA and FF. The mercury concentration will be monitored continuously while varying the performance of the SCR and SDA over the range of acceptable operating conditions. Variables may include adjusting the space velocity and temperature across the SCR by lowering the boiler load, adjusting the ammonia injection rate, and varying lime feed to the SDA. ADA-ES will work with Reaction Engineering to model the mercury oxidation potential of the SCR under various conditions, including the use of coal additives, prior to on-site testing. Another option for co-benefit mercury removal is through blending West Elk coal, a higher chlorine Western bituminous coal, with PRB coal. This combination may increase the overall mercury removal through two potential mechanisms: 1) increased oxidation across the SCR and subsequent removal in the SDA resulting from the higher chlorine content, or 2) increased removal across the FF due to unique characteristics of the West Elk coal. Mercury CEM measurements will be the sole basis for determining the success of all Co-Benefit Analyses.

Task 3.3. Parametric Tests

The goal of the parametric tests is to evaluate the mercury capture of several candidate sorbents under various operating conditions. Parametric tests will be conducted at full scale by distributing sorbents across the entire flue gas ductwork at the SDA inlet. Each sorbent will be injected at a variety of concentrations in order to closely establish the mercury control relationship. For a given sorbent, it is typical to test between two and four injection concentrations over a period lasting 4-12 hours. It is expected that the team will evaluate up to three sorbents during parametric testing. Initial parametric test runs will be conducted with the SO_x and NO_x control equipment operating at the standard conditions defined by the plant. The best sorbent material and optimal injection rate will be repeated with the SO_x and NO_x control equipment operating at conditions determined for optimal mercury removal from the Co-Benefit Analysis in Task 3.2. Key parameters include:

- Mercury sorbent
- Mercury sorbent injection concentration
- Injection location
- Unit combustion parameters
- SCR Operation - ammonia feed and space velocity
- SDA Operation - lime feed rate.
- FF Operation – cleaning cycle

Mercury CEM measurements will be the sole basis for determining the success of all Parametric Tests.

Task 3.4. Choose Long-Term Test Parameters

Upon completion of the Parametric Tests, ADA-ES will review results with the project team and identify the best options for achieving the goal of >90% mercury removal during a long-term test. The best one or two options will then be evaluated during two-day test periods to verify the performance seen during the Parametric Test. Following the verification tests, ADA-ES will compile a report summarizing the results and conclusions of the testing to date. This report will provide the data and analysis necessary to guide the project team and DOE in choosing the system parameters for the long-term test.

Task 3.5. Long-Term Test

After approval from the DOE COR, the sorbent selected in Task 3.4 will be continuously injected into the flue gas over a period of 11 months. This shall be done in conjunction with any operating changes or enhancement additives agreed to in Task 3.4. During this period, any long-term operational problems will be identified to determine if the chosen mercury control scheme is sustainable. Potential operational impacts that will be monitored include degradation of SDA or FF performance, injection system performance, and/or SCR performance if enhancement additives are used.

Long-term test measurements shall include a full set of flue gas measurements and solid sample analyses. These shall include CEM measurements at the SDA inlet and FF outlet Hg, as well as particulate, halogen, mercury and ammonia measurements by an outside contractor. The accuracy of the Hg CEM will be verified during these tests with an appropriate reference method, such as the Ontario Hydro method. It is the intent of the test team to operate the stack CEM as a compliance mercury CEM using the QA/QC procedures outlined in the CAMR and compliance monitoring requirements included in 40 CFR Part 60.49a. If the analyzer does not meet all certification requirements, the reference method check will be conducted at least three times during the long-term program. If a mercury CEM is approved as an instrumental reference method under 40 CFR Part 75.22 by the EPA Administrator, such instrumental method may be substituted for the Ontario Hydro measurements with permission from DOE and team members.

During the long-term test, Hardin may choose to make the site available for assessing the performance of other mercury CEMs. No funds were allocated in the DOE program for evaluating alternative CEMs, therefore, the CEM vendor or other interested party wishes to install the CEM will be responsible for all costs associated with its operation. However, upon approval from RMP and DOE, the data from the project mercury CEM will be provided to the CEM vendor for comparison in exchange for the operational data from the test CEM.

Task 4. Coal, Ash, and By-Product Sample Evaluation

In conjunction with each of the baseline and parametric tests, samples of coal and ash will be collected and analyzed. A Sample and Data Management Plan will be completed prior to site testing and included as an appendix in the final test plan.

Potential collection points are illustrated in Figure 2. The information is needed to complete the mercury mass balance around the unit and to clarify how and where the mercury is captured. Select coal samples will be analyzed for ultimate, proximate and calorific analyses as well as mercury and chlorine content. Fly ash and bottom ash samples will be analyzed for mercury content and LOI. At least one ash sample from baseline and from long-term testing will be tested for stability. These tests will include leaching of mercury and any chemical additive (in the coal or on the activated carbon) using the synthetic groundwater leaching procedure. Thermal desorption tests will also be conducted.

Additional samples shall also be collected in accordance with DOE/NETL requirements including fly ash samples taken from the FF during the baseline and long-term tests. These samples shall be made available for analysis at DOE/NETL's discretion. Bottom ash samples may also be taken if coal additives are used.

Figure 2. Sampling Locations for Hardin

Analysis of the fly ash will reflect the sorbent being injected. An important consideration for any plant contemplating sorbent injection is the impact on fly ash quality and disposal. With successful mercury capture in the FF, the fly ash mercury content will increase, as well as the sorbent content in the ash. If a chemically enhanced sorbent is used, the potential for additional ash contamination exists. Although previous test programs have shown that the byproducts mixed with activated carbon are highly stable, it is important to continue evaluating these byproducts. The primary pathways for mercury or halogen release would be volatilization and leaching, which DOE/NETL has already identified for testing

Task 5. Technology Transfer

Presentations will be made at selected conferences, with DOE approval, to increase exposure of the test results and receive comments on the applicability of the technology to the industry. Transferring the information generated during this project to the coal-fired utility customers will be an important part of the program. The ultimate goal of technology transfer is to make results available to the public as quickly, comprehensively and accurately as possible. Technology transfer activities performed in previous tests conducted by ADA-ES included participating in DOE/NETL-sponsored meetings and EPA Hg MACT Stakeholder meetings, presenting at more than 50 events or companies, hosting a Web site for project team members, presenting project information, and publication of more than 100 technical papers. ADA-ES will work with RMP and DOE/NETL in determining and supporting the key meetings, presentations and publications.

One of the key activities for Hardin's Air Quality Permit is the application for a Hg BACT emission limit from M-DEQ based on the performance of the mercury control equipment during the extended testing period. ADA-ES will work with RMP and M-DEQ to provide the information necessary for M-DEQ to assess the performance of the system. This includes

providing recommended sorbent injection rates and an incremental cost analysis for the dollars per pound of mercury removed.

Task 6. Management and Reporting

This task provides time for overall program management, and preparation of financial and administrative reports. Upon completion of the field testing and receipt of the subsequent laboratory analyses, ADA-ES will issue a formal test report. The report will summarize all testing activities, results, initial economic analyses and conclusions. Periodic meetings with DOE to discuss progress and obtain direction from the DOE project manager will also be supported.

Schedule

The schedule for the project at Hardin is included in Table 5.

Table 5. Project Schedule

Task	Dur. (m)	2006												2007												2008												
		A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O						
1. Site Coordination, Kick-Off Meetings, Develop Test Plan and QA/QC Plan	4																																					
2. Design, Procure and Install Equipment	4																																					
2.1 System Design and Procurement	1.5																																					
2.2 Installation of Analyzer System	1																																					
2.2 Installation of Injection Systems	1																																					
3. Field Testing	20																																					
3.1 Baseline Tests	1																																					
3.2 Co-Benefits Analysis	5																																					
Coal Blending	0.5																																					
Coal Additives	0.5																																					
Vary System Performance	4																																					
3.3 Parametric Tests	1																																					
3.4 Choose Long-Term Test Parameters	1																																					
3.5 Long-Term Test	12																																					
4. Coal, Ash, and By-Product Evaluations	21																																					
5. Technology Transfer	30																																					
6. Management and Reporting	30																																					

Milestones																																					
M1 Equipment Design Complete																																					
M2 Equipment Installed																																					
M3 Baseline Testing Complete (Task 3.1)																																					
M4 Complete Parametric Test (Task 3.3)																																					
M5 Complete Long Term Test (Task 3.5)																																					

Key Personnel and Contact Information

Key personnel for the Conesville tests are identified in Table 6.

Table 6. Key Project Personnel for Hardin Project

Name	Company	Role	Phone #	E-MAIL/Cell Phone
Andrew O’Palko	DOE/NETL	Contract Manager	304-285-4715	andrew.opalko@netl.doe.gov
Sharon Sjostrom	ADA-ES	Program Manager	303-339-8856	sharons@adaes.com 303-919-8538
Rick Patzman	RMP	Project Manager	701-221-6462	rick.patzman@centennialenergy.com
Jerry Amrhein	ADA-ES	Project Engineer	303-339-8840	jerrya@adaes.com 303-921-8138
Kevin Calloway	RMP	Plant Engineer	406 638-9140 ext: 1038	kalloway@coloradoenergy.com 406 679-0966
Connie Senior	Reaction Engineering	Tech Expert: SCR Modeling	801-364-6925 ext 37	senior@reaction-eng.com

Hardin Generating Station Contact Information

Phone: (406) 638-9140

Fax: (406) 638-9156

Plant Manager: Gary Arneson; garneson@coloradoenergy.com
Phone: (406) 638-9140 ext: 1002
Cell: (406) 690-4777

Plant Superintendent: Pat Morrell; pmorrell@coloradoenergy.com
Phone: (406) 638-9140
Cell: (406) 679-0963

Mailing Address: Colorado Energy Management
Hardin Generating Station
Attn: Kevin Calloway (Mercury Study)
Route 1, P.O. Box 1144A
Hardin, MT 59034

Shipping Address: Colorado Energy Management
Hardin Generating Station
Attn: Kevin Calloway (Mercury Study)
1 Sugar Factory Road
Hardin, MT 59034

Appendix A – Equipment Descriptions

Sorbent Injection System Description

The carbon injection system, shown installed at Holcomb in Figure 1, consists of a bulk-storage silo and twin blower/feeder trains. PAC is delivered in bulk pneumatic trucks and loaded into the silo, which is equipped with a bin vent bag filter. From the discharge section of the silo, the sorbent is metered by variable speed screw feeders into eductors that provide the motive force to carry the sorbent to the injection point. Regenerative blowers provide the conveying air. A PLC system is used to control system operation and adjust injection rates. The unit is approximately 50 feet high and 10 feet in diameter with an empty weight of 10 tons. The silo will hold 20 tons of sorbent. Flexible hose carries the sorbent from the feeders to distribution manifolds located on the flue gas ducts, feeding the injection probes. Each manifold supplies up to six injectors.

Mercury CEM Description

The Thermo Electron *Mercury Freedom System*TM CEM has been chosen for flue gas mercury measurements at Hardin. Three key components of the CEM are the sample extraction probe/converter, the mercury analyzer, and the calibration module. These are described briefly below and presented in Figure 3, a schematic of the entire system, showing the key components and other supporting instrumentation.

- **Sample Extraction Probe/Converter.** An inertial filter is used to separate a particulate-free vapor-phase sample while minimizing the interactions with fly ash, which can cause sampling artifacts. The sample is immediately diluted with pre-heated dilution air to minimize mercury reactions with other flue gas species.
- **Mercury Analyzer.** Mercury is measured directly in the analyzer using Cold Vapor Atomic Fluorescence Spectroscopy (CVAFS). There is no cross interference from SO₂ with CVAFS. Because the sample is diluted, it has low moisture, is relatively non-reactive and therefore has minimal interference from other gases.
- **Calibration Module.** The calibrator module incorporates a mercury source in a temperature-controlled chamber that can be heated or cooled to maintain the source at a precise temperature. The operator can program the calibrator to deliver zero or span gas to the analyzer, to the sample port between the inertial filter and the critical orifice, or upstream of the inertial filter.

Figure 3. Thermo Electron Mercury Freedom System™.

The intent of the project team is to configure the mercury CEMs to automatically follow the QA/QC procedures for a compliance mercury CEM as defined in the CAMR. Some aspects of this requirement are not available at the time of this proposal, such as NIST traceable calibration sources. Significant advancements are expected before mercury CEMs would be installed at Hardin.

The accuracy of the CEMs will be assessed by comparing the CEM concentration with a reference method during the baseline and long-term tests. At the time of this proposal, the method that has been approved in the CAMR and provides speciation information is the Ontario Hydro Method. EPA is actively working towards an instrumental reference method, which may be available for some or all of the relative accuracy tests scheduled during the program at Hardin. If a mercury CEM is approved as an instrumental reference method under 40 CFR Part 75.22 by the EPA Administrator, an instrumental method may be substituted for the Ontario Hydro measurements in this project with permission of DOE and team members. Sorbent traps, following a modified version of 40 CFR Part 75 Appendix K, will also be run periodically to check the accuracy of the CEMs and to facilitate troubleshooting.

The CEMs will be installed prior to baseline testing and they are expected to operate continually during field testing. The overall effectiveness of the technology will be assessed by comparing mercury emissions during the parametric and long-term tests against the baseline results. These mercury control results will then be blended with estimated operating costs to determine the mercury removal costs.

APPENDIX B: STANDARD CALCULATIONS

Standard Calculations

1. Standard Calculations

1.1. Sorbent Injection Concentration

The convention for describing the concentration of sorbent injected into a duct is pounds per million actual cubic foot of flue gas or lb/MMacf. This value is referred to as the “injection ratio” or the “injection concentration.” The actual mass flow rate of sorbent is therefore dependent on the total volumetric flow of flue gas at the point of injection. The mass flow rate is determined by the following calculation:

$$\dot{m}_{sorbent} = \frac{\dot{Q}_{fluegas}}{10^6} \times Ratio * 60 \quad 1$$

where,

$\dot{m}_{sorbent}$	lb/hr	mass feed rate of sorbent
$\dot{Q}_{fluegas}$	acfm	volumetric flow rate of flue gas
$Ratio$	lb/MMacf	sorbent injection ratio
60	min/hr	conversion factor

If the flue gas flow is provided in standard cubic feet per minute (scfm), the flowrate at actual temperature can be calculated as follows:

$$acfm = scfm * (459 + T_i) / (459 + 68) \quad 2$$

where T_i = temperature in degrees Fahrenheit at the injection location.

The actual injection ratio can be calculated as follows:

$$Ratio = \frac{\dot{m}_{sorbent} / 60}{\dot{Q}_{fluegas} / 10^6} \quad 3$$

1.2. Coal Mercury Concentration Conversion

The mercury concentration of the coal is typically reported by the lab in ng/g or µg/g. To convert ng/g to lb/TBtu, the gross calorific value (GCV) of the coal must be measured and both the mercury concentration and GCV must be on the same moisture basis (i.e. both dry or both wet). The following equation describes the conversion:

$$I_{Hg} = W_{Hg} \times \frac{1}{GCV} \times \frac{10^{-9} lb}{n lb} \times \frac{10^{12} Btu}{TBtu} \quad 4$$

where I = Hg lb/Tbtu, W = Hg ng/g

For example, if the coal mercury concentration were 54.3 ng/g and the GCV were 11942, both on a dry basis, then

$$I_{Hg} = 54.3 \text{ ng/g} / 11942 * 10^3 = 4.55 \text{ lb/Tbtu}$$

1.3. Flue Gas Mercury Concentration Conversion

Thermo CEMS data are measured in $\mu\text{g/wet sm}^3$ and using guidelines provided in Method 19 in Appendix A to Part 60, which uses an EPA F Factor and CO_2 values, one can convert into units of lb/TBtu. Note that TBtu equals 10^{12} Btu, or 10^6 MMBtu. An F factor is the ratio of combustion gas volume to heat inputs, and it is used to calculate emission rates from concentrations.

CO_2 based F-factor (F_c)

If the CO_2 concentration is measured on a wet basis:

$$E = C_w \times F_c \times \frac{100}{\% \text{CO}_2} \times 10^6 \text{ MMBtu / TBtu} \quad 5$$

Where,

E = emission rate in lb/TBtu

C_w = mercury concentration, wet basis, in lb Hg/scf. Convert from the CEMS basis of $\mu\text{g/wsm}^3$ as follows:

$$C_w (\text{lb / scf}) = C_w (\mu\text{g / wsm}^3) \times \frac{1\text{g}}{10^6 \mu\text{g}} \times \frac{1\text{lb}}{453.6\text{g}} \times \frac{1\text{m}^3}{35.31\text{ft}^3} \quad 6$$

$\% \text{CO}_{2w}$ = concentration of CO_2 on a wet basis, in %

F_c = carbon dioxide-based F factor, in scf CO_2 /MMBtu

The F_c factor is calculated using the following equation:

$$F_c = 0.321 \times 10^6 (\%C) / \text{GCV} \quad 7$$

Where,

$\%C$ = concentration of Carbon in coal, % dry basis
(from ultimate analysis if available)

GCV = gross calorific value, Btu/lb dry basis

If the CO_2 concentration is measured on a dry basis, you must adjust for the moisture fraction in the flue gas as follows:

$$E = \frac{C_w \times F_c}{1 - B_{ws}} \times \frac{100}{\% \text{CO}_{2d}} \times 10^6 \text{ MMBtu / TBtu} \quad 8$$

All terms are the same as above with the exception of

B_{ws} = moisture fraction of the flue gas, in %

$\% \text{CO}_{2d}$ = concentration of CO_2 on a dry basis, in %

O₂ based F-factor (F_d)

If the O₂ concentration is measured on a wet basis:

$$E = C_w \times Fd \frac{20.9}{20.9(1 - B_{ws}) - \%O_{2w}} \quad 9$$

If the O₂ concentration is measured on a dry basis, you must adjust for the moisture fraction in the flue gas as follows:

$$E = \frac{C_w \times Fd \times 20.9}{(1 - B_{ws})(20.9 - \%O_{2d})} \quad 10$$

The F_D factor is calculated using the following equation:

$$F_D = \frac{3.64 \times W_H + 1.53 \times W_C + 0.57 \times W_S + 0.14 \times W_N - 0.46 \times W_O}{HHV} \times 10^6 \quad 11$$

Where

- W_H = fraction of hydrogen in the coal
- W_C = fraction of carbon in the coal
- W_S = fraction of sulfur in the coal
- W_N = fraction of nitrogen in the coal
- W_O = fraction of oxygen in the coal
- HHV = higher heating value of the coal in lb/BTU

C_w is calculated as described above in Equation F-6.

1.4. Mercury Removed by Fly Ash

The mercury concentration in the fly ash is typically measured in ng/g. This can be converted to lb/TBtu using the following technique:

$$E_{ash} = \frac{\%A / 100}{GCV} \times K_1 \times K_2 \times C_{ash} \times 10^{12} (Btu / TBtu) \times 10^{-9} (lb / nlb) \quad 12$$

Where

- E_{ash} is the mercury collected by the ash in lb/TBtu
- %A is the fraction of ash in the coal sample
- GCV is the gross caloric value in lb/Btu
- K₁ is the fraction of ash entering the ESP (nominally 0.85 for PC plants)
- K₂ is the collection efficiency of the first collection field (nominally 0.8 for many ESPs)
- C_{ash} is the concentration of mercury in the ash, ng/g

APPENDIX C: HG-CEM QA/QC PROTOCOLS

ADA Hg-CEM QA/QC Protocol

Hg-CEM QA/QC Protocol

Mercury CEMS Quality Assurance/Quality Control Program

ADA has developed an extensive internal Mercury Continuous Emissions Monitoring System Quality Assurance and Quality Control Program that is implemented as a guideline during ADA's Thermo Fisher Mercury Freedom System™ operation and deployment.

In order to have confidence in the individual measurements and the conclusions based on those measurements, a set of quality assurance checks were developed during the test phase. Many of the quality control requirements were used as referenced in Appendix A and Appendix B of CFR 40 Part 75. While these QA/QC checks were generally observed, they are only guidelines. ADA has significant experience and expertise in designing and conducting test programs of this nature and in conducting the subsequent analyses.

A QA/QC program for the Hg-CEMs was not in place at the beginning of the Hardin project due to the unproven history of the CEMs in 2006 as well as a lack of clearly specified performance requirements in federal regulations. The ADA QA/QC program was developed through year of experience operating these systems at Hardin and at other sites.

Equipment Functionality Assessment

Each component of the Hg-CEMs was evaluated to ensure it was functioning according to the performance specifications supplied by the manufacturer. The CEMs were assembled and run through an exhaustive checklist to simulate and confirm typical operating conditions. The systems installed at Hardin were purchased specifically for this project and, therefore, were not used at any other facility.

Installation and Acceptance Procedure

The Hg-CEMs were installed in accordance with ADA established practices and procedures. Each step of the procedure was documented to ensure that the systems were installed and configured correctly and that components were not damaged during transportation.

An Hg-CEM was considered to be operating properly when it completed the certification procedures in Appendix A of CFR 40 Part 75, as applicable. The certification tests include a two-point calibration error test, 3-point linearity error test, a cycle time test, and a 3-point system integrity test. Periodic monitoring of the Hg-CEMs was conducted by the ADA Technology Group.

The low-, mid-, and high-level span values used for all calibration routines may be determined from mercury concentration data collected from previous test programs. If

this data is not available or accuracy can not be assured, then the type of coal burned may be used to determine the initial span values. ADA used previous test values during the installation procedure and made adjustments during the test program as conditions changed (e.g. fluctuations in coal mercury concentration and the onset of ACI).

ADA acquired a procedure used by ThermoFisher to evaluate their systems during production. This procedure was used by ADA during the installation of the two CEMs in September, 2006 to ensure that the systems were configured properly and to evaluate the performance of the system after installation. This procedure was later expanded to include a linearity test, cycle time test and 3-point system integrity test, and was used during the latter stages of the project.

The first Hg-CEM verification test was performed in September, 2007 after ThermoFisher released an upgrade package for the mercury system. The package included a lamp heater, calibration gas hydrator, nitrogen generator and new software packages. This upgrade did not include a mercuric chloride generator. Both systems passed the criteria for the 7-day calibration drift test, system cycle time test and the 3-point linearity check during this, and subsequent verification tests.

Daily Calibration Error Test

Daily calibration checks were modeled after the regulations defined by Appendix B of CFR 40 Part 75, Section 2.1.1 and 2.1.2. The CEMs are required to meet a performance specification of 5.0% of span *OR* $\pm 1.0 \mu\text{g/wscm}$ difference between the reference gas and the analyzer response for span values $< 10 \mu\text{g/wscm}$. The daily calibration checks are automatically initiated by the analyzer software each day, and the responses analyzed to determine if adjustments to the calibration coefficients are needed.

When a daily calibration error test failed, or when a CEM was returned to service after repair or maintenance, data were considered invalid until an additional calibration error test had been successfully completed. Small adjustments to the calibration coefficients are permitted after a successful calibration error test. These adjustments are made to maintain the highest precision possible. They can be made by means of a mathematical algorithm or by a manual calibration. However, an additional calibration error test is required if a manual calibration is performed.

To maximize the CEM availability and maintain high measurement precision, ADA developed an extensive program to analyze the calibration check responses and CEM operations. This program uses criteria that are stricter than those in federal and state regulations. The error criterion specified in CAMR is 5% or $1 \mu\text{g/wscm}$. The criteria used by ADA, based on the error of the calibration response, define the level of action required to maintain peak performance. If the difference in zero or span response is less than $\pm 0.1 \mu\text{g/wscm}$ and less than 0.5% error, the system did not require adjustment. If the error is greater than $0.1 \mu\text{g/wscm}$ or 0.5%, then there are several possible actions depending on if it is the first occurrence of the error and on what channel (zero or span) the error occurred. An error above $0.5 \mu\text{g/wscm}$ or 2.5% required a calibration factor update. This procedure was not in place when the Hg-

CEMs were installed at Hardin, and it changed during the life of the project due to upgrades in software and equipment. Many of the first calibration checks were unstable and inaccurate, but these improved significantly and are now a routine part of all projects.

Weekly System Integrity Check

Any ThermoFisher Mercury Freedom System may be equipped with a Mercuric Chloride Generator (MGC) depending on the intended use of the system and on state and federal regulations. At Hardin, the stack CEM is equipped with a MGC, while the AH outlet CEM is not. The MGC converts elemental mercury from the calibrator into oxidized mercury in a proprietary process. For systems equipped with a MGC, system integrity checks are required by CAMR and are performed to access the response of the system to low-, mid-, and high-levels oxidized mercury injected prior to the inertial filter in the extraction probe.

There are several criteria used to determine the validity of a system integrity check. According to Part 75, the CEM measurement must not differ from the reference value by more than 5.0% at any of the three levels. Another criterion, defined by ThermoFisher, is that the recovery efficiency for the oxidized mercury be greater than 90%. A third criterion is that the response must not differ from the reference value by more than 10% of the span value (the span value is not the same as the reference value).

An MGC was installed in the stack probe at Hardin in December, 2007 shortly before the two month outage. Initial tests in April, 2008 did not meet the test criteria. Several modifications were made to the MGC, as recommended by ThermoFisher, during the course of the project, but they did not produce results that passed acceptance criteria. As of the date of this report, the system integrity checks still do not pass the requirements of the test.

Quarterly Linearity Check

Linearity checks were performed to access the response of the system with the low-, mid- and high-level reference gas injected ahead of the inertial filter in non-repetitive, triplicate runs. Part 75 states that the CEM is required to meet a performance specification of 10.0% of reference or a difference of $\pm 1.0 \mu\text{g}/\text{m}^3$, whichever is less restrictive. Linearity checks are required each quarter and at least 30 days apart and must be completed within 24 unit operating hours. Linearity checks were performed manually by changing the span concentration of the calibrator.

Table E1 shows the results of all linearity checks performed during the project. The first complete linearity check performed on the inlet and stack CEMs at Hardin was performed on January 22, 2007. This linearity check failed, but an investigation found problems with the configuration of the CEMs and performance of the calibrators which were corrected, and a subsequent linearity test passed. Some linearity checks were not performed in a quarter-year because there was uncertainty regarding specific federal quality control requirements (2007) and/or because of plant

outages that disrupted the test schedule (2008). The stack CEM failed a few linearity checks in the ten quarters spanned by the project. These can be attributed to the use equipment that was later upgraded (June, 2007), the use of incorrect calibration concentrations (the test was initiated with incorrect settings in the calibrator and could not be stopped as per the rule), and calibrator maintenance activities (early in the project, the calibrators were found to be non-linear due to degradation of the mercury reservoir in the calibrator that was later corrected by use of nitrogen as the calibration carrier gas).

Table E1. Linearity Check Results.

HARDIN Hg-CEM LINEARITY CHECK – SDA INLET			
QUARTER	DATE	HIGH ERROR	RESULT
1Q 2007	3/17/07	1.6 / 9.1 %	PASS
2Q 2007	N/A	N/A	N/A
3Q 2007	9/19/07	0.50 / 4.1%	PASS
4Q 2007	N/A	N/A	N/A
1Q 2008	N/A	N/A	N/A
2Q 2008	4/4/08	0.31 / 3.8%	PASS
	4/28/08	0.31 / 4.0%	PASS
3Q 2008	7/25/08	0.45 / 7.2%	PASS
	9/17/08	0.39 / 4.7%	PASS
4Q 2008	11/18/08	0.15 / 2.0%	PASS

HARDIN Hg-CEM LINEARITY CHECK – STACK			
QUARTER	DATE	HIGH ERROR	RESULT
1Q 2007	3/17/07	4.48 / 47.0%	FAIL *
	3/25/07	0.25 / 2.0%	PASS
2Q 2007	N/A	N/A	N/A
3Q 2007	7/20/07	1.48 / 24.0%	FAIL *
	9/19/07	1.71 / 9.3%	PASS
4Q 2007	N/A	N/A	N/A
1Q 2008	N/A	N/A	N/A
2Q 2008	4/4/08	4.81 / 35.4%	FAIL *
	4/28/08	0.32 / 10.7%	PASS
3Q 2008	7/25/08	0.77 / 8.5%	PASS
3Q 2008	9/18/08	0.38 / 8.7%	PASS
4Q 2008	11/18/08	0.40 / 5.0%	PASS

* failed tests that were repeated after corrections were made

APPENDIX D: M30A RESULTS

**Relative Accuracy Test Audit (RATA) Utilizing EPA's
Method 30A and Performance Testing at Rocky Mountain
Power's Hardin Generating Station, Hardin, MT**

Test Dates: April 21st – 24th, 2008
Project Number 06-7008

DOE Award Number DE-FC26-06NT42774

Project Director: Sharon Sjostrom
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TABLE OF CONTENTS

EXECUTIVE SUMMARY	3
INTRODUCTION.....	5
Figure 1: Hardin Facility View.....	5
Facility Description	5
Mercury CEMS Description	6
Sampling Port Locations	6
Method 30A IRM Equipment & Description	8
Reference Analyzer Equipment and Method Description	8
APPROACH.....	10
CEMS Parameters	10
Linearity Check.....	10
7-Day Calibration Error Test	11
Cycle Time Test.....	11
3-Level System Integrity Check.....	12
Relative Accuracy Test Audit (RATA) & Bias Test	12
<i>Instrumental Analyzer Configuration</i>.....	12
Calibration Span & Gas Concentrations	12
Sample Point Selection	13
<i>Initial Measurement System Performance Tests</i>	14
Interference Test (Optional).....	14
Calibration Gas Verification	14
Measurement System Preparation.....	14
System Calibration Error Test	15
System Integrity Check.....	15
Measurement System Response Time	15
Dynamic Spiking Test (deferred until January 1, 2009).....	15
<i>Test Runs</i>	17
System Integrity Checks	17
Drift Check.....	17
Sampling	17
<i>Relative Accuracy Calculation</i>	18
<i>Bias Determination & Adjustment Factor Calculation</i>.....	19
RESULTS AND DISCUSSION	20
CONCLUSIONS	29
APPENDIX.....	30
Initial Measurement System Response Tests & Run Validations	30

LIST OF TABLES

Table 1: Summary of Test Results	3
Table 2: Key Parameters of the Hardin Power Plant.....	6
Table 3: Span and Range Value(s)	10
Table 4: IRM Calibration Span & Gas Concentrations.....	12
Table 5: Linearity Check - Stack Hg-CEMS.....	20
Table 6: Linearity Check - Air Heater Outlet Hg-CEMS.....	21
Table 7: 7-Day Calibration Error Test - Stack Hg-CEMS	22
Table 8: 7-Day Calibration Error Test - Air Heater Outlet Hg-CEMS	23
Table 9: Cycle Time Test - Stack Hg-CEMS.....	24
Table 10: Cycle Time Test - Air Heater Outlet Hg-CEMS.....	25
Table 11: 3-Level System Integrity Check - Stack Hg-CEMS.....	26
Table 12: RATA & Bias Test - Stack Hg-CEMS	27
Table 13: RATA & Bias Test - Air Heater Outlet Hg-CEMS	28
Table 14: IRM System Calibration Error Test.....	30
Table 15: IRM System Integrity Check.....	31
Table 16: IRM Dynamic Spiking Test	32
Table 17: Run Validation - Stack Hg-CEMS	33
Table 18: Run Validation - Air Heater Outlet Hg-CEMS	34

LIST OF FIGURES

Figure 1: Hardin Facility View.....	5
Figure 2: Stack Sampling Port Location	7
Figure 3: Air Heater Outlet Sampling Port Location.....	8
Figure 4: Thermo CEMS Configured for an IRM	9
Figure 5: Filter and Conversion Unit.....	9
Figure 6: IRM Probe Designed for Traversing.....	9
Figure 7: Stack Sampling Points	13
Figure 8: Air Heater Outlet Sampling Point	14

EXECUTIVE SUMMARY

ADA Environmental Solutions, Inc. (ADA-ES) conducted mercury continuous emissions monitoring system (Hg-CEMS) testing during the week of April 21, 2008 at Rocky Mountain Power's Hardin Generating Station, Hardin, MT using regulations outlined in 40 CFR Part 75.20. Method 30A was the instrumental reference method (IRM) employed to conduct a Relative Accuracy Test Audit (RATA) of the Stack Hg-CEMS, downstream of Activated Carbon Injection (ACI). Modified Method 30A procedures were also used for a RATA on the Air Heater Outlet Hg-CEMS, upstream of ACI.

This technical report was prepared with the support of the U.S. Department of Energy under Award No. DE-FC26-06NT42774, to be included in the "Long-Term Carbon Injection Field Test for >90% Mercury Removal for a PRB Unit with a Spray Dryer and Fabric Filter" project of DOE's "Phase III Mercury Control Technology Field Testing and Related Mercury Control Research and Development" program. This was the first of three RATA tests that will be performed during the Long-term Test Phase of this project as specified in the test plan.

The stack Hg-CEMS passed all performance tests conducted during this evaluation except the 3-Level System Integrity Check and the Bias Test. The air heater outlet CEMS passed all applicable performance tests except the Bias Test. The instrumental analyzer failed the dynamic spiking test. A summary of these results are presented in Table 1 and details are discussed in this report.

Table 1: Summary of Test Results

Test	Stack Hg-CEMS (downstream of ACI)	Air Heater Outlet Hg-CEMS (upstream of ACI)
Linearity Check	PASS	PASS
7-Day Calibration Error Test	PASS	PASS
Cycle Time Test	PASS	PASS
3-Level System Integrity Check	FAIL	N/A
Relative Accuracy Test Audit	PASS	PASS
<u>IRM System Performance Tests</u>		
Interference Check (Optional)	-	-
3-Point System Calibration Error Test	PASS	-
System Integrity Check	PASS	-
Measurement System Response	PASS	-
Dynamic Spiking Test	FAIL	-
Bias Test	FAIL	FAIL

* Note: The 3-Level System Integrity Check is not applicable to the CEMS installed on the Air Heater Outlet because no oxidizer is installed at this location.

It is important to note that the 121 MW plant had been operating at approximately 105 MW due to a transformer casualty and the subsequent replacement transformer's limitations. A new transformer capable of full load is scheduled to be installed in July 2008. Despite this lower output, the plant was still operating at the "high load" deemed to be the normal load for the unit as defined in Section 6.5.2.1 [40 CFR Part 75 Appendix A].

The failure of the 3-Level System Integrity Check on the Stack Hg-CEMS was attributed to improper insulation of the mercuric chloride generator. This unit will be upgraded and tested before the next RATA in June 2008. The failure of the Bias Tests was attributed to a flaw in the design of the Heating Ventilation and Air Conditioning (HVAC) system on the IRM that made it difficult to maintain constant temperature within the housing. This flaw has been corrected and the Bias Test will be repeated during the June test. No Bias Adjustment Factor (BAF) was implemented into the CEMS at this time.

A Linearity Check performed the week before the site visit on the Stack Hg-CEMS failed due to calibrator non-linearity. As a result, the IRM calibrator was used to successfully calibrate the Stack Hg-CEMS for the test period, and was later installed into the Stack system after the RATAs to allow for the non-linear unit's being serviced. The remaining tests were performed remotely with the IRM calibrator.

The Dynamic Spiking Test failure was attributed to difficulties in maintaining vapor phase oxidized mercury in the sample gas stream. Recovery of the oxidized mercury proved unsuccessful as evident in failure of both mean percentage recovery and absolute difference criteria. This test is intended to be reevaluated in August 2008 and its feasibility will be reassessed.

This report documents detailed operating procedures, and includes supporting documentation in a dedicated appendix.

INTRODUCTION

Rocky Mountain Power's Hardin Generating Station – Hardin, MT

Figure 1: Hardin Facility View

Facility Description

Rocky Mountain Power's Hardin Generating Station is a new and relatively small plant (121 MW) that was first brought online in December of 2005. It fires a pulverized Powder River Basin (PRB) coal from the nearby Absaloka Mine, and is configured with low NO_x burners and a Selective Catalytic Reduction (SCR) for NO_x control, a Spray Dryer Absorber (SDA) for SO₂ control, and a Fabric Filter (FF) for particulate control. The coal contains approximately 0.65% sulfur, 0.04 ppm mercury and <20 ppm chlorine. A commercial-grade Activated Carbon Injection (ACI) system is integrated with a new-generation mercury analyzer to allow automated feedback control of the outlet mercury emissions.

Table 2: Key Parameters of the Hardin Power Plant

Rated Capacity	121 (MW)
Range of Operation	81 – 121 MW
Operating Levels	Low: 81-93 MW Mid: 93-105 MW High (Normal): 105-121 MW
Coal (typical)	PRB, Absaloka Mine
Boiler Type	PC Boiler Opposing wall-fired
Sulfur Control	Spray Dryer with Recycle
Nitrogen Oxide Control	Low NO _x Burners/SCR
Particulate Control	Fabric Filter
Gas Flow Rate (ACI Location)	~ 550,000 acfm
Flue Gas Temperature (ACI Location)	260-320 °F

Mercury CEMS Description

The Mercury Freedom™ System manufactured by Thermo Fisher Corporation is installed at Hardin. This CEMS is being used to measure the mercury emissions at the Stack and the Air Heater Outlet. Thermo Electron's Mercury Freedom™ System is comprised of an Hg Analyzer (80i), Calibrator (81i), Probe Controller (82i), Probe (83i) and related peripheral components including an umbilical and instrument rack.

Sampling Port Locations

Air Sampling Associates, Inc. previously measured and documented the sampling port locations at the Stack and Air Heater Outlet depicted in Figures 2 and 3, respectively, during stack testing:

“The sampling ports on the SDA Inlet duct [Air Heater Outlet duct] are approximately 36 feet 9 1/2 inches above the ground. The sampling ports are located 13 feet 4 inches (1.12 equivalent duct diameters) downstream from a bend in the duct and 56 feet 3 inches (4.75 equivalent duct diameters) upstream from a bend in the duct. The sampling ports on the Stack are approximately 123 feet 1 1/2 inches above the ground. The sampling ports are located 33 feet 1 1/2 inches (3.64 stack diameters) downstream from the inlet to the Stack and > 18 feet 2 3/8 inches (> 2.00 Stack diameters) upstream from the outlet to the Stack.”

Figure 2: Stack Sampling Port Location [ASA, Inc.]

Figure 3: Air Heater Outlet Sampling Port Location [ASA, Inc.]

Method 30A IRM Equipment & Description

A Thermo Mercury Freedom™ System has been configured for IRM testing. A photo of the unit is shown in Figure 4. The unit consists of a standard Model 80i Mercury Analyzer and Model 81i Mercury Calibrator installed in a temperature controlled enclosure. Probe control (temperature, flow, pressure) is achieved through analog controls installed in the environmental enclosure. A standard Model 83i Probe, shown in Figure 5, has been modified by removing the mantle and stinger, connecting calibration gas to a port upstream of the sampling filter, and adding additional pressure monitoring capabilities to the flow measurement venturi. A modified mantle/stinger portion of the probe has been fabricated to facilitate traversing. A sketch of this component is shown in Figure 6. The mantle/stinger was coupled to the other probe components

by a 25-foot long heated umbilical. At Hardin Generating Station, the IRM enclosure was located at ground level while the probe enclosure, 25-foot heated umbilical, and mantle/stinger were located at the sampling platform.

Figure 4: Thermo CEMS Configured for an IRM

Figure 5: Filter and Conversion Unit

Figure 6: IRM Probe Designed for Traversing

APPROACH

CEMS Parameters

System parameters for the installed Hg-CEMS are presented in Table 3. The Maximum Potential Concentration (MPC), Removal Efficiency (RE), and Maximum Expected Concentration (MEC) were determined in order to calculate the Span (S), Range, and appropriate concentration levels. These calculated values are necessary for calibration of the analyzer, and consequently the validation of measured data.

Table 3: Span and Range Value(s)

	Air Heater Outlet Hg-CEMS (Upstream of ACI)	Stack Hg-CEMS (Downstream of ACI)	Reference
MPC	10 µg/scm	10 µg/scm	Section 2.1.7.1 40 CFR Part 75 Appendix A
RE	0%	90%	Equation A-2, Section 2.1.1.2 40 CFR Part 75 Appendix A
MEC	10 µg/scm	1 µg/scm	Section 2.1.7.2 40 CFR Part 75 Appendix A
S (High : Low)	20 µg/scm	20 µg/scm : 10 µg/scm	Section 2.1.7.3 40 CFR Part 75 Appendix A
Range	20 µg/scm	10 µg/scm	Section 2.1.7.3 40 CFR Part 75 Appendix A
Zero-level Concentration (0-20% * S)	0 µg/scm (0%)	0 µg/scm (0%) : 0 µg/scm (0%)	Section 5.2 40 CFR Part 75 Appendix A
Low-level Concentration (20-30% * S)	5 µg/scm (25%)	5 µg/scm (25%) : 3 µg/scm (30%)	Section 5.2 40 CFR Part 75 Appendix A
Mid-level Concentration (50-60% * S)	11 µg/scm (55%)	11 µg/scm (55%) : 5 µg/scm (50%)	Section 5.2 40 CFR Part 75 Appendix A
High-level Concentration (80-100% * S)	18 µg/scm (90%)	18 µg/scm (90%) : 9 µg/scm (90%)	Section 5.2 40 CFR Part 75 Appendix A

* The high span value on the Outlet CEM is neglected because Hg concentrations at the stack will never exceed 2.0 µg/scm by design of emissions control.

Performance Tests

The following tests were performed on the installed CEMS in accordance with applicable procedure outlined in 40 CFR Part 75 Appendix A:

- (A) Linearity Check
- (B) 7-Day Calibration Error Test
- (C) Cycle Time Test
- (D) 3-Level System Integrity Check
- (E) Relative Accuracy Test Audit (RATA)/Bias Test

(A) Linearity Check

A Linearity Check was conducted on the Hg monitor with the unit combusting fuel at conditions of typical stack temperature and pressure in accordance with procedures described in Section 6.2 [40 CFR Part 75 Appendix A]. The monitor was challenged with calibration gas at the low-, mid-, and high-range concentrations, passing through all monitor components used during normal sampling and through as much of the sampling probe as practical. The monitor was challenged three times with each reference gas, without the same gas's being used twice in succession.

Acceptance criteria:

- (1) $LE \leq 10.0\%$, where

$$LE = \frac{|R - A|}{R} \times 100$$

LE – Linear error, based upon the reference value.

R – Reference value of low-, mid-, or high-level concentration gas introduced into the monitoring system.

A – Average of the monitoring system response.

- (2) $|R - A| \leq 1.0 \mu\text{g}/\text{scm}$

(B) 7-Day Calibration Error Test

A 7-Day Calibration Error Test was performed according to procedures outlined in Section 6.3.1 [40 CFR Part 75 Appendix A] utilizing zero- and mid-level calibration concentration calibration gas. Mid-level has been deemed representative of the actual stack gas concentrations, and therefore selected in lieu of high-level gas. Each monitor was challenged once with calibration gas at both the low- and mid-level concentrations, passing through all monitor components used during normal sampling and through as much of the sampling probe as practical. Calibration error was calculated daily at approximately 24-hour intervals and evaluated in accordance with performance specifications outlined in Section 3.1 [40 CFR Part 75 Appendix A].

Acceptance criteria:

- (1) $CE_{\text{zero/upscale}} \leq 5.0\%$, where

$$CE = \frac{|R - A|}{S} \times 100$$

CE - Calibration error as a percentage of the span of the instrument.

R - Reference value of zero or upscale (high- or mid-level, as applicable) calibration gas introduced into the monitoring system.

A - Actual monitoring system response to the calibration gas.

S - Span of the instrument, as specified in Section 2 [40 CFR Part 75 Appendix A].

- (2) Alternatively, if $S = 10 \mu\text{g}/\text{scm}$, $|R - A| \leq 1.0 \mu\text{g}/\text{scm}$.

(C) Cycle Time Test

Using a zero-level and a high-level calibration gas alternately, an upscale and downscale cycle time was determined in accordance with Section 6.4 [40 CFR Part 75 Appendix A]. A zero-level concentration calibration gas was injected into the injection port until a steady-state was attained. The system was then placed in sample mode until a stable response to flue gas emissions was obtained. The upscale elapsed time was determined by evaluating the time required for a 95% step change from the zero-level up to the flue gas emission steady-state responses. An analogous calculation was used to determine the downscale elapsed time of a steady-state high-level calibration gas response down to measured flue gas emissions. The cycle time is the higher of the two elapsed times.

Acceptance Criterion:

- (1) Cycle time ≤ 15 min.

(D) 3-Level System Integrity Check

Oxidized mercury (Hg^{2+}) was utilized to conduct a 3-Level System Integrity Check with performance specifications outlined in Section 3.2(3)(iii) [40 CFR Part 75 Appendix A]. The monitor was challenged with calibration gas at the low-, mid-, and high-range concentrations, passing through all monitor components used during normal sampling and through as much of the sampling probe as practical. The monitor was challenged three times with each reference gas, without the same gas's being used twice in succession.

Acceptance Criterion:

(1) $CE \leq 5.0\%$, where

$$CE = \frac{|R - A|}{S} \times 100$$

CE - Calibration error as a percentage of the span of the instrument.

R - Reference value of zero-, mid-, and high-level calibration gas introduced into the monitoring system.

A - Actual monitoring system response to the calibration gas.

S - Span of the instrument, as specified in Section 2 [40 CFR Part 75 Appendix A].

(E) Relative Accuracy Test Audit (RATA) & Bias Test

As suggested in Section 6.5.1(b) [40 CFR Part 75 Appendix A], for the initial certification of a gas or Hg monitoring system and for recertification in which one or more tests are required (i.e., a linearity test, cycle time test, or 7-day calibration error test), EPA recommends that the RATA not be commenced until the other required tests of the CEMS have been passed.

Instrumental Analyzer Configuration

Calibration Span & Gas Concentrations

To the extent practicable the measured emissions are to be between 10 and 100% of the selected calibration span. It is recommended that the calibration span be at least twice the native concentration to accommodate the dynamic spiking procedure (Section 3.4, [Method 30A]). The selected value of the calibration span is limited by the capabilities of the calibrator. The parameters used for calibration and data validation tests of the instrumental analyzer are outlined in Table 4.

Table 4: IRM Calibration Span & Gas Concentrations

	Native Concentration = 2 $\mu\text{g}/\text{scm}$	
	Calibration Span (CS) = 10 $\mu\text{g}/\text{scm}$	
Gas Concentration	Allowable Range	Hg Concentration
Zero-level	Non-detectable	0 $\mu\text{g}/\text{scm}$ (0 %)
Low-level	10-30 % CS	3 $\mu\text{g}/\text{scm}$ (30 %)
Mid-level	40-60 % CS	5 $\mu\text{g}/\text{scm}$ (50 %)
High-level	100 % CS	9 $\mu\text{g}/\text{scm}$ (90 %)

Sample Point Selection

When Method 30A is used for relative accuracy testing of a Hg CEMS, the sampling site selection and sampling point layout procedures are referenced in the appropriate performance specification or applicable regulation described in Performance Specification 2, Section 8.1.3 [40 CFR Part 75 Appendix B] or Section 6.5.6 [40 CFR Part 75 Appendix A]. Alternatively, Section 8.1.3.4 [Method 30A] states that stratification testing need not be performed at a test location where it would otherwise be required to justify using fewer sample points or different sample points, if the Hg concentration in the stack gas is expected to be $3 \mu\text{g}/\text{m}^3$ or less at the time of a Hg monitoring system RATA or an Hg emissions test. Documentation of at least one hour of Hg concentration data is required just prior to the RATA or emissions test. If a particular test location qualifies for the stratification testing exemption, sampling shall be performed at three points, as described in Section 8.1.3.2.2 [Method 30A]. Since the stack diameter (or equivalent diameter, for a rectangular stack or duct) is greater than 7.8 ft, the three Stack sampling points were therefore located at 4.4, 14.6, and 29.6 percent of the stack diameter (109 3/16") from the stack or duct wall (see Figure 2). Since only modified Method 30A procedures were performed at the Air Heater Outlet, a single sampling point depicted in Figure 3 was selected at 78.74" from the duct wall.

Figure 7: Stack Sampling Points

Figure 8: Air Heater Outlet Sampling Point

Initial Measurement System Performance Tests

Initial measurement system performance tests need to be met in accordance with Method 30A on the instrumental analyzer prior to conducting the nine (9) required test runs and evaluating the relative accuracy. The performance requirements of this method must be met to validate data, and are listed below:

- (1) Interference Testing (Optional)
- (2) Calibration Gas Verification
- (3) Measurement System Preparation
- (4) 3-Point System Calibration Error Test
- (5) System Integrity Check
- (6) Measurement System Response Time Test
- (7) Dynamic Spiking (deferred until January 1, 2009)

(1) Interference Test (Optional)

It is recommended that this test be conducted prior to the initial use of the measurement system in the field to verify that the candidate test instrument is free from inherent biases or interferences resulting from common combustion emission constituents. The interference test procedure is found in Section 8.6 [Method 30A]. This procedure was not performed during this test period.

(2) Calibration Gas Verification

EPA Traceability Protocol for Qualification and Certification of Elemental Mercury Gas Generators and EPA Traceability Protocol for Qualification and Certification of Oxidized Mercury Gas Generators expected publication date December 2008, see www.epa.gov/ttn/emc.

(3) Measurement System Preparation

The measurement system was assembled, prepared, and preconditioned according to standard operating procedure.

(4) System Calibration Error Test

Using elemental mercury (Hg^0), a 3-point system calibration error test was conducted prior to the first test run. The low-, mid-, and high-level calibration gases were introduced in any order into the instrumental analyzer, and, after each gas injection, a stable response was obtained and recorded.

Acceptance criteria:

- i. $\text{SCE} \leq 5\%$, where

$$\text{SCE} = \frac{|C_s - C_v|}{CS} \times 100$$

SCE - System Calibration Error [%].

C_s - Measured concentration of the calibration gas [$\mu\text{g}/\text{scm}$].

C_v - Certified concentration of the calibration gas [$\mu\text{g}/\text{scm}$].

CS - Calibration Span [$\mu\text{g}/\text{scm}$].

- ii. Alternatively, $|C_s - C_v| \leq 0.5 \mu\text{g}/\text{scm}$

(5) System Integrity Check

Using oxidized mercury (Hg^{2+}), a two-point system integrity check was conducted as required before the first test run. The zero- and mid-level calibration gases were introduced into the instrumental analyzer, and, after each gas injection, a stable response was obtained and recorded.

Acceptance criteria:

- i. $\text{SCE} \leq 5\%$, where

$$\text{SCE} = \frac{|C_s - C_v|}{CS} \times 100$$

SCE - System Calibration Error [%].

C_s - Measured concentration of the calibration gas [$\mu\text{g}/\text{scm}$].

C_v - Certified concentration of the calibration gas [$\mu\text{g}/\text{scm}$].

CS - Calibration Span [$\mu\text{g}/\text{scm}$].

- ii. Alternatively, $|C_s - C_v| \leq 0.5 \mu\text{g}/\text{scm}$

(6) Measurement System Response Time

The measurement system response time provides the minimum sampling time for each sampling point. It is equal to the time that is required for the measured Hg concentration to increase from the stable low-level calibration gas response to a value within 5 percent of the stable high-level calibration gas response obtained during the system calibration error test in Section 8.2.4 [Method 30A], assuming the high-level calibration gas was injected immediately after the low-level.

(7) Dynamic Spiking Test (deferred until January 1, 2009)

The purpose of this procedure is to demonstrate that the site-specific flue gas matrix does not adversely affect the accuracy of the measurement system. If the specifications stated in Section 13.5 [Method 30A] are not met, the procedure must be repeated until satisfactory results are obtained. Dynamic spiking is a gas phase application of the

method of standard additions, which involves injecting a known quantity of Hg into the measurement system upstream of all sample conditioning components, similar to system calibration, except the probe is not flooded and the resulting sample stream includes both effluent gas and the spike gas. A written procedure that details how the spike is added to the system, how the spike dilution factor (DF) is measured, and how the Hg concentration data are collected and processed is required.

The spike gas must be a HgCl₂ calibration gas certified by an EPA traceability protocol (estimated promulgation ~December 2008), and chosen concentrations must produce the target levels while being injected at a volumetric flow rate that is ≤ 20 percent of the total volumetric flow rate through the measurement system. The target level, C_{target} for spiking must be 150 to 200 percent of the native Hg concentration, C_{native}. Alternately, if the Hg concentration is ≤ 1 µg/scm, the target level shall be between 1 and 4 µg/scm above the native concentration. At least 3 data points must be obtained, and the relative standard deviation specification must be met. Each baseline measurement must include at least 4 readings or 1 minute (whichever is greater) of stable responses.

$$C_{\text{native}} = 0.3 \text{ } \mu\text{g/scm}$$

$$C_{\text{target}} = 4.27 \text{ } \mu\text{g/scm}$$

Since the configuration of the IRM does not allow for accurate measurement of total volumetric flow rate through the system, a spike gas that includes a tracer for measuring the dilution factor (DF) was used.

DF Calculation:

$$DF = \frac{Q_{\text{probe}}}{Q_{\text{spike}}} = \frac{C_{\text{Tdir}} - C_{\text{Tnative}}}{C_{\text{Tv}} - C_{\text{Tnative}}}$$

Q_{probe} – Total flow rate of the stack gas sample plus the spike gas [liters/min].

Q_{spike} – Flow rate of the spike gas [liters/min].

C_{Tdir} – Tracer gas concentration injected with spike gas [ppm].

C_{Tv} – Diluted tracer gas concentration measured in a spiked sample [ppm].

C_{Tnative} – Measured tracer gas concentration present in native effluent gas [ppm].

Dynamic Spike Gas Concentration Calculation:

$$C_{\text{spike}}^* = DF \times (C_{\text{target}} - C_{\text{native}}) + C_{\text{native}}$$

C_{spike}^{*} - Hg concentration of the spike gas required to achieve a certain target value for the spiked sample Hg concentration [µg/scm].

C_{target} – Target Hg concentration of the spiked sample [µg/scm].

C_{native} – Vapor phase Hg concentration in the source effluent [µg/scm].

Spiked Sample Concentration Calculation:

$$C_{\text{ss}}^* = C_{\text{native}} + \frac{C_{\text{spike}} - C_{\text{native}}}{DF}$$

C_{ss}^{*} - Expected Hg concentration of the spiked sample at the target level [µg/scm].

C_{spike} – Actual Hg concentration of the spike gas [µg/scm].

Acceptance Criterion:

i.(a) $90\% \leq \bar{R} \leq 110\%$, where

$$R = \frac{DF(C_{ss} - C_{native}) + C_{native}}{C_{spike}} \times 100\%$$

R – Spike recovery [%].

C_{ss} – Measured Hg concentration of the spiked sample at the target level
[µg/scm].

i.(b) Alternatively, $|C_{ss}^* - C_{ss}| \leq 0.5 \text{ µg/scm}$

ii.(a) $RSD \leq 5.0\%$, where

$$RSD = \frac{100\%}{\bar{R}} \sqrt{\frac{\sum_{i=1}^n (R_i - \bar{R})^2}{n-1}}$$

RSD – Relative Standard Deviation [%].

Test Runs

After the instrumental analyzer has successfully met the acceptance criteria of the initial system performance tests, the minimum nine (9) test runs of the RATA were performed. One test run constitutes one sampling at each successive sample point. Run validations listed below must be performed while sampling.

System Integrity Checks

Before and after each test run, a two-point system integrity check using the same procedure as the initial system integrity check must be conducted. No adjustments may be made to the measurement system during the checks, other than to maintain the target calibration gas flow rate and the proper dilution ratio. This check may be skipped between each run provided that a system integrity check performed on completion of runs passes the allowed specification. If a post-run integrity check is failed, all test runs since the last passed system integrity check are invalid. If a check is failed, corrective action must be taken and another 3-point Hg⁰ System Calibration Error Test passed followed by another System Integrity Check before conducting any additional test runs.

Drift Check

Using the data from the successful pre- and post-run system integrity checks, calculate the zero and upscale drift. Exceeding the specification does not invalidate the run, but corrective action must be taken and a new 3-point Hg⁰ System Calibration Error Test and a System Integrity Check must be passed before any more runs are made.

Sampling

For each sample point determined from Section 8.1, Method 30A, the system must be allowed to flush and equilibrate for at least two times the measurement system response time before recording any data. The minimum sampling time at each sampling point must be at least two times the system response time, but not less than 10 minutes.

Relative Accuracy Calculation

Acceptance criteria:

(1) $RA \leq 20.0\%$, where

Arithmetic Mean:

$$d = RM - CEM$$

d – The difference between a reference method value and the corresponding continuous emission monitoring system value at a given point in time.

RM – Reference method value.

CEM – Continuous emission monitoring system value.

$$\bar{d} = \frac{\sum_{i=1}^n d_i}{n}$$

n – Number of data points.

Standard Deviation:

$$S_d = \sqrt{\frac{\sum_{i=1}^n d_i^2 - \frac{\left(\sum_{i=1}^n d_i\right)^2}{n}}{n-1}}$$

S_d – Standard deviation.

Confidence Coefficient:

$$cc = t_{0.025} \times \frac{S_d}{\sqrt{n}}$$

cc – Confidence coefficient.
 $t_{0.025}$ – t-value.

Relative Accuracy:

$$RA = \frac{|\bar{d}| + |cc|}{\overline{RM}} \times 100$$

RA – Relative accuracy of a data set.

RM – Arithmetic mean of the reference method values.

$\bar{d}$ – Mean difference between the reference method values and the corresponding continuous emission monitoring system values.

(2) Alternatively, if $\overline{RM} \leq 5.0 \mu\text{g/scm}$, $\overline{CEM} - \overline{RM} \leq 1.0 \mu\text{g/scm}$

Bias Determination & Adjustment Factor Calculation

If the following criterion is met for the relative accuracy test audit data set being tested, the monitoring system has passed the bias test:

(1) Acceptance criterion:

$$\bar{d} \leq |cc|$$

If the monitor or monitoring system fails to meet the bias test requirement, adjustment of the value obtained from the monitor is necessary using the following equation:

$$CEM_i^{Adjusted} = CEM_i^{Monitor} \times BAF$$

$CEM_i^{Adjusted}$ - Data value, adjusted for bias, at time i.

$CEM_i^{Monitor}$ - Data (measurement) provided by monitor at time i.

BAF – Bias Adjustment Factor.

Bias Adjustment Factor:

$$BAF = 1 + \frac{\bar{d}}{CEM}$$

If the monitoring system meets the normal or the alternative relative accuracy specification in section 3.3.8 of 40 CFR Part 75 Appendix A but fails the bias test, the owner or operator may either use the BAF calculated above or may use a default BAF of 1.250 for reporting purposes. Each time a RATA is passed and the appropriate BAF has been determined, the BAF is to be applied prospectively to all monitoring system data, beginning with the first clock hour following the hour in which the RATA was completed.

RESULTS AND DISCUSSION

Data from the Linearity Checks for the Stack and Air Heater Outlet Hg-CEMS are presented in Table 5 and Table 6, respectively. The results for the CEMS installed at both locations indicate compliance with performance specifications documented in 40 CFR Part 75 Appendix A.

Table 5: Linearity Check - Stack Hg-CEMS

Linearity Check				
Facility:	Hardin Generating Station	Date(s):	04/28/2008	
Project #:	06-7008	Unit(s) tested:	Stack Hg-CEMS	
Personnel:	Erik Zipp	Test Runs:	N/A	
		Analyzer Make/Model:	Thermo Mercury Freedom System™	
		Serial No:	0613917173	
Span, S =	10 µg/scm			

Calibration Gas Level	R [µg/scm]	A [µg/scm]	LE [%]	R-A [µg/scm]
Low-	3.00	2.68	10.67	0.32
Mid-	6.00	5.79	3.50	0.21
High-	9.00	8.57	4.78	0.43

LE - Linearity error
R - Reference value of calibration gas
A - Average of monitoring system response
S - Span value

Acceptance criteria:
(1) $LE \leq 10.0\%$
(2) Alternatively, $|R-A| \leq 1.0 \text{ µg/scm}$

Table 6: Linearity Check - Air Heater Outlet Hg-CEMS

Linearity Check				
Facility:	<u>Hardin Generating Station</u>	Date(s):	<u>04/28/2008</u>	
Project #:	<u>06-7008</u>	Unit(s) tested:	<u>Air Heater Outlet Hg-CEMS</u>	
Personnel:	<u>Erik Zipp</u>	Test Runs:	<u>N/A</u>	
		Analyzer Make/Model:	<u>Thermo Mercury Freedom</u>	
			<u>System™</u>	
Span, S =	<u>20</u> $\mu\text{g}/\text{scm}$	Serial No:	<u>0613917146</u>	
Calibration Gas Level	R [$\mu\text{g}/\text{scm}$]	A [$\mu\text{g}/\text{scm}$]	LE [%]	 R-A [$\mu\text{g}/\text{scm}$]
Low-	5.00	5.20	4.00	0.20
Mid-	11.00	11.31	2.82	0.31
High-	18.00	17.96	0.22	0.04
<p>LE - Linearity error R - Reference value of calibration gas A - Average of monitoring system response S - Span value</p> <p>Acceptance criteria: (1) $\text{LE} \leq 10.0\%$ (2) Alternatively, $R-A \leq 1.0 \mu\text{g}/\text{scm}$</p>				

Data from the 7-Day Calibration Error Tests for the Stack and Air Heater Outlet Hg-CEMS are presented in Table 7 and Table 8, respectively. Results for the CEMS installed at both locations also indicate compliance with performance specifications documented in 40 CFR Part 75 Appendix A.

Table 7: 7-Day Calibration Error Test - Stack Hg-CEMS

7-Day Calibration Error Test					
Facility:	<u>Hardin Generating Station</u>	Date(s):	<u>05/05/2008</u>		
Project #:	<u>06-7008</u>	Unit(s) tested:	<u>Stack Hg-CEMS</u>		
Personnel:	<u>Erik Zipp</u>	Test Runs:	<u>N/A</u>		
		Analyzer Make/Model:	<u>Thermo Mercury Freedom</u>		
			<u>System™</u>		
Span, S =	<u>10</u> $\mu\text{g}/\text{scm}$	Serial No:	<u>0613917173</u>		

Day	Calibration Gas Level	R $[\mu\text{g}/\text{scm}]$	A $[\mu\text{g}/\text{scm}]$	CE [%]	R-A $[\mu\text{g}/\text{scm}]$
1	Zero-	0.00	0.01	0.10	0.01
	Mid-	5.00	4.92	0.80	0.08
2	Zero-	0.00	0.01	0.10	0.01
	Mid-	5.00	4.88	1.20	0.12
3	Zero-	0.00	0.03	0.30	0.03
	Mid-	5.00	4.83	1.70	0.17
4	Zero-	0.00	0.04	0.40	0.04
	Mid-	5.00	4.86	1.40	0.14
5	Zero-	0.00	0.06	0.60	0.06
	Mid-	5.00	4.79	2.10	0.21
6	Zero-	0.00	0.03	0.30	0.03
	Mid-	5.00	4.84	1.60	0.16
7	Zero-	0.00	0.04	0.40	0.04
	Mid-	5.00	4.97	0.30	0.03

CE - Calibration error
R - Reference value of calibration gas
A - Actual monitoring system response
S - Span value

Acceptance criteria:
(1) $\text{CE} \leq 5.0\%$
(2) Alternatively, if $S = 10 \mu\text{g}/\text{scm}$: $|R-A| \leq 1.0 \mu\text{g}/\text{scm}$

Table 8: 7-Day Calibration Error Test - Air Heater Outlet Hg-CEMS**7-Day Calibration Error Test**

Facility:	Hardin Generating Station	Date(s):	05/05/2008
Project #:	06-7008	Unit(s) tested:	Air Heater Outlet Hg-CEMS
Personnel:	Erik Zipp	Test Runs:	N/A
		Analyzer Make/Model:	Thermo Mercury Freedom System™
Span, S =	20 µg/scm	Serial No:	0613917146

Day	Calibration Gas Level	R [µg/scm]	A [µg/scm]	CE [%]	R-A [µg/scm]
1	Zero	0.00	-0.02	0.10	0.02
	Mid-	11.00	10.86	0.70	0.14
2	Zero	0.00	-0.03	0.15	0.03
	Mid-	11.00	10.79	1.05	0.21
3	Zero	0.00	-0.05	0.25	0.05
	Mid-	11.00	10.84	0.80	0.16
4	Zero	0.00	0.02	0.10	0.02
	Mid-	11.00	10.87	0.65	0.13
5	Zero	0.00	-0.03	0.15	0.03
	Mid-	11.00	10.74	1.30	0.26
6	Zero	0.00	-0.03	0.15	0.03
	Mid-	11.00	11.16	0.80	0.16
7	Zero	0.00	-0.06	0.30	0.06
	Mid-	11.00	10.61	1.95	0.39

CE - Calibration error

R - Reference value of calibration gas

A - Actual monitoring system response

S - Span value

Acceptance criteria:

(1) $CE \leq 5.0\%$ (2) Alternatively, if $S = 10 \mu\text{g}/\text{scm}$: $|R-A| \leq 1.0 \mu\text{g}/\text{scm}$

Cycle Time Tests for the Stack and Air Heater Outlet Hg-CEMS are presented in Table 9 and Table 10, respectively. Both CEMS passed the performance criterion; however, improper procedure was followed in performing this test at the Stack Hg-CEMS. The mid-level concentration was used instead of the high-level, but this error does not indicate that the unit will fail when properly performed.

Table 9: Cycle Time Test - Stack Hg-CEMS

Cycle Time Test						
Facility: Hardin Generating Station			Date(s): 04/29/2008			
Project #: 06-7008			Unit(s) tested: Stack Hg-CEMS			
Personnel: Pattie Garcia			Test Runs: N/A			
			Analyzer Make/Model: Thermo Mercury Freedom			
			System™			
Span, S = 10 µg/scm			Serial No: 0613917173			
Calibration Gas Level	R [µg/scm]	Start Time	A _i [µg/scm]	End Time	A _f [µg/scm]	Cycle Time [min.]
Zero-	0.00	12:27	0.01	12:47	0.42	5 min.
Mid-	5.00	13:08	5.12	13:28	0.46	5 min.
<p>R - Reference value of calibration gas A_i - Initial stable monitor system response A_f - Final stable monitor system response S - Span value</p> <p>Acceptance criteria: (1) Cycle Time ≤ 15 min.</p>						

Table 10: Cycle Time Test - Air Heater Outlet Hg-CEMS

Cycle Time Test						
Facility:	Hardin Generating Station			Date(s):	05/21/2008	
Project #:	06-7008			Unit(s) tested:	Air Heater Outlet Hg-CEMS	
Personnel:	Pattie Garcia			Test Runs:	N/A	
				Analyzer Make/Model:	Thermo Mercury Freedom	
					System™	
Span, S =	20 μg/scm			Serial No:	0613917146	
Calibration Gas Level	R [μg/scm]	Start Time	A_i [μg/scm]	End Time	A_f [μg/scm]	Cycle Time [min.]
Zero-	0.00	10:22	0.03	10:42	4.27	5 min.
High-	18.00	11:05	18.21	11:25	4.37	5 min.
<p>R - Reference value of calibration gas A_i - Initial stable monitor system response A_f - Final stable monitor system response S - Span value</p> <p>Acceptance criteria: (1) Cycle Time ≤ 15 min.</p>						

The 3-Level System Integrity Check for the Stack Hg-CEMS is presented in Table 11. This test, which involves the injection of Hg^{2+} calibration gas concentrations, has proven problematic in meeting acceptance criteria. Concerns have been addressed to Thermo Fisher Corporation in attempts to resolve this problem. This unit will be upgraded and tested before the next RATA test in June 2008.

Table 11: 3-Level System Integrity Check - Stack Hg-CEMS

3-Level System Integrity Check			
Facility:	<u>Hardin Generating Station</u>	Date(s):	<u>05/05/2008</u>
Project #:	<u>06-7008</u>	Unit(s) tested:	<u>Stack Hg-CEMS</u>
Personnel:	<u>Erik Zipp</u>	Test Runs:	<u>N/A</u>
		Analyzer Make/Model:	<u>Thermo Mercury Freedom</u>
			<u>System™</u>
Span, S =	<u>10</u> $\mu\text{g}/\text{scm}$	Serial No:	<u>0613917173</u>

Calibration Gas Level	R [$\mu\text{g}/\text{scm}$]	A [$\mu\text{g}/\text{scm}$]	CE [%]
Low-	3.00	2.13	8.70
Mid-	6.00	4.49	15.10
High-	9.00	6.52	24.80

CE - Calibration error
 R - Reference value of calibration gas
 A - Actual monitoring system response
 S - Span value

Acceptance criteria:
 (1) $\text{CE} \leq 5.0\%$

The Relative Accuracy Test Audit conducted on the Stack Hg-CEMS demonstrated compliance with established performance specifications. The RATA conducted on Air Heater Outlet Hg-CEMS lacked the number of runs and sampling points required to meet the acceptance criteria, however the data trended to be acceptable. Bias tests on both monitoring systems failed the acceptance criterion, and bias adjustment factors were calculated but not implemented.

Table 12: RATA & Bias Test - Stack Hg-CEMS

Relative Accuracy Test Audit & Bias Test Summary						
Facility: Hardin Generating Station			Date(s): 04/23/2008			
Project #: 06-7008			Unit(s) tested: Stack Hg-CEMS			
Personnel: Sharon Sjostrom			Test Method: Method 30A			
Jim Domenico			Analyzer Make/Model: Thermo Mercury Freedom			
Brian Carlton			System™			
			Serial No: 0613917173			
Test Run	Start	End	Hg ^T [µg/scm]		d [µg/scm]	d ² [µg/scm]
			RM	CEM		
1	08:53	09:05	-0.12	0.13	-0.25	0.06
3	12:55	13:07	-0.06	0.21	-0.27	0.07
4	14:15	14:27	-0.20	0.22	-0.42	0.18
5	15:28	15:40	-0.10	0.23	-0.34	0.11
6	16:40	16:52	-0.15	0.27	-0.42	0.17
7	17:16	17:28	-0.21	0.27	-0.48	0.23
8	18:28	18:40	-0.06	0.25	-0.31	0.10
9	19:04	19:16	-0.12	0.25	-0.37	0.14
10	19:40	19:52	-0.18	0.23	-0.41	0.17
RM - Reference method value CEM - Continuous emission monitoring system value d - Difference between RM and CEM values n - Number of data points S _d - Standard deviation t _{0.025} - t-value cc - Confidence coefficient Acceptance criteria: (1) $RA \leq 20.0\%$ (2) Alternatively, if $\overline{RM} \leq 5.0 \mu\text{g/scm}$, $\overline{CEM} - \overline{RM} \leq 1.0 \mu\text{g/scm}$				n = 9		
				$\overline{d} = -0.36$		
				$\overline{d_i^2} = 0.14$		
				$\overline{RM} = -0.14$		
				$\overline{CEM} = 0.23$		
				S _d = 0.08		
				t _{0.025} = 2.306		
				cc = 0.059		
				RA = -311.85%		
				$\overline{CEM} - \overline{RM} = 0.36$		
BAF - Bias adjustment factor Acceptance criteria: (1) $\overline{d} \leq cc $						
				BAF = -0.595		

Table 13: RATA & Bias Test - Air Heater Outlet Hg-CEMS

Relative Accuracy Test Audit & Bias Test Summary						
Facility:	Hardin Generating Station			Date(s):	04/24/2008	
Project #:	06-7008			Unit(s) tested:	Air Heater Outlet Hg-CEMS	
Personnel:	Sharon Sjostrom			Test Method:	Method 30A	
	Jim Domenico			Analyzer Make/Model:	Thermo Mercury Freedom	
	Brian Carlton				System™	
				Serial No:	0613917146	
Test Run	Start	End	Hg ^T [µg/scm]		d [µg/scm]	d ² [µg/scm]
			RM	CEM		
1	16:04	16:19	2.26	2.66	-0.39	0.15
2	17:11	17:26	2.43	2.76	-0.34	0.11
3	18:05	18:20	2.38	2.56	-0.19	0.04
RM - Reference method value CEM - Continuous emission monitoring system value d - Difference between RM and CEM values n - Number of data points S _d - Standard deviation t _{0.025} - t-value cc - Confidence coefficient Acceptance criteria: (1) RA ≤ 20.0% (2) Alternatively, if $\frac{RM}{CEM - RM} \leq 5.0 \text{ } \mu\text{g/scm}$, $< 1.0 \text{ } \mu\text{g/scm}$				$n =$ 3		
				$\overline{d} =$ -0.31		
				$d_i^2 =$ 0.10		
				$\overline{RM} =$ 2.36		
				$\overline{CEM} =$ 2.66		
				$S_d =$ 0.11		
				$t_{0.025} =$ 4.303		
				$cc =$ 0.264		
				$RA =$ 24.20%		
				$\overline{CEM} - \overline{RM} =$ 0.31		
BAF - Bias adjustment factor Acceptance criteria: (1) $d \leq cc $						
				BAF = 0.885		

CONCLUSIONS

The Stack Hg-CEMS passed all performance tests conducted during this evaluation except the 3-Level System Integrity Check and the Bias Test. The Air Heater Outlet Hg-CEMS passed all applicable performance tests except the Bias Test. The IRM analyzer failed the Dynamic Spiking Test. A duplicate of the Summary of Results from Table 1 is presented below.

Summary of Results (From Table 1)

Test	Stack Hg-CEMS (downstream of ACI)	Air Heater Outlet Hg-CEMS (upstream of ACI)
Linearity Check	PASS	PASS
7-Day Calibration Error Test	PASS	PASS
Cycle Time Test	PASS	PASS
3-Level System Integrity Check	FAIL	N/A
Relative Accuracy Test Audit	PASS	PASS
<u>IRM System Performance Tests</u>		
Interference Check (Optional)	-	-
3-Point System Calibration Error Test	PASS	-
System Integrity Check	PASS	-
Measurement System Response	-	-
Dynamic Spiking Test	FAIL	-
Bias Test	FAIL	FAIL

This was the first of three in a series of tests to be performed at Rocky Mountain Power's Hardin Generating Station, Hardin, MT during the Long-term Test Phase of this project as specified in the test plan. The primary goal of this first round of tests was to demonstrate that the installed Hg-CEMS will comply with future established directives as well as to provide feedback of the recently approved EPA Method 30A reference method. Calibrator difficulties have been addressed and intend to be corrected prior to the next round of tests. It is believed that once these issues are corrected, the 3-Level System Integrity Check will pass performance criteria.

APPENDIX

Initial Measurement System Response Tests & Run Validations

Results from the IRM Pre-certification tests are presented in Tables 14 through 19 below.

Table 14: IRM System Calibration Error Test

System Calibration Error Test				
Facility:	<u>Hardin Generating Station</u>	Date(s):	<u>04/23/2008</u>	
Project #:	<u>06-7008</u>	Unit(s) tested:	<u>Stack Hg-CEMS</u>	
Personnel:	<u>Sharon Sjostrom</u>	Test Runs:	<u>N/A</u>	
	<u>Jim Domenico</u>	Analyzer Make/Model:	<u>Thermo Mercury Freedom</u>	
	<u>Brian Carlton</u>		<u>System™</u>	
CS =	<u>10</u> $\mu\text{g/scm}$	Serial No:		

Calibration Gas Level	C _v [$\mu\text{g/scm}$]	C _s [$\mu\text{g/scm}$]	SCE [%]	C _s -C _v [$\mu\text{g/scm}$]
Low-	3.00	3.42	4.20	0.42
Mid-	5.00	5.39	3.90	0.39
High-	9.00	8.97	0.30	0.03

SCE - System calibration error
 C_v - Certified concentration of calibration gas
 C_s - Measured concentration of calibration gas
 CS - Calibration span value

Acceptance criteria:
 (1) $\text{SCE} \leq 5.0\%$
 (2) Alternatively, $|C_s - C_v| \leq 0.5 \mu\text{g/scm}$

Table 15: IRM System Integrity Check

System Integrity Check				
Facility:	Hardin Generating Station	Date(s):	04/23/2008	
Project #:	06-7008	Unit(s) tested:	Stack Hg-CEMS	
Personnel:	Sharon Sjostrom	Test Runs:	N/A	
	Jim Domenico	Analyzer Make/Model:	Thermo Mercury Freedom	
	Brian Carlton		System™	
CS =	10 $\mu\text{g/scm}$	Serial No:		

Calibration Gas Level	C _v [$\mu\text{g/scm}$]	C _s [$\mu\text{g/scm}$]	SCE [%]	C _s -C _v [$\mu\text{g/scm}$]
Zero-	0.00	-0.05	0.50	0.05
Mid-	5.00	4.91	0.90	0.09

SCE - System calibration error
C_v - Certified concentration of calibration gas
C_s - Measured concentration of calibration gas
CS - Calibration span

Acceptance criteria:
(1) SCE $\leq$ 5.0%
(2) Alternatively, |C_s-C_v| $\leq$ 0.5 $\mu\text{g/scm}$

Table 16: IRM Measurement System Response Time Test

Measurement System Response Time Test						
Facility:	Hardin Generating Station	Date(s):	04/22/2008			
Project #:	06-7008	Unit(s) tested:	Stack Hg-CEMS			
Personnel:	Sharon Sjostrom	Test Runs:	N/A			
	Jim Domenico	Analyzer Make/Model:	Thermo Mercury Freedom			
	Brian Carlton		System™			
CS =	10 $\mu\text{g/scm}$	Serial No:	0613917173			

Calibration Gas Level	C _v [$\mu\text{g/scm}$]	Start Time	C _{s, i} [$\mu\text{g/scm}$]	End Time	C _{s, f} [$\mu\text{g/scm}$]	Response Time [min.]
Low-/High-	3.00/9.00	10:28	3.46	10:37	8.87	8 min.

SCE - System calibration error
C_v - Certified concentration of calibration gas
C_s - Measured concentration of calibration gas
(i=initial, f=final)
CS - Calibration span value

Acceptance criteria:
(1) Response Time $\leq$ 15.0 min.

Table 17: IRM Dynamic Spiking Test

Dynamic Spiking Test						
Facility: Hardin Generating Station			Date(s): 04/23/2008			
Project #: 06-7008			Unit(s) tested: Stack Hg-CEMS			
Personnel: Sharon Sjostrom			Test Runs: N/A			
Jim Domenico			Analyzer Make/Model: Thermo Mercury Freedom			
Brian Carlton			System™			
			Serial No: 0613917173			
CS = 10.00 µg/scm						
Est. C _{native} = 0.30 µg/scm			DF = 10			
C _{target} = 4.27 µg/scm			C* _{spike} = 40.00 µg/scm			
Run	C _T [ppm]	C _{ss} [µg/scm]	DF	C* _{ss} [µg/scm]	R [%]	C* _{ss} - C _{ss} [µg/scm]
1	3350.77	0.03				
	3037.34	2.29	10.69	3.77	60.36%	1.48
2	3450.23	0.14				
	3117.65	2.43	10.37	3.98	59.79%	1.55
3	3459.22	0.17				
	3116.55	2.34	10.09	4.12	55.15%	1.78
					R =	58.44%
					RSD =	4.89%
<div> <div> CS - Calibration span C_{native} - Vapor phase Hg concentration in the source effluent C_{target} - Target Hg concentration of the spiked sample C_T - Measured concentration of tracer gas C_{ss} - Measured Hg concentration of the spiked sample at the target level DF - Dilution factor of the spike gas C*_{spike} - Hg concentration of the sp </div> <div> Acceptance criteria: (1) DF ≥ 5 (2) $1.5 \leq C_{ss}^*/C_{native} \leq 2.0$ (3) $90\% \leq R \leq 110\%$ Alternatively, $C_{ss}^* - Hg^{2+} \leq 0.5 \text{ µg/scm}$ (4) RSD ≤ 5.0% </div> </div>						

Table 18: Run Validation - Stack Hg-CEMS

Run Validation									
Facility: Hardin Generating Station		Date(s): 04/23/2008							
Project #: 06-7008		Unit(s) tested: Stack Hg-CEMS							
Personnel: Sharon Sjostrom		Test Runs: N/A							
Jim Domenico		Analyzer Make/Model: Thermo Mercury Freedom							
Brian Carlton		System™							
CS = 10		Serial No:							
CS = 10		Serial No:							
Test Run	Time	Calibration Gas Level	C _v [µg/scm]	C _s [µg/scm]	SCE [%]	C _s -C _v [µg/scm]	D [%]	C _{s,pre} -C _{s,post} [µg/scm]	
Pre-run 1	07:52 - 08:04	Zero-	0.00	-0.05	0.50	0.05		0.45	
	08:04 - 08:16	Mid-	5.00	4.91	0.90	0.09		0.81	
Post-run 1	09:05 - 09:17	Zero-	0.00	-0.20	2.00	0.20	1.50	1.80	
	09:17 - 09:29	Mid-	5.00	4.75	2.50	0.25	1.60	2.25	
Post-run 2	10:16 - 10:28	Zero-	0.00	-0.36	3.60	0.36	1.60	3.24	
	10:28 - 10:40	Mid-	5.00	4.40	6.00	0.60	3.50	5.40	
Pre-run 2	11:51 - 12:03	Zero-	0.00	0.22	2.20	0.22		1.98	
	12:04 - 12:16	Mid-	5.00	5.18	1.80	0.18		1.62	
Post-run 3	13:09 - 13:21	Zero-	0.00	-0.35	3.50	0.35	1.30	3.15	
	13:24 - 13:36	Mid-	5.00	4.81	1.90	0.19	0.10	1.71	
Post-run 4	14:28 - 14:40	Zero-	0.00	-0.33	3.30	0.33	0.20	2.97	
	14:40 - 14:52	Mid-	5.00	4.91	0.90	0.09	1.00	0.81	
Post-run 5	15:40 - 15:52	Zero-	0.00	-0.21	2.10	0.21	1.20	1.89	
	15:52 - 16:04	Mid-	5.00	5.00	0.00	0.00	0.90	0.00	
Post-run 7	17:28 - 17:40	Zero-	0.00	-0.26	2.60	0.26	0.50	2.34	
	17:40 - 17:52	Mid-	5.00	4.92	0.80	0.08	0.80	0.72	
Post-run 10	19:52 - 20:04	Zero-	0.00	-0.23	2.30	0.23	0.30	2.07	
	20:04 - 20:16	Mid-	5.00	4.98	0.20	0.02	0.60	0.18	
SCE - System calibration error									
C _v - Certified concentration of calibration gas									
C _s - Measured concentration of calibration gas									
CS - Calibration span									
Acceptance criteria:									
(1) SCE ≤ 5.0%									
(2) Alternatively, C _s -C _v ≤ 5.0 µg/scm									
D - Drift									
C _{s,pre} - Pre-run measured concentraion of calibration gas									
C _{s,post} - Post-run measured concentraion of calibration gas									
Acceptance criteria:									
(1) D ≤ 3.0%									
(2) Alternatively, C _{s, post-run} -C _{s, pre-run} ≤ 0.3 µg/scm									

Table 19: Run Validation – Air Heater Outlet Hg-CEMS

Run Validation										
Facility:		Hardin Generating Station		Date(s):		04/24/2008				
Project #:		06-7008		Unit(s) tested:		Air Heater Outlet Hg-CEMS				
Personnel:		Jim Domenico		Test Runs:		N/A				
		Brian Carlton		Analyzer Make/Model:		Thermo Mercury Freedom System™				
CS =		10		Serial No:						
Test Run		Time	Calibration Gas Level	C_v [µg/scm]	C_s [µg/scm]	SCE [%]	 C_s-C_v [µg/scm]	D [%]	 C_{s,pre}-C_{s,post} [µg/scm]	
Pre-run 1	15:26 - 15:38	Zero-	0.00	0.01	0.10	0.01			0.09	
	15:38 - 15:50	Mid-	5.00	5.19	1.90	0.19			1.71	
Post-run 1	16:33 - 16:45	Zero-	0.00	-0.03	0.30	0.03		0.20	0.27	
	16:47 - 16:59	Mid-	5.00	5.03	0.30	0.03		1.60	0.27	
Post-run 2	17:26 - 17:40	Zero-	0.00	-0.07	0.70	0.07		0.40	0.63	
	17:40 - 17:52	Mid-	5.00	5.12	1.20	0.12		0.90	1.08	
<p>SCE - System calibration error C_v - Certified concentration of calibration gas C_s - Measured concentration of calibration gas CS - Calibration span</p> <p>Acceptance criteria: (1) SCE ≤ 5.0% (2) Alternatively, C_s-C_v ≤ 5.0 µg/scm</p>										<p>D - Drift C_{s,pre} - Pre-run measured concentration of calibration gas C_{s,post} - Post-run measured concentration of calibration gas</p> <p>Acceptance criteria: (1) D ≤ 3.0% (2) Alternatively, C_{s, post-run}-C_{s, pre-run} ≤ 0.3 µg/scm</p>

ADA-ES HG CEMS: DETERMINING SPAN AND RANGE

SYSTEM ID: 84

DATE: 5/5/08

PROJECT # AND LOCATION: 7009 HARDIN INLET DOCUMENT REVISION: 05/2008

REFERENCE: APPENDIX A TO PART 75 - SECTION 2.1.7

DETERMINE MAXIMUM POTENTIAL CONCENTRATION (MPC): There are three options for the initial MPC determination. Check the applicable option and enter the MPC below.

MPC (UG/M3)

10

1. Default values based on coal type: ____ Bituminous (9 ug/m3), X Sub-bituminous (10 ug/m3), Lignite (16 ug/m3), ____ waste coal, anthracite culm or bituminous gob (1 ug/m3). If different coals are blended, use highest MPC for any fuel in the blend.
2. ____ Site-specific emission testing upstream of add-on mercury controls or FGD and at least three runs at normal operating load: use the highest total mercury concentration from Ontario Hydro or Instrumental Reference Method.
3. ____ Historical CEMS data or sorbent trap monitoring system with at least 720 operating hours upstream of add-on mercury controls or FGD and met relative accuracy specification of less than 20%.

DETERMINE MAXIMUM EXPECTED CONCENTRATION (MEC): Determine the MEC during normal, stable operation of the unit with emission controls with the following equation, where RE is the expected average design removal efficiency of the control equipment.

$$MEC = MPC \left(\frac{100 - RE}{100} \right)$$

MEC UG/M3

N/A

DETERMINE HIGH SPAN CONCENTRATION: Round the MPC value to the next highest multiple of 10 ug/m3. An MPC of 10 ug/m3 would round to 20 ug/m3.

HIGH SPAN, S

20

For add-on mercury controls of FGD (but not short-term, non-representative operating conditions): If the MEC value is less than 20% of the high span value and if the high span value is 20 ug/m3 or greater, define a second low-span value of 10 ug/m3.

If only a high span value is required, set the full-scale range of the mercury analyzer to be greater than or equal to the span value. If two span values are required (add-on mercury controls or FGD) then (1) use two separate (high and low) measurement scales or (2) quality-assure two segments of a single measurement scale.

DETERMINE GAS LEVEL CONCENTRATIONS: Complete the table with the appropriate mercury concentrations for calibration checks. Define a second scale if applicable.

LEVEL	RANGE	SCALE	OPT SCALE
ZERO	0-20 % OF SPAN	0	N/A
LOW	20-30 % OF SPAN	5	
MID	50-60 % OF SPAN	11	
HIGH	80-100 % OF SPAN	18	

Daily calibrations are performed at zero and either the high- or mid-level concentrations if this is closer to the actual stack gas concentrations. Linearity checks are performed at the low-, mid-, and high-level gas concentrations.

TO BE COMPLETED UPON REVIEW

COMMENTS	SUCCESSFUL COMPLETION APPROVED SIGN AND DATE
REPLACE "DETERMINING SPAN AND RANGE VALUES" DOCUMENT OF 11/1/06	5/5/08

PLEASE FILE COMPLETED PAPERWORK IN EQUIPMENT BINDER OR PROJECT FOLDER

ADA-ES HG CEMS: 3-POINT LINEARITY CHECK

SYSTEM ID: 94

DATE: 4/28/08

PROJECT # AND LOCATION: 7009 HARDIN OUTLET DOCUMENT REVISION: 04/2008

REFERENCE: APPENDIX A TO PART 75 - SECTION 6.2

IDENTIFICATION OF EQUIPMENT: Identify each component of the complete mercury system by serial number.

80 HG ANALYZER	81 HG CALIBRATOR	82 HG CONTROLLER	83 HG PROBE	HG UMBILICALS
0013917173	0018117697	0018117711	0018117697	28849-02-03-01

3-POINT LINEARITY CHECK: Verify that the linearity check passes the criteria below.

RUN	SCALE	DATE AND TIME	CAL VALUE, R	CEM RESPONSE, A	LIN ERROR CE = (R-A)/R × 100	ABS ERROR (R - A)
1	LOW	4/28/08 1440	3.0	2.73	9.0	0.27
	MID	1450	6.0	5.79	3.5	0.21
	HIGH	1500	9.0	8.50	5.6	0.50
2	LOW	1510	3.0	2.67	11.0	0.33
	MID	1520	6.0	5.85	2.5	0.15
	HIGH	1531	9.0	8.66	3.8	0.34
3	LOW	1541	3.0	2.65	11.7	0.35
	MID	1552	6.0	5.74	4.3	0.26
	HIGH	1602	9.0	8.54	5.1	0.46

RUN	ZERO / UPSCALE	DATE AND TIME	CAL VALUE, R	CEM RESPONSE, A	LIN ERROR LE = (R-A)/R × 100	ABS ERROR (R - A)
AVG	LOW	4/28/08	3.0	2.68	10.7	0.32
	MID		6.0	5.79	3.5	0.21
	HIGH		9.0	8.57	4.8	0.43

PASSING CRITERIA: Linearity Error (LE) ≤ 10.0% of span OR Absolute Error (R-A) ≤ 1 ug/m3.

TO BE COMPLETED UPON REVIEW

FOLLOWUP REQUIRED	SUCCESSFUL COMPLETION APPROVED SIGN AND DATE
NONE - PASSED WITH ABS ERROR	4/29/08

PLEASE FILE COMPLETED PAPERWORK IN EQUIPMENT BINDER OR PROJECT FOLDER

ADA-ES HG CEMS: 3-POINT LINEARITY CHECK

SYSTEM ID: 84

DATE: 4/28/08

PROJECT # AND LOCATION: 7009 HARDIN INLET

DOCUMENT REVISION: 04/2008

REFERENCE: APPENDIX A TO PART 75 - SECTION 6.2

IDENTIFICATION OF EQUIPMENT: Identify each component of the complete mercury system by serial number.

80 HG ANALYZER	81 HG CALIBRATOR	82 HG CONTROLLER	83 HG PROBE	HG UMBILICALS
0613917146	0613917112	0618117700	0618117719	28849-02-02-01

3-POINT LINEARITY CHECK: Verify that the linearity check passes the criteria below.

RUN	SCALE	DATE AND TIME	CAL VALUE, R	CEM RESPONSE, A	LIN ERROR CE = (R-A)/R × 100	ABS ERROR (R - A)
1	LOW	4/4/08 703	5.0	5.08	1.6	0.08
	MID	713	11.0	11.25	2.27	0.25
	HIGH	722	18.0	17.72	1.56	0.28
2	LOW	735	5.0	5.22	4.4	0.22
	MID	745	11.0	11.37	3.36	0.37
	HIGH	755	18.0	18.09	0.5	0.09
3	LOW	807	5.0	5.30	6.0	0.30
	MID	817	11.0	11.30	2.73	0.30
	HIGH	827	18.0	18.08	0.44	0.08

RUN	ZERO / UPSCALE	DATE AND TIME	CAL VALUE, R	CEM RESPONSE, A	LIN ERROR LE = (R-A)/R × 100	ABS ERROR (R - A)
AVG	LOW	4/4/08	5.0	5.20	4.0	0.20
	MID		11.0	11.31	2.82	0.31
	HIGH		18.0	17.96	0.22	0.04

PASSING CRITERIA: Linearity Error (LE) ≤ 10.0% of span OR Absolute Error (R-A) ≤ 1 ug/m3.

TO BE COMPLETED UPON REVIEW

FOLLOWUP REQUIRED	SUCCESSFUL COMPLETION APPROVED SIGN AND DATE
NONE - PASSED	4/28/08

PLEASE FILE COMPLETED PAPERWORK IN EQUIPMENT BINDER OR PROJECT FOLDER

ADA-ES HG CEMS: 7-DAY CALIBRATION ERROR TEST

SYSTEM ID: 94

DATE: 5/5/08

PROJECT # AND LOCATION: 7009 HARDIN OUTLET

DOCUMENT REVISION: 04/2008

REFERENCE: APPENDIX A TO PART 75 - SECTION 6.3

IDENTIFICATION OF EQUIPMENT: Identify each component of the complete mercury system by serial number.

80 HG ANALYZER	81 HG CALIBRATOR	82 HG CONTROLLER	83 HG PROBE	HG UMBILICALS
0613917173	0618117097	0618117711	0618117697	28849-02-03-01

7-DAY CALIBRATION ERROR TEST: Verify that the calibration drift passes the criteria below. Span value is determined by APPENDIX A TO PART 75 - SECTION 2.1.4.2

SPAN VALUE, S

10.0

DAY	ZERO / UPSCALE	DATE AND TIME	CAL VALUE, R	CEM RESPONSE, A	CAL ERROR CE = (R-A)/S × 100	ABS ERROR (R - A)
1	ZERO	4/29 524	0.0	0.01	0.1	0.01
	UPSCALE	539	5.0	4.92	0.8	0.08
2	ZERO	4/30 524	0.0	0.01	0.1	0.01
	UPSCALE	539	5.0	4.88	1.2	0.12
3	ZERO	5/1 524	0.0	0.03	0.3	0.03
	UPSCALE	539	5.0	4.83	1.7	0.17
4	ZERO	5/2 524	0.0	0.04	0.4	0.04
	UPSCALE	539	5.0	4.86	1.4	0.14
5	ZERO	5/3 524	0.0	0.06	0.6	0.06
	UPSCALE	539	5.0	4.79	2.1	0.21
6	ZERO	5/4 524	0.0	0.03	0.3	0.03
	UPSCALE	539	5.0	4.84	1.6	0.16
7	ZERO	5/5 524	0.0	0.04	0.4	0.04
	UPSCALE	539	5.0	4.97	0.3	0.03

PASSING CRITERIA: Calibration Error (CE) ≤ 5.0% of span OR Absolute Error (R-A) ≤ 1 ug/m3.

TO BE COMPLETED UPON REVIEW

FOLLOWUP REQUIRED	SUCCESSFUL COMPLETION APPROVED SIGN AND DATE
NONE - PASSED 7-DAY DRIFT SEE ATTACHED WORKSHEET	5/5/08

PLEASE FILE COMPLETED PAPERWORK IN EQUIPMENT BINDER OR PROJECT FOLDER

ADA-ES HG CEMS: 7-DAY CALIBRATION ERROR TEST

SYSTEM ID: 84

DATE: 5/5/08

PROJECT # AND LOCATION: 7009 HARDIN INLET

DOCUMENT REVISION: 04/2008

REFERENCE: APPENDIX A TO PART 75 - SECTION 6.3

IDENTIFICATION OF EQUIPMENT: Identify each component of the complete mercury system by serial number.

80 HG ANALYZER	81 HG CALIBRATOR	82 HG CONTROLLER	83 HG PROBE	HG UMBILICALS
0613917146	0613917112	0618117700	0618117719	28849-02-02-01

7-DAY CALIBRATION ERROR TEST: Verify that the calibration drift passes the criteria below. Span value is determined by APPENDIX A TO PART 75 - SECTION 2.1.4.2

SPAN VALUE, S

20.0

DAY	ZERO / UPSCALE	DATE AND TIME	CAL VALUE, R	CEM RESPONSE, A	CAL ERROR CE = (R-A)/S x 100	ABS ERROR (R - A)
1	ZERO	4/14 524	0.0	-0.02	0.1	0.02
	UPSCALE	539	11.0	10.86	0.7	0.14
2	ZERO	4/15 524	0.0	-0.03	0.15	0.03
	UPSCALE	539	11.0	10.79	1.05	0.21
3	ZERO	4/16 524	0.0	-0.05	0.25	0.05
	UPSCALE	539	11.0	10.84	0.8	0.16
4	ZERO	4/17 524	0.0	0.02	0.1	0.02
	UPSCALE	539	11.0	10.87	0.65	0.13
5	ZERO	4/18 524	0.0	-0.03	0.15	0.03
	UPSCALE	539	11.0	10.74	1.3	0.26
6	ZERO	4/19 524	0.0	-0.03	0.15	0.03
	UPSCALE	539	11.0	11.16	0.8	0.16
7	ZERO	4/20 524	0.0	-0.06	0.3	0.06
	UPSCALE	539	11.0	10.61	1.95	0.39

PASSING CRITERIA: Calibration Error (CE) ≤ 5.0% of span OR Absolute Error (R-A) ≤ 1 ug/m3.

TO BE COMPLETED UPON REVIEW

FOLLOWUP REQUIRED	SUCCESSFUL COMPLETION APPROVED SIGN AND DATE
NONE - PASSED 7-DAY DRIFT SEE ATTACHED WORKSHEET	5/5/08

PLEASE FILE COMPLETED PAPERWORK IN EQUIPMENT BINDER OR PROJECT FOLDER

ADA-ES HG CEMS: CYCLE TIME TEST

SYSTEM ID: 94

DATE: 4/29/08

PROJECT # AND LOCATION: 7009 HARDIN OURET DOCUMENT REVISION: 04/2008

REFERENCE: APPENDIX A TO PART 75 - SECTION 6.4

IDENTIFICATION OF EQUIPMENT: Identify each component of the complete mercury system by serial number.

80 HG ANALYZER	81 HG CALIBRATOR	82 HG CONTROLLER	83 HG PROBE	HG UMBILICALS
0613917173	0618117697	0618117711	0618117697	28849-02-03-01

CYCLE TIME TEST: Verify that the linearity check passes the criteria below.

RUN	CAL VALUE, R	DATE AND TIME	STABLE START	STABLE END	STEP CHANGE START - END	CYCLE TIME 95% STEP
ZERO	0.0	4/30/08 1055	0.36	0.02	0.34	6 MINUTES
UPSCALE	5.0	1120	0.35	4.87	4.52	6 MINUTES

PASSING CRITERIA: Cycle Time cannot exceed 15 minutes.

TO BE COMPLETED UPON REVIEW

FOLLOWUP REQUIRED	SUCCESSFUL COMPLETION APPROVED SIGN AND DATE
PASSED	4/30/08

PLEASE FILE COMPLETED PAPERWORK IN EQUIPMENT BINDER OR PROJECT FOLDER

ADA-ES HG CEMS: CYCLE TIME TEST

SYSTEM ID: 84

DATE: 4/29/08

PROJECT # AND LOCATION: 7009 HARDIN INLET

DOCUMENT REVISION: 04/2008

REFERENCE: APPENDIX A TO PART 75 - SECTION 6.4

IDENTIFICATION OF EQUIPMENT: Identify each component of the complete mercury system by serial number.

80 HG ANALYZER	81 HG CALIBRATOR	82 HG CONTROLLER	83 HG PROBE	HG UMBILICALS
0613917146	0613917112	0618117700	0618117719	28849-02-02-01

CYCLE TIME TEST: Verify that the linearity check passes the criteria below.

RUN	CAL VALUE, R	DATE AND TIME	STABLE START	STABLE END	STEP CHANGE START - END	CYCLE TIME 95% STEP
ZERO	0.0	4/29/08 1057	4.20	0.04	4.16	6 MINUTES
UPSCALE	11.0	1123	4.65	10.90	6.25	7 MINUTES

PASSING CRITERIA: Cycle Time cannot exceed 15 minutes.

TO BE COMPLETED UPON REVIEW

FOLLOWUP REQUIRED	SUCCESSFUL COMPLETION APPROVED SIGN AND DATE
NONE - CRITERIA PASSED	4/30/08

PLEASE FILE COMPLETED PAPERWORK IN EQUIPMENT BINDER OR PROJECT FOLDER

ADA-ES HG CEMS: 3-POINT CONVERTER EFFICIENCY

SYSTEM ID: 94

DATE: 5/5/08

PROJECT # AND LOCATION: 7009 HARDIN OUTLET

DOCUMENT REVISION: 04/2008

REFERENCE: PERFORMANCE SPECIFICATION 12A - SECTION 8.3

IDENTIFICATION OF EQUIPMENT: Identify each component of the complete mercury system by serial number.

80 HG ANALYZER	81 HG CALIBRATOR	82 HG CONTROLLER	83 HG PROBE	HG UMBILICALS
0613917173	0618117697	0618117711	0618117697	28849-02-03-01

3-POINT CONVERTER EFFICIENCY CHECK: Verify that the linearity check passes the criteria below.

RUN	SCALE	DATE AND TIME	CAL VALUE, R	CEM RESPONSE, A	EFF ERROR EE = (R-A)/R × 100	ABS ERROR (R - A)
1	LOW	4/30 1159	3.0	2.13	29.0	0.87
	MID	1247	6.0	4.49	25.2	1.51
	HIGH	1338	9.0	6.52	27.6	2.48

PASSING CRITERIA: Efficiency Error (EE) ≤ 5.0% of span OR Absolute Error (R-A) ≤ 1 ug/m3.

ALTERNATE REFERENCE: MERCURIC CHLORIDE GENERATOR INSTRUCTION MANUAL - PAGE 3-7 "CALCULATIONS"
(THERMO SCIENTIFIC, JAN 28 2008, PART NUMBER 105648-00)

RUN	SCALE	CEM RESP, A1 ELEMENTAL	CEM RESP, A2 OXIDIZED	CL ₂ DILUTION FACTOR, CDF	CEM RESP, B2 B2 = A2 * CDF	EFFICIENCY EFF = B2 * A1
1	LOW	2.82	2.13	1.02	2.17	77.1
	MID	5.84	4.49	1.02	4.59	78.6
	HIGH	8.74	6.52	1.03	6.70	76.6

PASSING CRITERIA: Efficiency (EFF) should be between 95% and 105%. *

TO BE COMPLETED UPON REVIEW

FOLLOWUP REQUIRED	SUCCESSFUL COMPLETION APPROVED SIGN AND DATE
EFFICIENCY IS LINEAR BUT DOES NOT PASS CONVERSION CRITERIA SEE ATTACHED WORKSHEET PLEASE FILE COMPLETED PAPERWORK IN EQUIPMENT BINDER OR PROJECT FOLDER	5/5/08

ADA-ES HG CEMS: 3-POINT CONVERTER EFFICIENCY

SYSTEM ID: 84

DATE: 4/29/08

PROJECT # AND LOCATION: 7009 HARDIN INLET

DOCUMENT REVISION: 04/2008

REFERENCE: PERFORMANCE SPECIFICATION 12A - SECTION 8.3

IDENTIFICATION OF EQUIPMENT: Identify each component of the complete mercury system by serial number.

80 HG ANALYZER	81 HG CALIBRATOR	82 HG CONTROLLER	83 HG PROBE	HG UMBILICALS
0603917146	0603917112	0608117700	0608117719	28849-02-02-01

3-POINT CONVERTER EFFICIENCY CHECK: Verify that the linearity check passes the criteria below.

RUN	SCALE	DATE AND TIME	CAL VALUE, R	CEM RESPONSE, A	EFF ERROR $EE = (R-A)/R \times 100$	ABS ERROR (R - A)
1	LOW					
	MID					
	HIGH					

PASSING CRITERIA: Efficiency Error (EE) $\leq$ 5.0% of span OR Absolute Error (R-A) $\leq$ 1 ug/m3.

TO BE COMPLETED UPON REVIEW

FOLLOWUP REQUIRED	SUCCESSFUL COMPLETION APPROVED SIGN AND DATE
NO HG OXIDIZER COMPONENTS INSTALLED	4/29/08

PLEASE FILE COMPLETED PAPERWORK IN EQUIPMENT BINDER OR PROJECT FOLDER

ADA-ES SYSTEM FUNCTIONAL TEST REVIEW

SYS ID # 30 IRM

LOCATION: HARDIN M30A TESTING

REVIEW DATE: 4/18/08

DOCUMENT REVISION: 04/2008

80i MERCURY ANALYZER

INST ID / SN #: 0613917174 (SOA 033) (ADA #30)

TEST DATE: 4/10/08

PHYS	ELEC	CONFIG	TEMPS	PRES	FLOW	LEAK	LAMP	PMT	BKGS	COEFS	RESULT
OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	PASS

COMMENTS:

81i MERCURY CALIBRATOR

INST ID / SN #: 0613917697 (SOA 034) (ADA #31)

TEST DATE: 4/15/08

PHYS	ELEC	CONFIG	FANS	VALVES	TEMPS	PRES	HG MFC	DIL MFC	LINEAR	CALC	RESULT
OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	PASS

COMMENTS: LINEARITY 4% ERROR AT LOW (SUB 6.0 µG/M3) CONC - MAY HAVE ERROR WITH DIL MFC LOW FLOW. ALSO COULD NOT PASS LEAK CHECK.

82i MERCURY PROBE CONTROLLER

MERCURY UMBILICAL

INST ID / SN #: IRM 30

TEST DATE: 4/15/08

SN #: 28848-02-01-01

TEST DATE: 4/9/08

PHYS	ELEC	COMM	HEAT	VALVES	RESULT	PHYS	CLEAN	AMPHEN	TUBING	HEAT	RESULT
N/A	N/A	N/A	N/A	N/A	INC	OK	OK	OK	OK	OK	PASS

COMMENTS: NEW IRM ENCLOSURE, REWIRING PERFORMED, FORMAL FUNCTIONAL TEST ACTIVITIES NOT RECORDED

83i MERCURY PROBE

INST ID / SN #: 0618117722 (SOA 022) (ADA #23)

TEST DATE: 4/15/08

CLEAN	PHYS	CMPNTS	LEAK	TEMPS	PRES	SHT DN	VALVES	BB CYC	M CAL	A CAL	RESULT
OK	INC	INC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	INC

COMMENTS: FUNCTIONAL TEST OF MERCURY PROBE INCOMPLETE OR NOT RECORDED (RSQ 012)

ADDITIONAL EQUIPMENT

COMMENTS:

TO BE COMPLETED UPON REVIEW

FOLLOWUP REQUIRED	SUCCESSFUL COMPLETION APPROVED SIGN AND DATE

**Relative Accuracy Test Audit (RATA) Utilizing EPA's
Method 30A at Rocky Mountain Power's Hardin Generating
Station, Hardin, MT**

Test Dates: September 24th – 28th, 2008
Project Number 06-7008

DOE Award Number DE-FC26-06NT42774

Project Director: Sharon Sjostrom
Project Engineer: Jerry Amrhein

ADA Environmental Solutions, Inc.
8100 SouthPark Way, Unit B
Littleton, CO 80120

Executive Summary

ADA Environmental Solutions, Inc. (ADA-ES) conducted mercury continuous emissions monitoring system (Hg-CEMS) testing commencing September 24, 2008 and concluding September 28, 2008 at Rocky Mountain Power's Hardin Generating Station, Hardin, MT using regulations outlined in 40 CFR Part 75.20. Method 30A was the instrumental reference method (IRM) employed to conduct a Relative Accuracy Test Audit (RATA) of the Stack Hg-CEMS, downstream of Activated Carbon Injection (ACI). Modified Method 30A procedures were also used for a RATA on the Air Heater Outlet Hg-CEMS, upstream of ACI.

This technical report was prepared with the support of the U.S. Department of Energy under Award No. DE-FC26-06NT42774, to be included in the "Long-Term Carbon Injection Field Test for >90% Mercury Removal for a PRB Unit with a Spray Dryer and Fabric Filter" project of DOE's "Phase III Mercury Control Technology Field Testing and Related Mercury Control Research and Development" program. This was the second of three RATA tests that will be performed during the Long-term Test Phase of this project as specified in the test plan.

Method 30A requires Initial Measurement System Performance Tests described in Section 8.2 [Method 30A] in order to ascertain proper function of the instrumental analyzer. A summary of these tests and their results are presented in Table 1.

Table 1: Summary of Test Results

	Stack Hg-CEMS (downstream of ACI)	Air Heater Outlet Hg-CEMS (upstream of ACI)
Relative Accuracy Test Audit (RATA)	PASS	PASS
Interference Check (Optional)	-	-
3-Point System Calibration Error Test	PASS	PASS
System Integrity Check	PASS	PASS
Measurement System Response	PASS	PASS
Dynamic Spiking Test	Not Performed	Not Performed

* Note: The System Integrity Check on the CEMS installed at the Air Heater Outlet was performed with elemental mercury in lieu of oxidized because no chlorine bottle was installed to perform testing at this location.

The Dynamic Spiking Test was not performed during this RATA because it is not required until January 1, 2009. Successful completion of the Dynamic Spiking Test was not attained during previous testing during the week of April 20, 2008. Its merit will be reevaluated with direction from the EPA at a later date.

Both the Stack and the Air Heater Outlet Hg-CEMS successfully met performance criteria for RATA testing. Bias was determined and evaluated as out of specification, however bias adjustment factors were not implemented. Both of these systems are subject to the scrutiny of a well-developed QA/QC program which includes daily evaluation of potentially necessary correction factors, and, as such, implementation of any correction from this Bias Test has been deemed unnecessary.

Table of Contents

1. Introduction.....	4
1.1 Facility Description.....	4
1.2 Mercury CEMS Description	5
1.3 Sampling Port Locations	5
1.4 Method 30A Reference Analyzer Equipment and Method Description	7
2. Approach	9
2.1 Plant-Installed CEMS Parameters.....	9
2.2 Relative Accuracy Test Audit (RATA) & Bias Test	10
2.2.1 Instrumental Analyzer Configuration	10
2.2.1.1 Calibration Span & Gas Concentrations.....	10
2.2.1.2 Sample Point Selection	10
2.2.2 Initial Measurement System Performance Tests	11
2.2.2.1 Interference Test (Optional)	12
2.2.2.2 Calibration Gas Verification.....	12
2.2.2.3 Measurement System Preparation	12
2.2.2.4 System Calibration Error Test	12
2.2.2.5 System Integrity Check	12
2.2.2.6 Measurement System Response Time.....	13
2.2.2.7 Dynamic Spiking Test (deferred until January 1, 2009)	13
2.2.3 Test Runs	13
2.2.3.1 System Integrity Checks.....	13
2.2.3.2 Drift Check	13
2.2.3.3 Sampling	14
2.2.4 Relative Accuracy Calculation.....	14
2.2.5 Bias Determination & Adjustment Factor Calculation.....	15
3. Results and Discussion.....	16
4. Conclusions.....	21
5. Appendix.....	22
Initial Measurement System Response Tests	22

LIST OF TABLES

Table 1: Summary of Test Results	1
Table 2: Key Parameters of the Hardin Power Plant.....	5
Table 3: Span and Range Value(s)	9
Table 4: IRM Calibration Span & Gas Concentrations.....	10
Table 5: RATA & Bias Test - Stack Hg-CEMS	16
Table 6: Test Synopsis (Stack).....	17
Table 7: RATA & Bias Test - Air Heater Outlet Hg-CEMS	18
Table 8: Test Synopsis (Air Heater Outlet)	19
Table 9: IRM System Calibration Error Test (Stack).....	23
Table 10: IRM System Calibration Error Test (Air Heater Outlet).....	23
Table 11: IRM Measurement System Response Time (Stack)	24
Table 12: IRM Measurement System Response Time (Air Heater Outlet)	24
Table 13: IRM System Integrity Check (Stack).....	25
Table 14: IRM System Integrity Check (Air Heater Outlet).....	25

LIST OF FIGURES

Figure 1: Hardin Facility View.....	4
Figure 2: Stack Sampling Port Location [ASA, Inc.]	6
Figure 3: Air Heater Outlet Sampling Port Location [ASA, Inc.]	7
Figure 4: Thermo CEMS Configured for an IRM	8
Figure 5: Thermo Model 83i Probe, Filter and Conversion Unit.....	8
Figure 6: IRM Probe Designed for Traversing.....	9
Figure 7: Stack Sampling Points	11
Figure 8: Air Heater Outlet Sampling Point	11

1. Introduction

Rocky Mountain Power's Hardin Generating Station – Hardin, MT

Figure 1: Hardin Facility View

1.1 Facility Description

Rocky Mountain Power's Hardin Generating Station is a new and relatively small plant (121 MW) that was first brought online in December of 2005. Its key operating parameters are outlined in Table 2. Firing a pulverized Powder River Basin (PRB) coal from the nearby Absaloka Mine, the Hardin plant is configured with low NO_x burners and a Selective Catalytic Reduction (SCR) for NO_x control, a Spray Dryer Absorber (SDA) for SO₂ control, and a Fabric Filter (FF) for particulate control. The coal contains approximately 0.65% sulfur, 0.04 ppm mercury and <20 ppm chlorine. A commercial-grade Activated Carbon Injection (ACI) system is integrated with a new-generation mercury analyzer to allow automated feedback control of the outlet mercury emissions.

Table 2: Key Parameters of the Hardin Power Plant

Rated Capacity	121 (MW)
Range of Operation	81 – 121 MW
Operating Levels	Low: 81-93 MW Mid: 93-105 MW High (Normal): 105-121 MW
Coal (typical)	PRB, Absaloka Mine
Boiler Type	PC Boiler Opposing wall-fired
Sulfur Control	Spray Dryer with Recycle
Nitrogen Oxide Control	Low NO _x Burners/SCR
Particulate Control	Fabric Filter
Gas Flow Rate (ACI Location)	~ 550,000 acfm
Flue Gas Temperature (ACI Location)	260-320 °F

1.2 Mercury CEMS Description

The Mercury Freedom™ System manufactured by Thermo Fisher Corporation is installed at Hardin to continuously measure the mercury emissions at the Stack and the Air Heater Outlet. Thermo Electron's Mercury Freedom™ System is comprised of a Hg Analyzer (80i), Calibrator (81i), Probe Controller (82i), Probe (83i) and related peripheral components including an umbilical and instrument rack.

1.3 Sampling Port Locations

Air Sampling Associates, Inc. previously measured and documented the sampling port locations at the Stack and Air Heater Outlet depicted in Figures 2 and 3, respectively, during stack testing:

“The sampling ports on the SDA Inlet duct [Air Heater Outlet duct] are approximately 36 feet 9 1/2 inches above the ground. The sampling ports are located 13 feet 4 inches (1.12 equivalent duct diameters) downstream from a bend in the duct and 56 feet 3 inches (4.75 equivalent duct diameters) upstream from a bend in the duct. The sampling ports on the Stack are approximately 123 feet 1 1/2 inches above the ground. The sampling ports are located 33 feet 1 1/2 inches (3.64 stack diameters) downstream from the inlet to the Stack and > 18 feet 2 3/8 inches (> 2.00 Stack diameters) upstream from the outlet to the Stack.”

Figure 2: Stack Sampling Port Location [ASA, Inc.]

Figure 3: Air Heater Outlet Sampling Port Location [ASA, Inc.]

1.4 Method 30A Reference Analyzer Equipment & Method Description

A Thermo Mercury Freedom™ System has been configured for IRM testing. A photo of the unit is shown in Figure 4. The unit consists of a standard Model 80i Mercury Analyzer and Model 81i Mercury Calibrator installed in a temperature controlled enclosure. Probe control (temperature, flow, pressure) is achieved through analog controls installed in the environmental enclosure. A standard Model 83i Probe, shown in Figure 5, has been

modified by removing the mantle and stinger, connecting calibration gas to a port upstream of the sampling filter, and adding additional pressure monitoring capabilities to the flow measurement venturi. A modified mantle/stinger portion of the probe has been fabricated to facilitate traversing. A sketch of this component is shown in Figure 6. The mantle/stinger has been coupled to the other probe components by a 25-foot long heated umbilical. At Hardin Generating Station, the IRM enclosure was located at ground level while the probe enclosure, 25-foot heated umbilical, and mantle/stinger were located at the sampling platform.

Figure 4: Thermo CEMS Configured for an IRM

Figure 5: Thermo Model 83i Probe, Filter and Conversion Unit

Figure 6: IRM Probe Designed for Traversing

2. Approach

2.1 Plant-Installed CEMS Parameters

System parameters for the installed Hg-CEMS are presented in Table 3. The Maximum Potential Concentration (MPC), Removal Efficiency (RE), and Maximum Expected Concentration (MEC) were determined in order to calculate the Span (S), Range, and appropriate concentration levels. These calculated values are necessary for calibration of the analyzer, and consequently the validation of measured data.

Table 3: Span and Range Value(s)

	Air Heater Outlet Hg-CEMS (Upstream of ACI)	Stack Hg-CEMS (Downstream of ACI)	Reference
MPC	10 µg/scm	10 µg/scm	Section 2.1.7.1 40 CFR Part 75 Appendix A
RE	0%	90%	Equation A-2, Section 2.1.1.2 40 CFR Part 75 Appendix A
MEC	10 µg/scm	1 µg/scm	Section 2.1.7.2 40 CFR Part 75 Appendix A
S (High : Low)	20 µg/scm	20 µg/scm : 10 µg/scm	Section 2.1.7.3 40 CFR Part 75 Appendix A
Range	20 µg/scm	10 µg/scm	Section 2.1.7.3 40 CFR Part 75 Appendix A
Zero-level Concentration (0-20% * S)	0 µg/scm (0%)	0 µg/scm (0%) : 0 µg/scm (0%)	Section 5.2 40 CFR Part 75 Appendix A
Low-level Concentration (20-30% * S)	5 µg/scm (25%)	5 µg/scm (25%) : 3 µg/scm (30%)	Section 5.2 40 CFR Part 75 Appendix A
Mid-level Concentration (50-60% * S)	11 µg/scm (55%)	11 µg/scm (55%) : 5 µg/scm (50%)	Section 5.2 40 CFR Part 75 Appendix A
High-level Concentration (80-100% * S)	18 µg/scm (90%)	18 µg/scm (90%) : 9 µg/scm (90%)	Section 5.2 40 CFR Part 75 Appendix A

* The high span value on the Outlet CEM is neglected because Hg concentrations at the stack will never exceed 2.0 µg/scm by design of emissions control.

2.2 Relative Accuracy Test Audit (RATA) & Bias Test

2.2.1 Instrumental Analyzer Configuration

2.2.1.1 Calibration Span & Gas Concentrations

To the extent practicable the measured emissions are to be between 10 and 100% of the selected calibration span. It is recommended that the calibration span be at least twice the native concentration to accommodate the dynamic spiking procedure (Section 3.4, [Method 30A]). The selected value of the calibration span is limited by the capabilities of the calibrator. The parameters used for calibration and data validation tests of the instrumental analyzer are outlined in Table 4.

Table 4: IRM Calibration Span & Gas Concentrations

	Native Concentration =	2 µg/scm
	Calibration Span (CS) =	10 µg/scm
Gas Concentration	Allowable Range	Hg Concentration
Zero-level	Non-detectable	0 µg/scm (0 %)
Low-level	10-30 % CS	3 µg/scm (30 %)
Mid-level	40-60 % CS	5 µg/scm (50 %)
High-level	100 % CS	10 µg/scm (100 %)

2.2.1.2 Sample Point Selection

When Method 30A is used for relative accuracy testing of a Hg-CEMS, the sampling site selection and sampling point layout procedures are referenced in the appropriate performance specification or applicable regulation described in Performance Specification 2, Section 8.1.3 [40 CFR Part 75 Appendix B] or Section 6.5.6 [40 CFR Part 75 Appendix A]. Alternatively, Section 8.1.3.4 [Method 30A] states that stratification testing need not be performed at a test location where it would otherwise be required to justify using fewer sample points or different sample points, if the Hg concentration in the stack gas is expected to be 3 µg/m³ or less at the time of a Hg monitoring system RATA or an Hg emissions test. Documentation of at least one hour of Hg concentration data is required just prior to the RATA or emissions test. If a particular test location qualifies for the stratification testing exemption, sampling shall be performed at three points, as described in Section 8.1.3.2.2 [Method 30A]. Since the stack diameter (or equivalent diameter, for a rectangular stack or duct) is greater than 7.8 ft, the three Stack sampling points were therefore located at 4.4, 14.6, and 29.6 percent of the stack diameter (109 3/16”) from the stack or duct wall (see Figure 2). Since only modified Method 30A procedures were performed at the Air Heater Outlet, a single sampling point depicted in Figure 3 was selected at 78.74” from the duct wall.

Figure 7: Stack Sampling Points

Figure 8: Air Heater Outlet Sampling Point

2.2.2 Initial Measurement System Performance Tests

Initial measurement system performance tests need to be conducted on the instrumental analyzer prior to starting the nine (9) required test runs. The performance requirements of this method must be met to validate data, and are described below:

- (1) Interference Testing (Optional)
- (2) Calibration Gas Verification
- (3) Measurement System Preparation
- (4) 3-Point System Calibration Error Test
- (5) System Integrity Check

- (6) Measurement System Response Time Test
- (7) Dynamic Spiking (deferred until January 1, 2009)

2.2.2.1 Interference Test (Optional)

It is recommended that this test be conducted prior to the initial use of the measurement system in the field to verify that the candidate test instrument is free from inherent biases or interferences resulting from common combustion emission constituents. The interference test procedure is found in Section 8.6 [Method 30A]. This procedure was not performed during this test period.

2.2.2.2 Calibration Gas Verification

EPA Traceability Protocol for Qualification and Certification of Elemental Mercury Gas Generators and EPA Traceability Protocol for Qualification and Certification of Oxidized Mercury Gas Generators expected publication date December 2008, see www.epa.gov/ttn/emc.

2.2.2.3 Measurement System Preparation

The measurement system was assembled, prepared, and preconditioned according to standard operating procedure.

2.2.2.4 System Calibration Error Test

Using elemental mercury (Hg^0), a 3-point system calibration error test was conducted prior to the first test run. The low-, mid-, and high-level calibration gases were introduced in any order into the instrumental analyzer, and, after each gas injection, a stable response was obtained and recorded.

Acceptance criteria:

- i. $\text{SCE} \leq \pm 5\%$, where

$$\text{SCE} = \frac{C_s - C_v}{CS} \times 100$$

SCE - System Calibration Error [%].

C_s - Measured concentration of the calibration gas [$\mu\text{g}/\text{scm}$].

C_v - Certified concentration of the calibration gas [$\mu\text{g}/\text{scm}$].

CS - Calibration Span [$\mu\text{g}/\text{scm}$].

- ii. Alternatively, $|C_s - C_v| \leq 0.5 \mu\text{g}/\text{scm}$

2.2.2.5 System Integrity Check

Using oxidized mercury (Hg^{2+}), a two-point system integrity check was conducted as required before the first test run. The zero- and mid-level calibration gases were introduced into the instrumental analyzer, and, after each gas injection, a stable response was obtained and recorded.

Acceptance criteria:

- i. $\text{SCE} \leq \pm 5\%$, where

$$\text{SCE} = \frac{C_s - C_v}{CS} \times 100$$

SCE - System Calibration Error [%].

C_s - Measured concentration of the calibration gas [$\mu\text{g}/\text{scm}$].

C_v - Certified concentration of the calibration gas [$\mu\text{g}/\text{scm}$].

CS - Calibration Span [$\mu\text{g}/\text{scm}$].

- ii. Alternatively, $|C_s - C_v| \leq 0.5 \mu\text{g}/\text{scm}$

2.2.2.6 Measurement System Response Time

The measurement system response time provides the minimum sampling time for each sampling point. It is equal to the time that is required for the measured Hg concentration to increase from the stable low-level calibration gas response to a value within 5 percent of the stable high-level calibration gas response obtained during the system calibration error test in Section 8.2.4 [Method 30A], assuming the high-level calibration gas was injected immediately after the low-level.

2.2.2.7 Dynamic Spiking Test (deferred until January 1, 2009)

2.2.3 Test Runs

After the instrumental analyzer successfully met the acceptance criteria of the Initial System Performance Tests, the minimum nine (9) test runs of the RATA were performed. One test run constitutes sampling once at each of the successive sample points. The run validations listed below must be performed while sampling.

2.2.3.1 System Integrity Checks

Before and after each test run, a two-point system integrity check using the same procedure as the initial system integrity check must be conducted. No adjustments may be made to the measurement system during the checks, other than to maintain the target calibration gas flow rate and the proper dilution ratio. This check may be skipped between each run provided that a system integrity check performed on completion of runs passes the allowed specification. If a post-run integrity check is failed, all test runs since the last passed system integrity check are invalid. If a check is failed, corrective action must be taken and another 3-point Hg^0 System Calibration Error Test passed followed by another System Integrity Check before conducting any additional test runs.

2.2.3.2 Drift Check

Using the data from the successful pre- and post-run system integrity checks, calculate the zero and upscale drift. Exceeding the specification does not invalidate the run, but corrective action must be taken and a new 3-point Hg^0 System Calibration Error Test and a System Integrity Check must be passed before any more runs are made.

Acceptance criteria:

- i. $D \leq 3.0\%$, where

$$D = |SCE_f - SCE_i|$$

D - Drift [%].

$SCE_{i,f}$ - System Calibration Error, pre/post-run [%].

- ii. Alternatively, $|C_{s,f} - C_{s,i}| \leq 0.3 \mu\text{g/scm}$
 $C_{s,i/f}$ – Measured concentration of the calibration gas, pre/post-run [$\mu\text{g/scm}$].

2.2.3.3 Sampling

For each sample point determined from Section 8.1, Method 30A, the system must be allowed to flush and equilibrate for at least two times the measurement system response time before recording any data. The minimum sampling time at each sampling point must be at least two times the system response time, but not less than 10 minutes.

2.2.4 Relative Accuracy Calculation

Acceptance criteria:

- i. $RA \leq 20.0\%$, where

Arithmetic Mean:

$$d = RM - CEM$$

d – The difference between a reference method value and the corresponding continuous emission monitoring system value at a given point in time.

RM – Reference method value.

CEM – Continuous emission monitoring system value.

$$\bar{d} = \frac{\sum_{i=1}^n d_i}{n}$$

n – Number of data points.

Standard Deviation:

$$S_d = \sqrt{\frac{\sum_{i=1}^n d_i^2 - \frac{\left(\sum_{i=1}^n d_i\right)^2}{n}}{n-1}}$$

S_d – Standard deviation.

Confidence Coefficient:

$$cc = t_{0.025} \times \frac{S_d}{\sqrt{n}}$$

cc – Confidence coefficient.

t_{0.025} – t-value.

Relative Accuracy:

$$RA = \frac{|\bar{d}| + |cc|}{RM} \times 100$$

RA – Relative accuracy of a data set.

RM – Arithmetic mean of the reference method values.

$\bar{d}$ – Mean difference between the reference method values and the corresponding continuous emission monitoring system values.

- ii. Alternatively, if $\overline{RM} \leq 5.0 \text{ } \mu\text{g/scm}$, $\overline{CEM} - \overline{RM} \leq \pm 1.0 \text{ } \mu\text{g/scm}$

2.2.5 Bias Determination & Adjustment Factor Calculation

If the following criterion is met for the relative accuracy test audit data set being tested, the monitoring system has passed the bias test:

Acceptance criterion:

$$|\bar{d}| \leq |cc|$$

If the monitor or monitoring system fails to meet the bias test requirement, adjustment of the value obtained from the monitor is necessary using the following equation:

$$CEM_i^{Adjusted} = CEM_i^{Monitor} \times BAF$$

$CEM_i^{Adjusted}$ - Data value, adjusted for bias, at time i.

$CEM_i^{Monitor}$ - Data (measurement) provided by monitor at time i.

BAF – Bias Adjustment Factor.

Bias Adjustment Factor:

$$BAF = 1 + \frac{\bar{d}}{\overline{CEM}}$$

If the monitoring system meets the normal or the alternative relative accuracy specification in section 3.3.8 of 40 CFR Part 75 Appendix A but fails the bias test, the owner or operator may either use the BAF calculated above or may use a default BAF of 1.250 for reporting purposes. Each time a RATA is passed and the appropriate BAF has been determined, the BAF is to be applied prospectively to all monitoring system data, beginning with the first clock hour following the hour in which the RATA was completed.

3. Results and Discussion

A full 9-run, 3-point RATA was successfully performed on the installed CEMS at the Stack location (see Table 5). Relative Accuracy was calculated to be 30.64% ($\leq 20\%$ is passing), however the difference between the average installed CEMS response and Reference Method response was 0.12 $\mu\text{g}/\text{scm}$ ($\leq 1.0 \mu\text{g}/\text{scm}$ is passing alternative criteria for average Reference Method responses $\leq 5.0 \mu\text{g}/\text{scm}$).

Table 5: RATA & Bias Test - Stack Hg-CEMS

Relative Accuracy Test Audit & Bias Test Summary						
Facility: Hardin Generating Station			Date(s): 09/24/2008			
Project #: 06-7008			Unit(s) tested: Stack Hg-CEMS			
Personnel: David Young			Test Method: Method 30A			
Jim Domenico			Analyzer Make/Model: Thermo Mercury Freedom System™			
			Serial No: 0613917173			
Test Run	Start	End	Hg ^T [$\mu\text{g}/\text{scm}$]		d [$\mu\text{g}/\text{scm}$]	d ² [$\mu\text{g}/\text{scm}$]
			RM	CEM		
1	12:00	12:36	0.37	0.52	-0.15	0.02
2	13:12	13:48	0.49	0.55	-0.06	0.00
3	13:48	14:24	0.43	0.50	-0.07	0.00
4	14:24	15:00	0.46	0.62	-0.16	0.03
5	15:48	16:24	0.59	0.71	-0.12	0.01
6	16:24	17:00	0.62	0.77	-0.15	0.02
7	17:48	18:24	0.65	0.76	-0.11	0.01
8	18:24	19:00	0.50	0.69	-0.19	0.04
9	19:43	20:19	0.48	0.58	-0.10	0.01
RM - Reference method value CEM - Continuous emission monitoring system value d - Difference between RM and CEM values n - Number of data points S _d - Standard deviation t _{0.025} - t-value cc - Confidence coefficient Acceptance criteria: (1) $RA \leq 20.0\%$ (2) Alternatively, if $\overline{RM} \leq 5.0 \mu\text{g}/\text{scm}$, $\overline{CEM} - \overline{RM} \leq \pm 1.0 \mu\text{g}/\text{scm}$				n = 9		
				$\overline{d} = -0.12$		
				$d_i^2 = 0.02$		
				$\overline{RM} = 0.51$		
				$\overline{CEM} = 0.63$		
				S _d = 0.04		
				t _{0.025} = 2.306		
				cc = 0.033		
				RA = 30.64%		
				$\overline{CEM} - \overline{RM} = 0.12$		
BAF - Bias adjustment factor Acceptance criteria: (1) $ \overline{d} \leq cc $				BAF = 0.806		

A Test Synopsis for the Stack Hg-CEMS RATA is included in Table 6. All Initial System Performance Test and Run Validation performance specifications were met.

Table 6: Test Synopsis (Stack)

Test Synopsis									
Facility: Hardin Generating Station Project #: 06-7008 Personnel: David Young Jim Domenico					Date(s): 09/24/2008 Unit(s) tested: Stack Hg-CEMS Test Runs: 1-9 Analyzer Make/Model: Thermo Mercury Freedom System™ Serial No: 0613917173				
CS = 10 µg/scm									
Action	Time	Calibration	C _v	C _s	C _{CEM}	SCE	C _s -C _v	D	C _{s,pre} -C _{s,post}
Sample Point	Start	End	Gas Level	µg/scm	µg/scm	µg/scm	[%]	[%]	µg/scm
Sys Cal Error Test	10:39	10:52	Low	3.00	2.56		-4.36	0.44	
	10:52	11:02	High	10.00	9.73		-2.66	0.27	
	11:02	11:10	Mid	5.00	5.19		1.87	0.19	
Meas Sys Resp Time Test	10:52	11:02	Low	3.00	2.56	Measurement Sys Resp Time = 5 min.			
			High	10.00	9.73				
Sys Integrity Test	11:12	11:25	Zero	0.00	0.07		0.69	0.07	
	11:25	11:38	Mid	5.00	5.15		1.53	0.15	
Run 1 3-2-1	12:00	12:12			0.37	0.52			
	12:12	12:24			0.37	0.52			
	12:24	12:36			0.38	0.53			
Sys Integrity Test	12:36	12:48	Zero	0.00	-0.07		-0.73	0.07	1.42
	12:48	13:00	Mid	5.00	4.94		-0.61	0.06	2.14
Run 2 1-2-3	13:12	13:24			0.49	0.54			
	13:24	13:36			0.54	0.54			
	13:36	13:48			0.45	0.57			
Run 3 3-2-1	13:48	14:00			0.40	0.54			
	14:00	14:12			0.46	0.41			
Run 4 1-2-3	14:12	14:24			0.44	0.55			
	14:24	14:36			0.47	0.62			
Run 5 3-2-1	14:36	14:48			0.45	0.64			
	14:48	15:00			0.45	0.60			
Sys Integrity Test	15:00	15:12	Zero	0.00	-0.08		-0.82	0.08	0.09
	15:12	15:32	Mid	5.00	4.74		-2.61	0.26	2.00
Run 6 1-2-3	15:48	16:00			0.64	0.73			
	16:00	16:12			0.58	0.70			
	16:12	16:24			0.55	0.69			
Run 7 3-2-1	16:24	16:36			0.58	0.73			
	16:36	16:48			0.59	0.79			
Run 8 1-2-3	16:48	17:00			0.68	0.78			
	17:00	17:13	Zero	0.00	-0.12		-1.24	0.12	0.41
Sys Integrity Test	17:13	17:28	Mid	5.00	4.61		-3.95	0.39	1.34
Run 9 3-2-1	17:48	18:00			0.68	0.77			
	18:00	18:12			0.69	0.77			
	18:12	18:24			0.57	0.73			
Run 10 1-2-3	18:24	18:36			0.53	0.71			
	18:36	18:48			0.49	0.69			
Run 11 3-2-1	18:48	19:00			0.48	0.68			
	19:00	19:15	Zero	0.00	-0.13		-1.34	0.13	0.10
Sys Integrity Test	19:15	19:35	Mid	5.00	4.56		-4.38	0.44	0.43
Run 12 3-2-1	19:43	19:55			0.53	0.64			
	19:55	20:07			0.45	0.51			
	20:07	20:19			0.45	0.59			
Run 13 3-2-1	20:19	20:34	Zero	0.00	-0.16		-1.61	0.16	0.38
	20:34	20:49	Mid	5.00	4.59		-4.15	0.41	0.20
SCE - System calibration error C _v - Certified concentration of calibration gas C _s - Measured concentration of calibration gas CS - Calibration span Acceptance criteria: (1) SCE ≤ ±5.0% (2) Alternatively, C _s -C _v ≤ 0.5 µg/scm					D - Drift C _{s,pre} - Pre-run measured concentraion of calibration gas C _{s,post} - Post-run measured concentraion of calibration gas Acceptance criteria: (1) D ≤ 3.0% (2) Alternatively, C _{s, post-run} -C _{s, pre-run} ≤ 0.3 µg/scm				

A modified 9-run, single-point RATA was successfully performed on the installed CEMS at the Air Heater Outlet location. Relative Accuracy was calculated to be 18.57% (20% is passing). It was not in the original scope of the Test Plan to perform a full RATA at this location, so the test was modified to be performed at a single sample point. This particular location lacked an installed chlorine calibration gas cylinder required to properly perform System Integrity Tests on the instrumental analyzer, so elemental mercury standards were used in lieu of oxidized mercury.

Table 7: RATA & Bias Test - Air Heater Outlet Hg-CEMS

Relative Accuracy Test Audit & Bias Test Summary						
Facility: Hardin Generating Station			Date(s): 09/27/2008 - 09/28/2008			
Project #: 06-7008			Unit(s) tested: Air Heater Outlet Hg-CEMS			
Personnel: David Young			Test Method: Method 30A			
Jim Domenico			Analyzer Make/Model: Thermo Mercury Freedom			
			System™			
			Serial No: 0613917146			
Test Run	Start	End	Hg ^T [µg/scm]		d [µg/scm]	d ² [µg/scm]
			RM	CEM		
1	23:40	23:52	3.98	4.54	-0.56	0.31
2	23:52	00:04	3.92	4.11	-0.19	0.04
3	00:04	00:16	3.83	3.77	0.06	0.00
4	00:16	00:28	3.85	4.46	-0.61	0.38
5	00:28	00:40	3.79	4.45	-0.66	0.43
6	00:40	00:52	3.82	4.51	-0.69	0.48
7	00:52	01:04	3.74	4.49	-0.75	0.56
8	01:04	01:16	3.44	4.08	-0.64	0.41
9	01:58	02:10	3.87	4.50	-0.63	0.40
10	02:10	02:22	3.77	4.46	-0.69	0.47
11	02:22	02:34	3.73	4.31	-0.58	0.34
RM - Reference method value CEM - Continuous emission monitoring system value d - Difference between RM and CEM values n - Number of data points S _d - Standard deviation t _{0.025} - t-value cc - Confidence coefficient Acceptance criteria: (1) RA ≤ 20.0% (2) Alternatively, if $\overline{RM} \leq 5.0 \text{ µg/scm}$, $CEM - RM \leq \pm 1.0 \text{ µg/scm}$				n = 11		
				$\overline{d} = -0.54$		
				$d_i^2 = 0.35$		
				$RM = 3.80$		
				$CEM = 4.33$		
				$S_d = 0.25$		
				$t_{0.025} = 2.228$		
				cc = 0.165		
				RA = 18.57%		
				$CEM - RM = 0.54$		
BAF - Bias adjustment factor Acceptance criteria: (1) $ \overline{d} \leq cc $				BAF = 0.876		

A Test Synopsis for the Air Heater Outlet Hg-CEMS RATA is included in Table 8. All Initial System Performance Test and Run Validation performance specifications were met.

Table 8: Test Synopsis (Air Heater Outlet)

Test Synopsis										
Facility: Hardin Generating Station					Date(s): 09/27/2008 - 09/28/2008					
Project #: 06-7008					Unit(s) tested: Air Heater Outlet Hg-CEMS					
Personnel: David Young					Test Runs: 1-11					
Jim Domenico					Analyzer Make/Model: Thermo Mercury Freedom System™					
CS = 10 µg/scm					Serial No: 0613917146					
Action	Time		Calibration	C _v	C _s	C _{CEM}	SCE	C _s -C _v	D	C _{s,pre} -C _{s,post}
Sample Point	Start	End	Gas Level	[µg/scm]	[µg/scm]	[µg/scm]	[%]	[µg/scm]	[%]	[µg/scm]
Sys Cal Error Test	22:10	22:25	Low	3.00	3.02		0.24	0.02		
	22:25	22:40	High	10.00	10.30		3.03	0.30		
	22:40	22:55	Mid	5.00	4.99		-0.07	0.01		
Meas Sys Resp Time Test	22:25	22:40	Low	3.00	3.02	Measurement Sys Resp Time = 6 min.				
			High	10.00	10.30					
Sys Integrity Test	22:55	23:10	Zero	0.00	0.22		2.21	0.22		
	23:10	23:25	Mid	5.00	4.91		-0.90	0.09		
Run 1 1	23:40	23:52			3.98	4.54				
Run 2 1	23:52	00:04			3.92	4.11				
Run 3 1	00:04	00:16			3.83	3.77				
Run 4 1	00:16	00:28			3.85	4.46				
Run 5 1	00:28	00:40			3.79	4.45				
Run 6 1	00:40	00:52			3.82	4.51				
Run 7 1	00:52	01:04			3.74	4.49				
Run 8 1	01:04	01:16			3.44	4.08				
Sys Integrity Test	01:16	01:31	Zero	0.00	0.06		0.56	0.06	1.65	0.17
	01:31	01:46	Mid	5.00	4.89		-1.14	0.11	0.24	0.02
Run 9 1	01:58	02:10			3.87	4.50				
Run 10 1	02:10	02:22			3.77	4.46				
Run 11 1	02:22	02:34			3.73	4.31				
Sys Integrity Test	02:36	02:51	Zero	0.00	0.08		0.78	0.08	0.22	0.02
	02:51	03:06	Mid	5.00	4.99		-0.15	0.01	0.99	0.10
SCE - System calibration error C _v - Certified concentration of calibration gas C _s - Measured concentration of calibration gas CS - Calibration span Acceptance criteria: (1) SCE ≤ ±5.0% (2) Alternatively, C _s -C _v ≤ 0.5 µg/scm					D - Drift C _{s,pre} - Pre-run measured concentraion of calibration gas C _{s,post} - Post-run measured concentraion of calibration gas Acceptance criteria: (1) D ≤ 3.0% (2) Alternatively, C _{s, post-run} -C _{s, pre-run} ≤ 0.3 µg/scm					

Bias tests on both monitoring systems failed the acceptance criterion, and bias adjustment factors were calculated but not implemented. In order to determine bias, the absolute value of the average difference between CEMS and RM values, $|\bar{d}|$, must be less than or equal to the confidence coefficient, cc, of the data. For the Stack Hg-CEMS RATA, $|\bar{d}|$ was determined to be 0.12 and cc was 0.033. For the Air Heater Outlet Hg-CEMS RATA, $|\bar{d}|$ was determined to be 0.54 and cc was 0.165. Bias Adjustment Factors were calculated but were not implemented into the installed CEMS. Both of these systems are subject to the scrutiny of a well-developed Quality Assurance/Quality Control (QA/QC) program which includes daily evaluation of potentially necessary correction factors, and, as such, implementation of any correction from this Bias Test has been deemed unnecessary.

4. Conclusions

The Relative Accuracy Test Audits conducted on both the Stack and the Air Heater Outlet Hg-CEMS passed established performance specifications. Bias was evident between responses of both systems and the instrumental analyzer; however correction factors were not implemented because this would interfere with the daily CEMS QA/QC program.

All Initial System Performance Tests required for validation of the instrumental analyzer passed performance criteria at both locations prior to commencing each first test run. Run validations were performed as described in section 2.2.3 of this report.

A duplicate of the Summary of Test Results from Table 1 is presented below.

Summary of Test Results (From Table 1)

	Stack Hg-CEMS (downstream of ACI)	Air Heater Outlet Hg-CEMS (upstream of ACI)
Relative Accuracy Test Audit (RATA)	PASS	PASS
Interference Check (Optional)	-	-
3-Point System Calibration Error Test	PASS	PASS
System Integrity Check	PASS	PASS
Measurement System Response	PASS	PASS
Dynamic Spiking Test	Not Performed	Not Performed

This was the second of three in a series of tests to be performed at Rocky Mountain Power's Hardin Generating Station, Hardin, MT during the Long-term Test Phase of this project as specified in the test plan. The primary goal of these tests was to demonstrate that the installed Hg-CEMS will comply with future established directives, as well as to provide feedback of the recently approved EPA Method 30A reference method.

5. Appendix

5.1 Initial Measurement System Response Tests

Results from the instrumental analyzer's pre-certification tests are presented below in Tables 9 through 14.

Table 9: IRM System Calibration Error Test (Stack)

System Calibration Error Test						
Facility: Hardin Generating Station		Date(s): 09/24/2008				
Project #: 06-7008		Unit(s) tested: Stack Hg-CEMS				
Personnel: David Young		Test Runs: N/A				
Jim Domenico		Analyzer Make/Model: Thermo Mercury Freedom				
		System™				
CS = 10 µg/scm		Serial No: 0613917173				

Time		Calibration	C_v	C_s	SCE	 C_s-C_v
<i>Start</i>	<i>End</i>	Gas Level	[µg/scm]	[µg/scm]	[%]	[µg/scm]
10:39	10:52	Low-	3.00	2.56	-4.36	0.44
10:52	11:02	High-	10.00	9.73	-2.66	0.27
11:02	11:10	Mid-	5.00	5.19	1.87	0.19

SCE - System calibration error
C_v - Certified concentration of calibration gas
C_s - Measured concentration of calibration gas
CS - Calibration span value

Acceptance criteria:
(1) SCE ≤ ±5.0%
(2) Alternatively, |C_s-C_v| ≤ 0.5 µg/scm

Table 10: IRM System Calibration Error Test (Air Heater Outlet)

System Calibration Error Test						
Facility: Hardin Generating Station		Date(s): 09/27/2008 - 09/28/2008				
Project #: 06-7008		Unit(s) tested: Air Heater Outlet Hg-CEMS				
Personnel: David Young		Test Runs: N/A				
Jim Domenico		Analyzer Make/Model: Thermo Mercury Freedom				
		System™				
CS = 10 µg/scm		Serial No: 0613917146				

Time		Calibration	C_v	C_s	SCE	 C_s-C_v
<i>Start</i>	<i>End</i>	Gas Level	[µg/scm]	[µg/scm]	[%]	[µg/scm]
00:00	00:34	Low-	3.00	3.02	0.24	0.02
00:00	07:16	High-	10.00	10.30	3.03	0.30
00:00	23:49	Mid-	5.00	4.99	-0.07	0.01

SCE - System calibration error
C_v - Certified concentration of calibration gas
C_s - Measured concentration of calibration gas
CS - Calibration span value

Acceptance criteria:
(1) SCE ≤ ±5.0%
(2) Alternatively, |C_s-C_v| ≤ 0.5 µg/scm

Table 11: IRM Measurement System Response Time (Stack)

Measurement System Response Time Test						
Facility:	Hardin Generating Station			Date(s):	09/24/2008	
Project #:	06-7008			Unit(s) tested:	Stack Hg-CEMS	
Personnel:	David Young			Test Runs:	N/A	
	Jim Domenico			Analyzer Make/Model:	Thermo Mercury Freedom	
					System™	
CS =	10 μg/scm			Serial No:	0613917173	
Calibration Gas Level	C_v [μg/scm]	Start Time	C_{s, i} [μg/scm]	End Time	C_{s, f} [μg/scm]	Response Time [min.]
Low-/High-	3.00/10.00	10:52	2.56	11:02	9.73	05:00
<p>SCE - System calibration error C_v - Certified concentration of calibration gas C_s - Measured concentration of calibration gas (i=initial, f=final) CS - Calibration span value</p> <p>Acceptance criteria: (1) Response Time ≤ 15.0 min.</p>						

Table 12: IRM Measurement System Response Time (Air Heater Outlet)

Measurement System Response Time Test						
Facility:	Hardin Generating Station			Date(s):	09/27/2008 - 09/28/2008	
Project #:	06-7008			Unit(s) tested:	Air Heater Outlet Hg-CEMS	
Personnel:	David Young			Test Runs:	N/A	
	Jim Domenico			Analyzer Make/Model:	Thermo Mercury Freedom	
					System™	
CS =	10 μg/scm			Serial No:	0613917146	
Calibration Gas Level	C_v [μg/scm]	Start Time	C_{s, i} [μg/scm]	End Time	C_{s, f} [μg/scm]	Response Time [min.]
Low-/High-	3.00/10.00	22:25	3.02	22:40	10.30	06:00
<p>SCE - System calibration error C_v - Certified concentration of calibration gas C_s - Measured concentration of calibration gas (i=initial, f=final) CS - Calibration span value</p> <p>Acceptance criteria: (1) Response Time ≤ 15.0 min.</p>						

Table 13: IRM System Integrity Check (Stack)

System Integrity Check				
Facility:	<u>Hardin Generating Station</u>	Date(s):	<u>09/24/2008</u>	
Project #:	<u>06-7008</u>	Unit(s) tested:	<u>Stack Hg-CEMS</u>	
Personnel:	<u>David Young</u>	Test Runs:	<u>N/A</u>	
	<u>Jim Domenico</u>	Analyzer Make/Model:	<u>Thermo Mercury Freedom</u>	
			<u>System™</u>	
CS =	<u>10</u> $\mu\text{g/scm}$	Serial No:	<u>0613917173</u>	

Calibration Gas Level	C _v [$\mu\text{g/scm}$]	C _s [$\mu\text{g/scm}$]	SCE [%]	C _s -C _v [$\mu\text{g/scm}$]
Zero-	0.00	0.07	0.69	0.07
Mid-	5.00	5.15	1.53	0.15

SCE - System calibration error
C_v - Certified concentration of calibration gas
C_s - Measured concentration of calibration gas
CS - Calibration span

Acceptance criteria:
(1) SCE $\leq \pm 5.0\%$
(2) Alternatively, |C_s-C_v| $\leq 0.5 \mu\text{g/scm}$

Table 14: IRM System Integrity Check (Air Heater Outlet)

System Integrity Check				
Facility:	<u>Hardin Generating Station</u>	Date(s):	<u>09/27/2008 - 09/28/2008</u>	
Project #:	<u>06-7008</u>	Unit(s) tested:	<u>Air Heater Outlet Hg-CEMS</u>	
Personnel:	<u>David Young</u>	Test Runs:	<u>N/A</u>	
	<u>Jim Domenico</u>	Analyzer Make/Model:	<u>Thermo Mercury Freedom</u>	
			<u>System™</u>	
CS =	<u>10</u> $\mu\text{g/scm}$	Serial No:	<u>0613917146</u>	

Calibration Gas Level	C _v [$\mu\text{g/scm}$]	C _s [$\mu\text{g/scm}$]	SCE [%]	C _s -C _v [$\mu\text{g/scm}$]
Zero-	0.00	0.22	2.21	0.22
Mid-	5.00	4.91	-0.90	0.09

SCE - System calibration error
C_v - Certified concentration of calibration gas
C_s - Measured concentration of calibration gas
CS - Calibration span

Acceptance criteria:
(1) SCE $\leq \pm 5.0\%$
(2) Alternatively, |C_s-C_v| $\leq 0.5 \mu\text{g/scm}$

**Relative Accuracy Test Audit (RATA) Utilizing EPA's
Method 30A at Rocky Mountain Power's Hardin Generating
Station, Hardin, MT**

Test Dates: October 15th – 18th, 2008
Project Number 06-7008

DOE Award Number DE-FC26-06NT42774

Project Director: Sharon Sjostrom
Project Engineer: Jerry Amrhein

ADA Environmental Solutions, Inc.
8100 SouthPark Way, Unit B
Littleton, CO 80120

Executive Summary

ADA Environmental Solutions, Inc. (ADA-ES) conducted mercury continuous emissions monitoring system (Hg-CEMS) testing commencing October 15, 2008 and concluding October 18, 2008 at Rocky Mountain Power's Hardin Generating Station, Hardin, MT using regulations outlined in 40 CFR Part 75.20. Method 30A was the instrumental reference method (IRM) employed to conduct a Relative Accuracy Test Audit (RATA) of the Stack Hg-CEMS, downstream of Activated Carbon Injection (ACI). Modified Method 30A procedures were also used for a RATA on the Air Heater Outlet Hg-CEMS, upstream of ACI.

This technical report was prepared with the support of the U.S. Department of Energy under Award No. DE-FC26-06NT42774, to be included in the "Long-Term Carbon Injection Field Test for >90% Mercury Removal for a PRB Unit with a Spray Dryer and Fabric Filter" project of DOE's "Phase III Mercury Control Technology Field Testing and Related Mercury Control Research and Development" program. This was the third of three RATA tests that were performed during the Long-term Test Phase of this project as specified in the test plan.

Method 30A requires Initial Measurement System Performance Tests described in Section 8.2 [Method 30A] in order to ascertain proper function of the instrumental analyzer. Challenges with successful completion of oxidized calibrations during System Integrity Tests on the instrumental analyzer necessitated substituting elemental mercury standards. Note that the Dynamic Spiking Test is not required until January 1, 2009, and was not performed as part of this RATA. A summary of the tests performed is presented in Table 1.

Table 1: Summary of Test Results

	Stack Hg-CEMS (downstream of ACI)	Air Heater Outlet Hg-CEMS (upstream of ACI)
Relative Accuracy Test Audit (RATA)	PASS	PASS
Interference Check (Optional)	-	-
3-Point System Calibration Error Test	PASS	PASS
System Integrity Check	PASS	PASS
Measurement System Response	PASS	PASS
Dynamic Spiking Test	Not Performed	Not Performed

* Note: The System Integrity Check on the CEMS installed at the Air Heater Outlet was performed with elemental mercury in lieu of oxidized because no chlorine bottle was installed to perform testing at this location.

Under the noted conditions, both the Stack and the Air Heater Outlet Hg-CEMS successfully met performance criteria for RATA testing using Method 30A as the reference method. Bias was determined and evaluated as out of specification at the Air Heater Outlet, however bias adjustment factors were not implemented. Both of these systems are subject to the scrutiny of a well-developed QA/QC program which includes daily evaluation of potentially necessary correction factors, and, as such, implementation of any correction from this Bias Test has been deemed unnecessary.

Table of Contents

1. Introduction.....	4
1.1 Facility Description.....	4
1.2 Mercury CEMS Description	5
1.3 Sampling Port Locations	5
1.4 Method 30A Reference Analyzer Equipment and Method Description	7
2. Approach	9
2.1 Plant-Installed CEMS Parameters.....	9
2.2 Relative Accuracy Test Audit (RATA) & Bias Test	10
2.2.1 Instrumental Analyzer Configuration	10
2.2.1.1 Calibration Span & Gas Concentrations	10
2.2.1.2 Sample Point Selection	10
2.2.2 Initial Measurement System Performance Tests	11
2.2.2.1 Interference Test (Optional)	12
2.2.2.2 Calibration Gas Verification.....	12
2.2.2.3 Measurement System Preparation	12
2.2.2.4 System Calibration Error Test	12
2.2.2.5 System Integrity Check	12
2.2.2.6 Measurement System Response Time	13
2.2.2.7 Dynamic Spiking Test (deferred until January 1, 2009)	13
2.2.3 Test Runs	13
2.2.3.1 System Integrity Checks.....	13
2.2.3.2 Drift Check	13
2.2.3.3 Sampling	14
2.2.4 Relative Accuracy Calculation.....	14
2.2.5 Bias Determination & Adjustment Factor Calculation.....	15
3. Results and Discussion.....	16
4. Conclusions.....	22
5. Appendix.....	23
Initial Measurement System Response Tests	23

LIST OF TABLES

Table 1: Summary of Test Results	1
Table 2: Key Parameters of the Hardin Power Plant.....	5
Table 3: Span and Range Value(s)	9
Table 4: IRM Calibration Span & Gas Concentrations.....	10
Table 5: RATA & Bias Test - Stack Hg-CEMS	17
Table 6: Test Synopsis (Stack).....	18
Table 7: RATA & Bias Test - Air Heater Outlet Hg-CEMS	19
Table 8: Test Synopsis (Air Heater Outlet)	20
Table 9: IRM System Calibration Error Test (Stack).....	24
Table 10: IRM System Calibration Error Test (Air Heater Outlet).....	24
Table 11: IRM Measurement System Response Time (Stack)	25
Table 12: IRM Measurement System Response Time (Air Heater Outlet)	25
Table 13: IRM System Integrity Check (Stack).....	26
Table 14: IRM System Integrity Check (Air Heater Outlet).....	26

LIST OF FIGURES

Figure 1: Hardin Facility View.....	4
Figure 2: Stack Sampling Port Location [ASA, Inc.]	6
Figure 3: Air Heater Outlet Sampling Port Location [ASA, Inc.]	7
Figure 4: Thermo CEMS Configured for an IRM	8
Figure 5: Thermo Model 83i Probe, Filter and Conversion Unit.....	8
Figure 6: IRM Probe Designed for Traversing.....	9
Figure 7: Stack Sampling Points	11
Figure 8: Air Heater Outlet Sampling Point	11

1. Introduction

Rocky Mountain Power's Hardin Generating Station – Hardin, MT

Figure 1: Hardin Facility View

1.1 Facility Description

Rocky Mountain Power's Hardin Generating Station is a new and relatively small plant (121 MW) that was first brought online in December of 2005. Its key operating parameters are outlined in Table 2. Firing a pulverized Powder River Basin (PRB) coal from the nearby Absaloka Mine, the Hardin plant is configured with low NO_x burners and a Selective Catalytic Reduction (SCR) for NO_x control, a Spray Dryer Absorber (SDA) for SO₂ control, and a Fabric Filter (FF) for particulate control. The coal contains approximately 0.65% sulfur, 0.04 ppm mercury and <20 ppm chlorine. A commercial-grade Activated Carbon Injection (ACI) system is integrated with a new-generation mercury analyzer to allow automated feedback control of the outlet mercury emissions.

Table 2: Key Parameters of the Hardin Power Plant

Rated Capacity	121 (MW)
Range of Operation	81 – 121 MW
Operating Levels	Low: 81-93 MW Mid: 93-105 MW High (Normal): 105-121 MW
Coal (typical)	PRB, Absaloka Mine
Boiler Type	PC Boiler Opposing wall-fired
Sulfur Control	Spray Dryer with Recycle
Nitrogen Oxide Control	Low NO _x Burners/SCR
Particulate Control	Fabric Filter
Gas Flow Rate (ACI Location)	~ 550,000 acfm
Flue Gas Temperature (ACI Location)	260-320 °F

1.2 Mercury CEMS Description

The Mercury Freedom™ System manufactured by Thermo Fisher Corporation is installed at Hardin to continuously measure the mercury emissions at the Stack and the Air Heater Outlet. Thermo Electron's Mercury Freedom™ System is comprised of a Hg Analyzer (80i), Calibrator (81i), Probe Controller (82i), Probe (83i) and related peripheral components including an umbilical and instrument rack.

1.3 Sampling Port Locations

Air Sampling Associates, Inc. previously measured and documented the sampling port locations at the Stack and Air Heater Outlet depicted in Figures 2 and 3, respectively, during stack testing:

“The sampling ports on the SDA Inlet duct [Air Heater Outlet duct] are approximately 36 feet 9 1/2 inches above the ground. The sampling ports are located 13 feet 4 inches (1.12 equivalent duct diameters) downstream from a bend in the duct and 56 feet 3 inches (4.75 equivalent duct diameters) upstream from a bend in the duct. The sampling ports on the Stack are approximately 123 feet 1 1/2 inches above the ground. The sampling ports are located 33 feet 1 1/2 inches (3.64 stack diameters) downstream from the inlet to the Stack and > 18 feet 2 3/8 inches (> 2.00 Stack diameters) upstream from the outlet to the Stack.”

Figure 2: Stack Sampling Port Location [ASA, Inc.]

Figure 3: Air Heater Outlet Sampling Port Location [ASA, Inc.]

1.4 Method 30A Reference Analyzer Equipment & Method Description

A Thermo Mercury Freedom™ System has been configured for IRM testing. A photo of the unit is shown in Figure 4. The unit consists of a standard Model 80i Mercury Analyzer and Model 81i Mercury Calibrator installed in a temperature controlled enclosure. Probe control (temperature, flow, pressure) is achieved through analog controls installed in the environmental enclosure. A standard Model 83i Probe, shown in Figure 5, has been

modified by removing the mantle and stinger, connecting calibration gas to a port upstream of the sampling filter, and adding additional pressure monitoring capabilities to the flow measurement venturi. A modified mantle/stinger portion of the probe has been fabricated to facilitate traversing. A sketch of this component is shown in Figure 6. The mantle/stinger has been coupled to the other probe components by a 25-foot long heated umbilical. At Hardin Generating Station, the IRM enclosure was located at ground level while the probe enclosure, 25-foot heated umbilical, and mantle/stinger were located at the sampling platform.

Figure 4: Thermo CEMS Configured for an IRM

Figure 5: Thermo Model 83i Probe, Filter and Conversion Unit

Figure 6: IRM Probe Designed for Traversing

2. Approach

2.1 Plant-Installed CEMS Parameters

System parameters for the installed Hg-CEMS are presented in Table 3. The Maximum Potential Concentration (MPC), Removal Efficiency (RE), and Maximum Expected Concentration (MEC) were determined in order to calculate the Span (S), Range, and appropriate concentration levels. These calculated values are necessary for calibration of the analyzer, and consequently the validation of measured data.

Table 3: Span and Range Value(s)

	Air Heater Outlet Hg-CEMS (Upstream of ACI)	Stack Hg-CEMS (Downstream of ACI)	Reference
MPC	10 µg/scm	10 µg/scm	Section 2.1.7.1 40 CFR Part 75 Appendix A
RE	0%	90%	Equation A-2, Section 2.1.1.2 40 CFR Part 75 Appendix A
MEC	10 µg/scm	1 µg/scm	Section 2.1.7.2 40 CFR Part 75 Appendix A
S (High : Low)	20 µg/scm	20 µg/scm : 10 µg/scm	Section 2.1.7.3 40 CFR Part 75 Appendix A
Range	20 µg/scm	10 µg/scm	Section 2.1.7.3 40 CFR Part 75 Appendix A
Zero-level Concentration (0-20% * S)	0 µg/scm (0%)	0 µg/scm (0%) : 0 µg/scm (0%)	Section 5.2 40 CFR Part 75 Appendix A
Low-level Concentration (20-30% * S)	5 µg/scm (25%)	5 µg/scm (25%) : 3 µg/scm (30%)	Section 5.2 40 CFR Part 75 Appendix A
Mid-level Concentration (50-60% * S)	11 µg/scm (55%)	11 µg/scm (55%) : 5 µg/scm (50%)	Section 5.2 40 CFR Part 75 Appendix A
High-level Concentration (80-100% * S)	18 µg/scm (90%)	18 µg/scm (90%) : 9 µg/scm (90%)	Section 5.2 40 CFR Part 75 Appendix A

* The high span value on the Outlet CEM is neglected because Hg concentrations at the stack will never exceed 2.0 µg/scm by design of emissions control.

2.2 Relative Accuracy Test Audit (RATA) & Bias Test

2.2.1 Instrumental Analyzer Configuration

2.2.1.1 Calibration Span & Gas Concentrations

To the extent practicable the measured emissions are to be between 10 and 100% of the selected calibration span. It is recommended that the calibration span be at least twice the native concentration to accommodate the dynamic spiking procedure (Section 3.4, [Method 30A]). The selected value of the calibration span is limited by the capabilities of the calibrator. The parameters used for calibration and data validation tests of the instrumental analyzer are outlined in Table 4.

Table 4: IRM Calibration Span & Gas Concentrations

	Native Concentration = 2 µg/scm	
	Calibration Span (CS) = 10 µg/scm	
Gas Concentration	Allowable Range	Hg Concentration
Zero-level	Non-detectable	0 µg/scm (0 %)
Low-level	10-30 % CS	3 µg/scm (30 %)
Mid-level	40-60 % CS	5 µg/scm (50 %)
High-level	100 % CS	10 µg/scm (100 %)

2.2.1.2 Sample Point Selection

When Method 30A is used for relative accuracy testing of a Hg-CEMS, the sampling site selection and sampling point layout procedures are referenced in the appropriate performance specification or applicable regulation described in Performance Specification 2, Section 8.1.3 [40 CFR Part 75 Appendix B] or Section 6.5.6 [40 CFR Part 75 Appendix A]. Alternatively, Section 8.1.3.4 [Method 30A] states that stratification testing need not be performed at a test location where it would otherwise be required to justify using fewer sample points or different sample points, if the Hg concentration in the stack gas is expected to be 3 µg/m³ or less at the time of a Hg monitoring system RATA or an Hg emissions test. Documentation of at least one hour of Hg concentration data is required just prior to the RATA or emissions test. If a particular test location qualifies for the stratification testing exemption, sampling shall be performed at three points, as described in Section 8.1.3.2.2 [Method 30A]. Since the stack diameter (or equivalent diameter, for a rectangular stack or duct) is greater than 7.8 ft, the three Stack sampling points were therefore located at 4.4, 14.6, and 29.6 percent of the stack diameter (109 3/16") from the stack or duct wall (see Figure 2). Since only modified Method 30A procedures were performed at the Air Heater Outlet, a single sampling point depicted in Figure 3 was selected at 78.74" from the duct wall.

Figure 7: Stack Sampling Points

Figure 8: Air Heater Outlet Sampling Point

2.2.2 Initial Measurement System Performance Tests

Initial measurement system performance tests need to be conducted on the instrumental analyzer prior to starting the nine (9) required test runs. The performance requirements of this method must be met to validate data, and are described below:

- (1) Interference Testing (Optional)
- (2) Calibration Gas Verification
- (3) Measurement System Preparation
- (4) 3-Point System Calibration Error Test
- (5) System Integrity Check

- (6) Measurement System Response Time Test
- (7) Dynamic Spiking (deferred until January 1, 2009)

2.2.2.1 Interference Test (Optional)

It is recommended that this test be conducted prior to the initial use of the measurement system in the field to verify that the candidate test instrument is free from inherent biases or interferences resulting from common combustion emission constituents. The interference test procedure is found in Section 8.6 [Method 30A]. This procedure was not performed during this test period.

2.2.2.2 Calibration Gas Verification

EPA Traceability Protocol for Qualification and Certification of Elemental Mercury Gas Generators and EPA Traceability Protocol for Qualification and Certification of Oxidized Mercury Gas Generators expected publication date December 2008, see www.epa.gov/ttn/emc.

2.2.2.3 Measurement System Preparation

The measurement system was assembled, prepared, and preconditioned according to standard operating procedure.

2.2.2.4 System Calibration Error Test

Using elemental mercury (Hg^0), a 3-point system calibration error test was conducted prior to the first test run. The low-, mid-, and high-level calibration gases were introduced in any order into the instrumental analyzer, and, after each gas injection, a stable response was obtained and recorded.

Acceptance criteria:

- i. $\text{SCE} \leq \pm 5\%$, where

$$\text{SCE} = \frac{C_s - C_v}{CS} \times 100$$

SCE - System Calibration Error [%].

C_s - Measured concentration of the calibration gas [$\mu\text{g}/\text{scm}$].

C_v - Certified concentration of the calibration gas [$\mu\text{g}/\text{scm}$].

CS - Calibration Span [$\mu\text{g}/\text{scm}$].

- ii. Alternatively, $|C_s - C_v| \leq 0.5 \mu\text{g}/\text{scm}$

2.2.2.5 System Integrity Check

Using oxidized mercury (Hg^{2+}), a two-point system integrity check was conducted as required before the first test run. The zero- and mid-level calibration gases were introduced into the instrumental analyzer, and, after each gas injection, a stable response was obtained and recorded.

Acceptance criteria:

- i. $\text{SCE} \leq \pm 5\%$, where

$$\text{SCE} = \frac{C_s - C_v}{CS} \times 100$$

SCE - System Calibration Error [%].

C_s - Measured concentration of the calibration gas [$\mu\text{g}/\text{scm}$].

C_v - Certified concentration of the calibration gas [$\mu\text{g}/\text{scm}$].

CS - Calibration Span [$\mu\text{g}/\text{scm}$].

- ii. Alternatively, $|C_s - C_v| \leq 0.5 \mu\text{g}/\text{scm}$

2.2.2.6 Measurement System Response Time

The measurement system response time provides the minimum sampling time for each sampling point. It is equal to the time that is required for the measured Hg concentration to increase from the stable low-level calibration gas response to a value within 5 percent of the stable high-level calibration gas response obtained during the system calibration error test in Section 8.2.4 [Method 30A], assuming the high-level calibration gas was injected immediately after the low-level.

2.2.2.7 Dynamic Spiking Test (deferred until January 1, 2009)

2.2.3 Test Runs

After the instrumental analyzer successfully met the acceptance criteria of the Initial System Performance Tests, the minimum nine (9) test runs of the RATA were performed. One test run constitutes sampling once at each of the successive sample points. The run validations listed below must be performed while sampling.

2.2.3.1 System Integrity Checks

Before and after each test run, a two-point system integrity check using the same procedure as the initial system integrity check must be conducted. No adjustments may be made to the measurement system during the checks, other than to maintain the target calibration gas flow rate and the proper dilution ratio. This check may be skipped between each run provided that a system integrity check performed on completion of runs passes the allowed specification. If a post-run integrity check is failed, all test runs since the last passed system integrity check are invalid. If a check is failed, corrective action must be taken and another 3-point Hg^0 System Calibration Error Test passed followed by another System Integrity Check before conducting any additional test runs.

2.2.3.2 Drift Check

Using the data from the successful pre- and post-run system integrity checks, calculate the zero and upscale drift. Exceeding the specification does not invalidate the run, but corrective action must be taken and a new 3-point Hg^0 System Calibration Error Test and a System Integrity Check must be passed before any more runs are made.

Acceptance criteria:

- i. $D \leq 3.0\%$, where

$$D = |SCE_f - SCE_i|$$

D - Drift [%].

$SCE_{i,f}$ - System Calibration Error, pre/post-run [%].

- ii. Alternatively, $|C_{s,f} - C_{s,i}| \leq 0.3 \mu\text{g/scm}$
 $C_{s,i/f}$ – Measured concentration of the calibration gas, pre/post-run [$\mu\text{g/scm}$].

2.2.3.3 Sampling

For each sample point determined from Section 8.1, Method 30A, the system must be allowed to flush and equilibrate for at least two times the measurement system response time before recording any data. The minimum sampling time at each sampling point must be at least two times the system response time, but not less than 10 minutes.

2.2.4 Relative Accuracy Calculation

Acceptance criteria:

- i. $RA \leq 20.0\%$, where

Arithmetic Mean:

$$d = RM - CEM$$

d – The difference between a reference method value and the corresponding continuous emission monitoring system value at a given point in time.

RM – Reference method value.

CEM – Continuous emission monitoring system value.

$$\bar{d} = \frac{\sum_{i=1}^n d_i}{n}$$

n – Number of data points.

Standard Deviation:

$$S_d = \sqrt{\frac{\sum_{i=1}^n d_i^2 - \frac{\left(\sum_{i=1}^n d_i\right)^2}{n}}{n-1}}$$

S_d – Standard deviation.

Confidence Coefficient:

$$cc = t_{0.025} \times \frac{S_d}{\sqrt{n}}$$

cc – Confidence coefficient.

t_{0.025} – t-value.

Relative Accuracy:

$$RA = \frac{|\bar{d}| + |cc|}{RM} \times 100$$

RA – Relative accuracy of a data set.

RM – Arithmetic mean of the reference method values.

$\bar{d}$ – Mean difference between the reference method values and the corresponding continuous emission monitoring system values.

- ii. Alternatively, if $\overline{RM} \leq 5.0 \text{ } \mu\text{g/scm}$, $\overline{CEM} - \overline{RM} \leq \pm 1.0 \text{ } \mu\text{g/scm}$

2.2.5 Bias Determination & Adjustment Factor Calculation

If the following criterion is met for the relative accuracy test audit data set being tested, the monitoring system has passed the bias test:

Acceptance criterion:

$$|\bar{d}| \leq |cc|$$

If the monitor or monitoring system fails to meet the bias test requirement, adjustment of the value obtained from the monitor is necessary using the following equation:

$$CEM_i^{Adjusted} = CEM_i^{Monitor} \times BAF$$

$CEM_i^{Adjusted}$ - Data value, adjusted for bias, at time i.

$CEM_i^{Monitor}$ - Data (measurement) provided by monitor at time i.

BAF – Bias Adjustment Factor.

Bias Adjustment Factor:

$$BAF = 1 + \frac{\bar{d}}{\overline{CEM}}$$

If the monitoring system meets the normal or the alternative relative accuracy specification in section 3.3.8 of 40 CFR Part 75 Appendix A but fails the bias test, the owner or operator may either use the BAF calculated above or may use a default BAF of 1.250 for reporting purposes. Each time a RATA is passed and the appropriate BAF has been determined, the BAF is to be applied prospectively to all monitoring system data, beginning with the first clock hour following the hour in which the RATA was completed.

3. Results and Discussion

Since the last two RATAs indicated no stratification at the sampling location on the Stack, a single sample point at 32.32" from the duct wall was elected in lieu of the three points previously tested. Numerous attempts were made to successfully measure the 5.0 µg/wscm oxidized mercury injections of the required System Integrity Tests on the instrumental analyzer, however all of these yielded stable responses below the 4.5 µg/wscm lower boundary of the performance specification. Due to these difficulties, a substitution of elemental mercury standards was made. Under these noted conditions, a 9-run, single-point RATA was performed on the installed Hg-CEMS (see Table 5). Relative Accuracy was calculated to be 32.86% ($\leq 20\%$ is passing), however the difference between the average installed CEMS response and Reference Method response was 0.06 µg/scm (≤ 1.0 µg/scm is passing alternative criteria for average Reference Method responses ≤ 5.0 µg/scm).

Table 5: RATA & Bias Test - Stack Hg-CEMS

Relative Accuracy Test Audit & Bias Test Summary						
Facility: Hardin Generating Station			Date(s): 10/18/2008			
Project #: 06-7008			Unit(s) tested: Stack Hg-CEMS			
Personnel: David Young			Test Method: Method 30A			
Jim Domenico			Analyzer Make/Model: Thermo Mercury Freedom			
			System™			
			Serial No: 0613917173			
Test Run	Start	End	Hg ^T [µg/scm]		d [µg/scm]	d ² [µg/scm]
			RM	CEM		
1	16:10	16:20	0.55	0.53	0.02	0.00
2	16:20	16:30	0.50	0.51	-0.01	0.00
3	16:30	16:40	0.48	0.53	-0.05	0.00
4	16:40	16:50	0.51	0.53	-0.02	0.00
5	16:50	17:00	0.52	0.53	-0.01	0.00
6	17:00	17:10	0.48	0.36	0.12	0.01
7	17:10	17:20	0.31	0.51	-0.20	0.04
8	17:20	17:30	0.33	0.52	-0.19	0.04
9	17:30	17:40	0.32	0.51	-0.20	0.04
RM - Reference method value CEM - Continuous emission monitoring system value d - Difference between RM and CEM values n - Number of data points S _d - Standard deviation t _{0.025} - t-value cc - Confidence coefficient Acceptance criteria: (1) $RA \leq 20.0\%$ (2) Alternatively, if $\overline{RM} \leq 5.0 \text{ µg/scm}$, $\overline{CEM} - \overline{RM} \leq \pm 1.0 \text{ µg/scm}$				n = 9		
				$\overline{d} = -0.06$		
				$d_i^2 = 0.01$		
				$\overline{RM} = 0.44$		
				$\overline{CEM} = 0.50$		
				S _d = 0.11		
				t _{0.025} = 2.306		
				cc = 0.085		
				RA = 32.86%		
				$\overline{CEM} - \overline{RM} = 0.06$		
BAF - Bias adjustment factor Acceptance criteria: (1) $ \overline{d} \leq cc $				BAF = 0.880		

A Test Synopsis for the Stack Hg-CEMS RATA is included in Table 6. All Initial System Performance Test and Run Validation performance specifications were met; however, note that the System Integrity Tests were performed with elemental vice oxidized mercury standards.

Table 6: Test Synopsis (Stack)

Test Synopsis										
Facility: Hardin Generating Station			Date(s): 10/18/2008							
Project #: 06-7008			Unit(s) tested: Stack Hg-CEMS							
Personnel: David Young			Test Runs: 1-9							
Jim Domenico			Analyzer Make/Model: Thermo Mercury Freedom							
Sharon Sjostrom			System™							
CS = 10 µg/scm			Serial No: 0613917173							
Action	Time		Calibration	C _v	C _s	C _{CEM}	SCE	C _s -C _v	D	C _{s,pre} -C _{s,post}
Sample Point	Start	End	Gas Level	[µg/scm]	[µg/scm]	[µg/scm]	[%]	[µg/scm]	[%]	[µg/scm]
Sys Cal Error Test	14:35	14:50	Low	3.00	2.70		-2.96	0.30		
	14:50	15:05	High	10.00	9.75		-2.52	0.25		
	15:05	15:20	Mid	5.00	4.75		-2.49	0.25		
Meas Sys Resp Time Test	14:50	15:05	Low	3.00	2.70	Measurement Sys Resp Time = 4 min.				
			High	10.00	9.75					
Sys Integrity Test	15:30	15:45	Zero	0.00	0.02		0.22	0.02		
	15:45	16:00	Mid	5.00	4.83		-1.66	0.17		
Run 1 1	16:10	16:20			0.55	0.53				
Run 2 1	16:20	16:30			0.50	0.51				
Run 3 1	16:30	16:40			0.48	0.53				
Run 4 1	16:40	16:50			0.51	0.53				
Run 5 1	16:50	17:00			0.52	0.53				
Run 6 1	17:00	17:10			0.48	0.36				
Run 7 1	17:10	17:20			0.31	0.51				
Run 8 1	17:20	17:30			0.33	0.52				
Run 9 1	17:30	17:40			0.32	0.51				
Sys Integrity Test	17:52	18:07	Zero	0.00	-0.19		-1.92	0.19	2.14	0.21
	18:07	18:22	Mid	5.00	4.65		-3.53	0.35	1.87	0.19
SCE - System calibration error C _v - Certified concentration of calibration gas C _s - Measured concentration of calibration gas CS - Calibration span Acceptance criteria: (1) SCE ≤ 5.0% (2) Alternatively, C _s -C _v ≤ 5.0 µg/scm					D - Drift C _{s,pre} - Pre-run measured concentraion of calibration gas C _{s,post} - Post-run measured concentraion of calibration gas Acceptance criteria: (1) D ≤ 3.0% (2) Alternatively, C _{s, post-run} -C _{s, pre-run} ≤ 0.3 µg/scm					

A modified 9-run, single-point RATA was successfully performed on the installed CEMS at the Air Heater Outlet location. Relative Accuracy was calculated to be 13.55% (20% is passing). It was not in the original scope of the Test Plan to perform a full RATA at this location, so the test was modified to be performed at a single sample point. This particular location lacked an installed chlorine calibration gas cylinder required to properly perform System Integrity Tests on the instrumental analyzer, so elemental mercury standards were used in lieu of oxidized mercury.

Table 7: RATA & Bias Test - Air Heater Outlet Hg-CEMS

Relative Accuracy Test Audit & Bias Test Summary						
Facility: Hardin Generating Station			Date(s): 10/15/2008 - 10/16/2008			
Project #: 06-7008			Unit(s) tested: Air Heater Outlet Hg-CEMS			
Personnel: David Young			Test Method: Method 30A			
Jim Domenico			Analyzer Make/Model: Thermo Mercury Freedom			
			System™			
			Serial No: 0613917146			
Test Run	Start	End	Hg ^T [µg/scm]		d [µg/scm]	d ² [µg/scm]
			RM	CEM		
1	23:50	00:00	4.08	4.76	-0.67	0.45
2	00:00	00:10	4.07	4.21	-0.14	0.02
3	00:10	00:20	4.22	4.79	-0.56	0.32
4	00:20	00:30	4.24	4.69	-0.45	0.20
5	00:30	00:40	4.35	4.85	-0.50	0.25
6	00:40	00:50	4.28	4.77	-0.50	0.25
7	00:50	01:00	4.33	4.72	-0.39	0.15
8	01:00	01:10	4.36	4.87	-0.51	0.26
9	01:10	01:20	4.45	4.92	-0.47	0.22
RM - Reference method value CEM - Continuous emission monitoring system value d - Difference between RM and CEM values n - Number of data points S _d - Standard deviation t _{0.025} - t-value cc - Confidence coefficient Acceptance criteria: (1) $RA \leq 20.0\%$ (2) Alternatively, if $\overline{RM} \leq 5.0 \text{ µg/scm}$, $\overline{CEM} - \overline{RM} \leq \pm 1.0 \text{ µg/scm}$				n = 9		
				$\overline{d} = -0.47$		
				$d_i^2 = 0.24$		
				$\overline{RM} = 4.26$		
				$\overline{CEM} = 4.73$		
				$S_d = 0.15$		
				$t_{0.025} = 2.306$		
				cc = 0.112		
				RA = 13.55%		
BAF - Bias adjustment factor Acceptance criteria: (1) $ \overline{d} \leq cc $				$\overline{CEM} - \overline{RM} = 0.47$		
				BAF = 0.901		

A Test Synopsis for the Air Heater Outlet Hg-CEMS RATA is included in Table 8. All Initial System Performance Test and Run Validation performance specifications were met.

Table 8: Test Synopsis (Air Heater Outlet)

Test Synopsis										
Facility: Hardin Generating Station			Date(s): 10/15/2008 - 10/16/2008							
Project #: 06-7008			Unit(s) tested: Air Heater Outlet Hg-CEMS							
Personnel: David Young			Test Runs: 1-9							
Jim Domenico			Analyzer Make/Model: Thermo Mercury Freedom							
			System™							
CS = 10 µg/scm			Serial No: 0613917146							
Action	Time		Calibration	C _v	C _s	C _{CEM}	SCE	C _s -C _v	D	C _{s,pre} -C _{s,post}
Sample Point	Start	End	Gas Level	[µg/scm]	[µg/scm]	[µg/scm]	[%]	[µg/scm]	[%]	[µg/scm]
Sys Cal Error Test	22:15	22:30	Low	3.00	2.90		-1.04	0.10		
	22:30	22:45	High	10.00	9.93		-0.68	0.07		
	22:45	23:00	Mid	5.00	4.74		-2.63	0.26		
Meas Sys Resp Time Test	22:30	22:45	Low	3.00	2.90	Measurement Sys Resp Time = 5 min.				
			High	10.00	9.93					
Sys Integrity Test	23:10	23:25	Zero	0.00	-0.14		-1.39	0.14		
	23:25	23:40	Mid	5.00	4.67		-3.34	0.33		
Run 1	23:50	00:00			4.08	4.76				
Run 2	00:00	00:10			4.07	4.21				
Run 3	00:10	00:20			4.22	4.79				
Run 4	00:20	00:30			4.24	4.69				
Run 5	00:30	00:40			4.35	4.85				
Run 6	00:40	00:50			4.28	4.77				
Run 7	00:50	01:00			4.33	4.72				
Run 8	01:00	01:10			4.36	4.87				
Run 9	01:10	01:20			4.45	4.92				
Sys Integrity Test	01:30	01:45	Zero	0.00	0.07		0.73	0.07	2.12	0.21
	01:45	02:00	Mid	5.00	4.81		-1.89	0.19	1.45	0.14
SCE - System calibration error C _v - Certified concentration of calibration gas C _s - Measured concentration of calibration gas CS - Calibration span Acceptance criteria: (1) SCE ≤ 5.0% (2) Alternatively, C _s -C _v ≤ 5.0 µg/scm					D - Drift C _{s,pre} - Pre-run measured concentraion of calibration gas C _{s,post} - Post-run measured concentraion of calibration gas Acceptance criteria: (1) D ≤ 3.0% (2) Alternatively, C _{s, post-run} -C _{s, pre-run} ≤ 0.3 µg/scm					

The Bias Test performed on the Stack Hg-CEMS indicated no bias. That performed on the Air Heater Outlet Hg-CEMS, however, did reveal bias in monitor readings. In order to determine bias, the absolute value of the average difference between CEMS and RM values, $|\bar{d}|$, must be less than or equal to the confidence coefficient, cc, of the data. For the Stack Hg-CEMS RATA, $|\bar{d}|$ was determined to be 0.06 and cc was 0.085. For the Air Heater Outlet Hg-CEMS RATA, $|\bar{d}|$ was determined to be 0.47 and cc was 0.112. Bias Adjustment Factors were calculated but were not implemented into the installed CEMS. Both of these systems are subject to the scrutiny of a well-developed Quality Assurance/Quality Control (QA/QC) program which includes daily evaluation of potentially necessary correction factors, and, as such, implementation of any correction from this Bias Test has been deemed unnecessary.

4. Conclusions

The Relative Accuracy Test Audit conducted on Stack Hg-CEMS passed established performance specifications. Elemental mercury was used to perform the System Integrity Tests on the instrumental analyzer due to problems satisfying acceptance criteria using oxidized mercury. No bias was evident between the Stack Hg-CEMS and the instrumental analyzer.

The RATA conducted on the Air Heater Outlet Hg-CEMS also passed established performance specifications under modified conditions. No chlorine calibration gas bottle was installed at this location which is required for the oxidized mercury calibrations of the System Integrity Tests. It is also believed that similar problems to those observed at the Stack location would have challenged the tests. Bias was evident between responses of this system and the instrumental analyzer; however correction factors were not implemented because this would interfere with the daily CEMS QA/QC program.

All Initial System Performance Tests required for validation of the instrumental analyzer passed performance criteria at both locations prior to commencing each first test run, but the System Integrity Tests were performed with elemental vice oxidized mercury standards. Run validations were performed as described in section 2.2.3 of this report.

A duplicate of the Summary of Test Results from Table 1 is presented below.

Summary of Test Results (From Table 1)

	Stack Hg-CEMS (downstream of ACI)	Air Heater Outlet Hg-CEMS (upstream of ACI)
Relative Accuracy Test Audit (RATA)	PASS	PASS
Interference Check (Optional)	-	-
3-Point System Calibration Error Test	PASS	PASS
System Integrity Check	PASS	PASS
Measurement System Response	PASS	PASS
Dynamic Spiking Test	Not Performed	Not Performed

This was the third of three in a series of tests to be performed at Rocky Mountain Power's Hardin Generating Station, Hardin, MT during the Long-term Test Phase of this project as specified in the test plan. The primary goal of these tests was to demonstrate that the installed Hg-CEMS will comply with future established directives, as well as to provide feedback of the recently approved EPA Method 30A reference method.

5. Appendix

5.1 Initial Measurement System Response Tests & Run Validations

Results from the instrumental analyzer's pre-certification tests are presented below in Tables 9 through 14.

Table 9: IRM System Calibration Error Test (Stack)

System Calibration Error Test						
Facility: Hardin Generating Station		Date(s): 10/18/2008				
Project #: 06-7008		Unit(s) tested: Stack Hg-CEMS				
Personnel: David Young		Test Runs: N/A				
Jim Domenico		Analyzer Make/Model: Thermo Mercury Freedom				
		System™				
CS = 10 µg/scm		Serial No: 0613917173				

Time		Calibration	C_v	C_s	SCE	 C_s-C_v
<i>Start</i>	<i>End</i>	Gas Level	[µg/scm]	[µg/scm]	[%]	[µg/scm]
14:35	14:50	Low-	3.00	2.70	-2.96	0.30
14:50	15:05	High-	10.00	9.75	-2.52	0.25
15:05	15:20	Mid-	5.00	4.75	-2.49	0.25

SCE - System calibration error
C_v - Certified concentration of calibration gas
C_s - Measured concentration of calibration gas
CS - Calibration span value

Acceptance criteria:
(1) SCE ≤ ±5.0%
(2) Alternatively, |C_s-C_v| ≤ 0.5 µg/scm

Table 10: IRM System Calibration Error Test (Air Heater Outlet)

System Calibration Error Test						
Facility: Hardin Generating Station		Date(s): 10/15/2008 - 10/16/2008				
Project #: 06-7008		Unit(s) tested: Air Heater Outlet Hg-CEMS				
Personnel: David Young		Test Runs: N/A				
Jim Domenico		Analyzer Make/Model: Thermo Mercury Freedom				
		System™				
CS = 10 µg/scm		Serial No: 0613917146				

Time		Calibration	C_v	C_s	SCE	 C_s-C_v
<i>Start</i>	<i>End</i>	Gas Level	[µg/scm]	[µg/scm]	[%]	[µg/scm]
22:15	22:30	Low-	3.00	2.90	-1.04	0.10
22:30	22:45	High-	10.00	9.93	-0.68	0.07
22:45	23:00	Mid-	5.00	4.74	-2.63	0.26

SCE - System calibration error
C_v - Certified concentration of calibration gas
C_s - Measured concentration of calibration gas
CS - Calibration span value

Acceptance criteria:
(1) SCE ≤ ±5.0%
(2) Alternatively, |C_s-C_v| ≤ 0.5 µg/scm

Table 11: IRM Measurement System Response Time (Stack)

Measurement System Response Time Test						
Facility: Hardin Generating Station			Date(s): 10/18/2008			
Project #: 06-7008			Unit(s) tested: Stack Hg-CEMS			
Personnel: David Young			Test Runs: N/A			
			Analyzer Make/Model: Thermo Mercury Freedom			
Jim Domenico			System™			
CS = 10 µg/scm			Serial No: 0613917173			
Calibration Gas Level	C_v [µg/scm]	Start Time	C_{s, i} [µg/scm]	End Time	C_{s, f} [µg/scm]	Response Time [min.]
Low-/High-	3.00/10.00	14:50	2.70	15:05	9.75	04:00
<p>SCE - System calibration error C_v - Certified concentration of calibration gas C_s - Measured concentration of calibration gas (i=initial, f=final) CS - Calibration span value</p> <p>Acceptance criteria: (1) Response Time ≤ 15.0 min.</p>						

Table 12: IRM Measurement System Response Time (Air Heater Outlet)

Measurement System Response Time Test						
Facility: Hardin Generating Station			Date(s): 10/15/2008 - 10/16/2008			
Project #: 06-7008			Unit(s) tested: Air Heater Outlet Hg-CEMS			
Personnel: David Young			Test Runs: N/A			
			Analyzer Make/Model: Thermo Mercury Freedom			
Jim Domenico			System™			
CS = 10 µg/scm			9.4349687	Serial No: 0613917146		
Calibration Gas Level	C_v [µg/scm]	Start Time	C_{s, i} [µg/scm]	End Time	C_{s, f} [µg/scm]	Response Time [min.]
Low-/High-	3.00/10.00	22:30	2.90	22:45	9.93	05:00
<p>SCE - System calibration error C_v - Certified concentration of calibration gas C_s - Measured concentration of calibration gas (i=initial, f=final) CS - Calibration span value</p> <p>Acceptance criteria: (1) Response Time ≤ 15.0 min.</p>						

Table 13: IRM System Integrity Check (Stack)

System Integrity Check				
Facility:	Hardin Generating Station	Date(s):	10/18/2008	
Project #:	06-7008	Unit(s) tested:	Stack Hg-CEMS	
Personnel:	David Young	Test Runs:	N/A	
	Jim Domenico	Analyzer Make/Model:	Thermo Mercury Freedom System™	
CS =	10 µg/scm	Serial No:	0613917173	

Calibration Gas Level	C _v [µg/scm]	C _s [µg/scm]	SCE [%]	C _s -C _v [µg/scm]
Zero-	0.00	0.02	0.22	0.02
Mid-	5.00	4.83	-1.66	0.17

SCE - System calibration error
C_v - Certified concentration of calibration gas
C_s - Measured concentration of calibration gas
CS - Calibration span

Acceptance criteria:
(1) SCE ≤ ±5.0%
(2) Alternatively, |C_s-C_v| ≤ 0.5 µg/scm

Table 14: IRM System Integrity Check (Air Heater Outlet)

System Integrity Check				
Facility:	Hardin Generating Station	Date(s):	10/15/2008 - 10/16/2008	
Project #:	06-7008	Unit(s) tested:	Air Heater Outlet Hg-CEMS	
Personnel:	David Young	Test Runs:	N/A	
	Jim Domenico	Analyzer Make/Model:	Thermo Mercury Freedom System™	
CS =	10 µg/scm	Serial No:	0613917146	

Calibration Gas Level	C _v [µg/scm]	C _s [µg/scm]	SCE [%]	C _s -C _v [µg/scm]
Zero-	0.00	-0.14	-1.39	0.14
Mid-	5.00	4.67	-3.34	0.33

SCE - System calibration error
C_v - Certified concentration of calibration gas
C_s - Measured concentration of calibration gas
CS - Calibration span

Acceptance criteria:
(1) SCE ≤ ±5.0%
(2) Alternatively, |C_s-C_v| ≤ 0.5 µg/scm

APPENDIX E: MANUAL GAS SAMPLING RESULTS

STACK SAMPLING REPORT
FOR
PARTICULATE MATTER, HYDROGEN HALIDE & HALOGEN,
AMMONIA, MERCURY SPECIATION, AND SULFUR TRIOXIDE TESTING
ON THE
ROCKY MOUNTAIN POWER
HARDIN POWER PLANT
SDA INLET DUCT AND STACK
HARDIN, MONTANA

PROJECT NO. 06-057

NOVEMBER AND DECEMBER, 2006

PREPARED FOR:
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(Total Number of pages including cover: 904)

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
SUMMARY OF RESULTS	4
SUMMARY OF RESULTS	9
DISCUSSION OF SAMPLING RESULTS	11
DESCRIPTION OF SAMPLING LOCATIONS.....	16
SAMPLING AND ANALYTICAL PROCEDURES	19
TEST NARRATIVE.....	32
APPENDICES	35
Appendix A: Location of Traverse Points.....	A-1
Appendix B: Nomenclature and Equations for Calculation of Source Emissions.....	B-1
Appendix C: Calibration Data	C-1
Appendix D: Field Data.....	D-1
Appendix E: EPA Test Methods 5B and 202 (Particulate Matter) Analytical Data	E-1
Appendix F: EPA Test Methods 17, 26A, and CTM027 (Particulate Matter, Hydrogen Halides & Halogens, and Ammonia) Analytical Data – SDA Inlet Duct	F-1
Appendix G: EPA Conditional Test Methods 5 and 26A (Particulate Matter and Hydrogen Halides & Halogens) Analytical Data – Stack.....	G-1
Appendix H: EPA Test Methods 5, 17 (Particulate Matter), and ASTM D6784-02 (Ontario Hydro) Mercury Speciation Test Method Analytical Data	H-1
Appendix I: NCASI Method 8A (Sulfur Trioxide) Analytical Data	I-1
Appendix J: Chain of Custodies.....	J-1
Appendix K: Resumes of Test Personnel	K-1

TABLES

Table 1: Summary of Sampling Results	4
Table 2: SDA Inlet Duct Particulate Matter, Hydrogen Halides & Halogens, and Ammonia Summary of Sampling Results	5
Table 3: SDA Inlet Duct Particulate Matter and Speciated Mercury Summary of Sampling Results	6
Table 4: SDA Inlet Duct Sulfur Trioxide Summary of Sampling Results.....	7
Table 5: Stack Particulate Matter Summary of Sampling Results	8
Table 6: Stack Particulate Matter and Hydrogen Halides & Halogens Summary of Sampling Results	9
Table 7: Stack Particulate Matter and Speciated Mercury Summary of Sampling Results	10
Table 8: EPA Test Methods 5B and 202 Sampling Train Condenser/Absorbing System.....	20
Table 9: EPA Test Method 26A Condenser/Absorbing System	23
Table 10: ASTM D6784-02 (Ontario Hydro) Speciated Mercury Test Method Condenser/Absorbing System.....	27
Table 11: NCASI Method 8A Condenser/Absorbing System.....	30
Table 12: Location Traverse Points - Stack.....	A-3
Table 13: Calibration Data.....	C-2

FIGURES

Figure 1: SDA Inlet Duct.....	17
Figure 2: Stack	18
Figure 3: EPA Test Methods 5B and 202 Sampling Train	21
Figure 4: EPA Test Methods 17, 26A, and CTM027 SDA Inlet Duct Sampling Train	24
Figure 5: EPA Test Methods 5 and 26A Stack Sampling Train	25
Figure 6: ASTM D6784-02 (Ontario Hydro) Mercury Speciation Test Method Sampling Train - SDA Inlet Duct.....	28
Figure 7: ASTM D6784-02 (Ontario Hydro) Mercury Speciation Test Method Sampling Train - Stack	29
Figure 8: NCASI Method 8A SDA Inlet Duct Sampling Train	31
Figure 9: Location of Traverse Points - SDA Inlet Duct.....	A-2
Figure 10: Location of Traverse Points - Stack	A-4

EXECUTIVE SUMMARY

Air Sampling Associates, Inc. of Lewisville, Texas conducted stack testing at the Rocky Mountain Power, Hardin Power Plant, located in Hardin, Montana. The purpose of the stack testing was to determine particulate matter emissions, hydrogen halide and halogen emissions, ammonia emissions, speciated mercury emissions, and sulfur trioxide emissions at the SDA Inlet Duct; and to determine particulate matter emissions, hydrogen halide and halogen emissions, and speciated mercury emissions at the Stack. The testing was conducted on November 27 through December 3, 2006.

The sampling team consisted of Mr. Bill Mullins, Mr. Bill Hefley, Mr. Gary Goldman, Mr. Patrick Selakovich, and Mr. Scot Jackson. Mr. Mullins was the test team leader.

Mr. Jerry Amrhein of ADA-ES was the project manager.

The procedures set forth in Title 40 of the Code of Federal Regulations, Part 60 (40CFR60), Appendix A, Test Methods 1, 2, 3, 4, 5, 5B, 17, 26A, 202, and Conditional Test Method CTM027; ASTM D6784-02 (Ontario Hydro) Mercury Speciation Method; and the National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI) Method 8A were followed during testing.

Triplicate samples for particulate matter collected at the SDA Inlet Duct according to EPA Test Method 17, in conjunction with EPA Test Methods 26A and CTM027, indicated an average of 10,640.09 pounds per hour, based on the 'front half' analysis of the sampling train.

Triplicate samples for hydrogen halides & halogens collected at the SDA Inlet Duct according to EPA Test Method 26A, in conjunction with EPA Test Method 17 and Conditional Test Method CTM027, indicated an average concentration of hydrogen

bromide and an average concentration of bromine that were below the detectable limit of the sampling procedure. The sampling results indicated an average concentration of hydrogen chloride that was below the detectable limit of the sampling procedure and an average concentration of chlorine that was equal to 0.263 mg/dscm. The sampling results indicated an average concentration of hydrogen fluoride and an average concentration of fluoride that were below the detectable limit of the sampling procedure.

Triplicate samples for ammonia collected at the SDA Inlet Duct according to EPA Conditional Test Method CTM027, in conjunction with EPA Test Methods 17 and 26A, indicated an average concentration of ammonia equal to 3.2 ppm.

Triplicate samples for speciated mercury collected at the SDA Inlet Duct according to the ASTM D6784-02 (Ontario Hydro) Mercury Speciation Method indicated that the average total mercury was equal to 3.965 lbs/10¹² Btu. The average total mercury was 14.25% particulate mercury, 39.23% oxidized mercury, and 46.53% elemental mercury. Samples for particulate matter collected using the optional test procedures in the ASTM D6784-02 (Ontario Hydro) Mercury Speciation Method indicated an average of 8,837.89 pounds per hour, based on the analysis of the 'front half' of the sampling trains.

Triplicate samples for sulfur trioxide were collected at the SDA Inlet Duct according to NCASI Method 8A indicated an average concentration of sulfur trioxide was equal to 3.50 ppm.

Triplicate samples for particulate matter collected at the Stack according to EPA Test Methods 5 and 202 indicated an average of 32.22 pounds per hour, based on the analysis of the 'front half' and 'back half' of the sampling trains.

Triplicate samples for hydrogen halides & halogens collected at the Stack indicated an average concentration of hydrogen bromide and an average concentration of bromine that were below the detectable limit of the sampling procedure. The sampling results

indicated an average concentration of hydrogen chloride that was below the detectable limit of the sampling procedure and an average concentration of chlorine that was equal to 0.384 mg/dscm. The sampling results indicated an average concentration of hydrogen fluoride and an average concentration of fluoride that were below the detectable limit of the sampling procedure. Samples for particulate matter collected using the optional test procedures in EPA Test Method 26A indicated an average of 22.09 pounds per hour, based on the analysis of the 'front half' of the sampling trains.

Triplicate samples for speciated mercury collected at the Stack according to the ASTM D6784-02 (Ontario Hydro) Mercury Speciation Method indicated that the average total mercury was equal to 3.745 lbs/10¹² Btu. The average total mercury was 98.84% elemental mercury. Samples for particulate matter collected using the optional test procedures in the ASTM D6784-02 (Ontario Hydro) Mercury Speciation Method indicated an average of 20.49 pounds per hour, based on the analysis of the 'front half' of the sampling trains.

Billy J. Mullins, Jr. P.E., Q.E.P., D.E.E.

SUMMARY OF RESULTS

Table 1: Summary of Sampling Results

Sampling Trains - Parameters	SDA Inlet Duct Average	Stack Average
EPA 5B		
- Moisture (%)	NA	14.80
- Flow Rate (DSCFM)	NA	294,956
- Particulate Matter (lbs/hr – total)	NA	32.22
EPA 5 / 17 / 26A / CTM027		
- Moisture (%)	10.69	15.07
- Flow Rate (DSCFM)	292,800	293,809
- Particulate Matter (lbs/hr – front half)	10,640.09	22.09
- Chlorine (mg/dscm)	0.263	0.384
- Ammonia (ppm)	3.2	NA
EPA 5 / 17 / ASTM D6784-02		
- Moisture (%)	10.18	14.72
- Flow Rate (DSCFM)	291,987	295,482
- Particulate Matter (lbs/hr – front half)	8,837.89	20.49
- Total Mercury (lbs/10 ¹² Btu)	3.965	3.745
NCASI 8A		
- Moisture (%)	10.47	NA
- Sulfur Trioxide (ppm)	3.50	NA

SUMMARY OF RESULTS

Table 2: SDA Inlet Duct Particulate Matter, Hydrogen Halides & Halogens, and Ammonia Summary of Sampling Results

Run No.	1	2	3	Average
Test Date	11/30/06	12/01/06	12/01/06	-----
Test Time	1454-1559	1203-1305	1647-1749	-----
Flow Rate – DSCFM*	290,174	294,636	293,589	292,800
Stack Temp. - °F	319	316	322	319
O₂ - %Vol. (dry)	5.2	6.0	5.7	5.6
CO₂ - %Vol. (dry)	14.3	13.3	13.8	13.8
Percent Excess Air	32.2	39.0	36.5	35.9
Moisture Content - %	10.85	10.76	10.47	10.69
Percent Isokinetic	89.3	95.3	96.4	93.7
Sample Volume – DSCM	0.634	0.687	0.693	0.671
Particulate Matter – gr/dscf (Front Half) – lbs/hr (Front Half)	4.1271 10,263.30	4.5853 11,578.01	4.0059 10,078.95	4.2394 10,640.09
Hydrogen Bromide – mg – mg/dscm	ND ND	ND ND	ND ND	ND ND
Bromine – mg – mg/dscm	ND ND	ND ND	ND ND	ND ND
Hydrogen Chloride – mg – mg/dscm	ND ND	ND ND	ND ND	ND ND
Chlorine – mg – mg/dscm	0.216 0.341	0.151 0.220	0.159 0.229	0.175 0.263
Hydrogen Fluoride – mg – mg/dscm	ND ND	ND ND	ND ND	ND ND
Fluorine – mg – mg/dscm	ND ND	ND ND	ND ND	ND ND
Ammonia - ppm	4.8	1.6	3.3	3.2

* 29.92" Hg, 68° F (760 mm Hg, 20 °C)

SUMMARY OF RESULTS

Table 3: SDA Inlet Duct Particulate Matter and Speciated Mercury
Summary of Sampling Results

Run No.	1	2	3	Average
Test Date	12/01/06	12/02/06	12/02/06	-----
Test Time	0857-1059	0919-1121	1712-1914	-----
Flow Rate – DSCFM*	288,573	292,703	294,686	291,987
Stack Temp. - °F	315	317	320	317
O₂ - %Vol. (dry)	6.4	6.1	6.2	6.2
CO₂ - %Vol. (dry)	14.2	13.9	13.1	13.7
Percent Excess Air	43.7	40.4	40.8	41.6
Moisture Content - %	10.24	10.26	10.04	10.18
Percent Isokinetic	96.0	95.3	96.9	96.1
Sample Volume – DSCM	1.343	1.352	1.383	1.359
Particulate Matter				
– gr/dscf (Front Half)	3.4560	3.8851	3.2552	3.5321
– lbs/hr (Front Half)	8,546.94	9,745.73	8,220.99	8,837.89
Particle Bound Mercury				
– µg	0.6100	1.5000	0.6400	0.9167
– µg/dscm	0.4542	1.1095	0.4628	0.6755
– lbs/10 ¹² Btu**	0.400	0.957	0.402	0.586
Oxidized Mercury				
– µg	1.6000	1.7000	3.3000	2.2000
– µg/dscm	1.1914	1.2574	2.3861	1.6116
– lbs/10 ¹² Btu**	1.049	1.085	2.072	1.402
Elemental Mercury				
– µg	3.6640	4.7000	0.8480	3.0707
– µg/dscm	2.7282	3.4763	0.6132	2.2726
– lbs/10 ¹² Btu**	2.402	2.999	0.532	1.978
Total Mercury				
– µg	5.8740	7.9000	4.7880	6.1873
– µg/dscm	4.3738	5.8432	3.4620	4.5597
– lbs/10 ¹² Btu**	3.850	5.040	3.006	3.965

* 29.92" Hg, 68° F (760 mm Hg, 20 °C)

** Calculated using an F_d Factor of 9,780

SUMMARY OF RESULTS

**Table 4: SDA Inlet Duct Sulfur Trioxide
Summary of Sampling Results**

<i>Run No.</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>Average</i>
<i>Test Date</i>	11/30/06	11/30/06	12/01/06	-----
<i>Test Time</i>	1323-1423	1648-1748	1401-1501	-----
<i>Sample Volume – DSCM*</i>	0.549	0.558	0.557	0.555
<i>Moisture Content - %</i>	10.06	10.70	10.67	10.48
<i>Sulfur Trioxide - ppm</i>	3.69	4.20	2.60	3.50

* 29.92" Hg, 68° F (760 mm Hg, 20 °C)

SUMMARY OF RESULTS

**Table 5: Stack Particulate Matter
Summary of Sampling Results**

Run No.	4	5	6	Average
Test Date	11/30/06	11/30/06	11/30/06	-----
Test Time	1334-1542	1204-1409	1215-1419	-----
Flow Rate – DSCFM*	297,911	290,628	296,329	294,956
Stack Temperature - °F	210	206	205	207
O₂ – % Volume dry	7.9	6.2	6.2	6.8
CO₂ – % Volume dry	12.1	13.0	13.3	12.8
Percent Excess Air	59.4	40.8	41.0	47.1
Moisture Content - %	14.69	15.13	14.59	14.80
Percent Isokinetic	99.6	99.5	98.2	99.1
Particulate Matter				
- gr/dscf (Front Half)	0.0058	0.0074	0.0078	0.0070
- lbs/mmBtu (Front Half)**	0.0130	0.0147	0.0155	0.0144
- lbs/hr (Front Half)	14.83	18.40	19.83	17.69
Particulate Matter				
- gr/dscf (Total)	0.0135	0.0148	0.0100	0.0128
- lbs/mmBtu (Total)**	0.0580	0.0294	0.0199	0.0358
- lbs/hr (Total)	34.44	36.81	25.42	32.22

* 29.92" Hg, 68° F (760 mm Hg, 20 °C)

** Calculated using an F_d Factor of 9,780

SUMMARY OF RESULTS

Table 6: Stack Particulate Matter and Hydrogen Halides & Halogens
Summary of Sampling Results

Run No.	1	2	3	Average
Test Date	11/30/06	12/01/06	12/02/06	-----
Test Time	1642-1759	1509-1626	2025-2141	-----
Flow Rate – DSCFM*	294,798	297,054	289,575	293,809
Stack Temp. - °F	211	204	213	209
O₂ - %Vol. (dry)	7.6	6.7	6.3	6.9
CO₂ - %Vol. (dry)	11.6	12.8	13.2	12.5
Percent Excess Air	55.0	45.8	41.9	47.6
Moisture Content - %	15.31	14.98	14.93	15.07
Percent Isokinetic	104.0	99.7	100.4	101.4
Sample Volume – DSCM	1.239	1.197	1.175	1.204
Particulate Matter				
– gr/dscf (Front Half)	0.0084	0.0091	0.0088	0.0088
– lbs/hr (Front Half)	21.17	23.27	21.83	22.09
Hydrogen Bromide				
– mg	ND	ND	ND	ND
– mg/dscm	ND	ND	ND	ND
Bromine				
– mg	ND	ND	ND	ND
– mg/dscm	ND	ND	ND	ND
Hydrogen Chloride				
– mg	ND	ND	ND	ND
– mg/dscm	ND	ND	ND	ND
Chlorine				
– mg	0.440	0.480	0.483	0.468
– mg/dscm	0.355	0.387	0.411	0.384
Hydrogen Fluoride				
– mg	ND	ND	ND	ND
– mg/dscm	ND	ND	ND	ND
Fluorine				
– mg	ND	ND	ND	ND
– mg/dscm	ND	ND	ND	ND

* 29.92" Hg, 68° F (760 mm Hg, 20 °C)

SUMMARY OF RESULTS

Table 7: Stack Particulate Matter and Speciated Mercury
Summary of Sampling Results

Run No.	1	2	3	Average
Test Date	12/01/06	12/02/06	12/02/06	-----
Test Time	0857-1105	0919-1124	1712-1917	-----
Flow Rate – DSCFM*	295,083	299,743	291,619	295,482
Stack Temp. - °F	212	207	212	210
O₂ - %Vol. (dry)	6.2	6.4	6.2	6.3
CO₂ - %Vol. (dry)	12.8	13.2	13.3	13.1
Percent Excess Air	40.6	42.9	41.0	41.5
Moisture Content - %	14.77	14.88	14.52	14.72
Percent Isokinetic	99.8	100.5	99.1	99.8
Sample Volume – DSCM	1.983	2.028	1.945	1.985
Particulate Matter				
– gr/dscf (Front Half)	0.0085	0.0072	0.0086	0.0081
– lbs/hr (Front Half)	21.57	18.39	21.51	20.49
Particle Bound Mercury				
- µg	0.0380	ND	0.0090	<0.0157
- µg/dscm	0.0192	ND	0.0046	<0.0079
- lbs/10 ¹² Btu**	0.017	ND	0.004	<0.007
Oxidized Mercury				
- µg	0.1100	ND	0.0800	<0.0633
- µg/dscm	0.0555	ND	0.0411	<0.0322
- lbs/10 ¹² Btu**	0.048	ND	0.036	<0.028
Elemental Mercury				
- µg	6.8410	12.1000	6.4640	8.4683
- µg/dscm	3.4498	5.9665	3.3234	4.2466
- lbs/10 ¹² Btu**	2.995	5.251	2.885	3.710
Total Mercury				
- µg	6.9890	12.1000	6.5530	8.5473
- µg/dscm	3.5245	5.9665	3.3692	4.2867
- lbs/10 ¹² Btu**	3.059	5.251	2.924	3.745

* 29.92" Hg, 68° F (760 mm Hg, 20 °C)

** Calculated using an F_d Factor of 9,780

DISCUSSION OF SAMPLING RESULTS

SDA Inlet Duct

Particulate Matter, Hydrogen Halides & Halogens, and Ammonia

The three tests for particulate matter, hydrogen halides & halogens, and ammonia taken at the SDA Inlet Duct appeared to be an accurate representation of the actual emissions during the tests. All leak checks performed on the reference method sampling train and pitot tubes showed no leaks before or after testing. The indicative parameters of the tests were in close agreement. The measured moisture contents (%M) were within 2.09% of the mean value. The measured flow rates (DSCFM) were within 0.90% of the mean value. Run No. 1 exceeded the specified rates of sampling for the test. The specified rates of sampling are 90% to 110% isokinetic. The greatest deviation from 100% isokinetic, Run No. 1, was 10.7%. Any effect on the data would be a slightly high bias.

The concentrations (gr/dscf – front Half) of particulate matter for the three tests showed a range of -5.51 percent to +8.16 percent variation from the mean value of 4.2394 gr/dscf – front half.

The concentrations (mg/dscm) of hydrogen bromide and bromine for the three tests were below the minimum reporting limit of the reference method.

The concentrations (mg/dscm) of hydrogen chloride for the three tests were below the minimum reporting limit of the reference method. The concentrations of chlorine (mg/dscm) of for the three tests showed a range of -16.46% to +29.49% variation from the mean value of 0.263 mg/dscm.

The concentrations (mg/dscm) of hydrogen fluoride and fluorine for the three tests were below the minimum reporting limit of the reference method.

The concentrations (ppm) of ammonia for the three tests showed a range of -50.52% to +48.45% variation from the mean value of 3.2 ppm. The high variation is due to the low concentrations of ammonia measured.

Particulate Matter and Speciated Mercury

The three tests for particulate matter and speciated mercury taken at the SDA Inlet Duct appeared to be an accurate representation of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes indicated no leaks before or after each test. The indicative parameters calculated from the field data were in reasonable agreement. The measured moisture contents for the three runs were within 1.37% of the mean value. The measured flow rates (DSCFM) for the tests were within 1.17% of the mean value. The rates of sampling for the three tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100% isokinetic was 4.7%.

The concentrations (gr/dscf – front Half) of particulate matter for the three tests showed a range of -7.84 percent to +9.99 percent variation from the mean value of 3.5321 gr/dscf – front half.

The calculated emissions (lbs/10¹² Btu) of total mercury for the three tests showed a range of -24.19% to +27.10% deviation from the mean value of 3.965 lbs/10¹² Btu.

Sulfur Trioxide

The three tests for sulfur trioxide taken at the SDA Inlet Duct appeared to be an accurate representation of the actual emissions during the tests. All leak checks performed on the reference method sampling train and pitot tubes showed no leaks before or after testing. The indicative parameters of the tests were in close agreement. The measured moisture contents (%M) were within 3.98% of the mean value.

The concentrations (ppm) of sulfur dioxide for the three tests showed a range of -25.64 percent to +20.11 percent variation from the mean value of 3.50 ppm.

Stack

Particulate Matter

The three tests for particulate matter at the Stack appeared to be an accurate representation of the actual emissions during the tests. All leak checks performed on the reference method sampling train and pitot tubes showed no leaks before or after testing. The indicative parameters of the tests were in close agreement. The measured moisture contents (%M) were within 2.21% of the mean value. The measured flow rates (DSCFM) were within 1.47% of the mean value. The rates of sampling for the tests were within the specified limits (90% to 110% isokinetic). The greatest deviation from 100% isokinetic was 1.8%.

The concentrations (gr/dscf – total) of particulate matter for the three tests showed a range of -21.88 percent to +15.63 percent variation from the mean value of 0.0128 gr/dscf – total.

Particulate Matter and Hydrogen Halides & Halogens

The three tests for particulate matter and hydrogen halides & halogens taken at the Stack appeared to be an accurate representation of the actual emissions during the tests. All leak checks performed on the reference method sampling train and pitot tubes showed no leaks before or after testing. The indicative parameters of the tests were in close agreement. The measured moisture contents (%M) were within 1.57% of the mean value. The measured flow rates (DSCFM) were within 1.44% of the mean value. The rates of sampling for the tests were within the specified limits (90% to 110% isokinetic). The greatest deviation from 100% isokinetic was 4.0%.

The concentrations (gr/dscf – Front Half) of particulate matter for the three tests showed a range of -4.55 percent to +3.41 percent variation from the mean value of 0.0088 gr/dscf – front half.

The concentrations (mg/dscm) of hydrogen bromide and bromine for the three tests were below the minimum reporting limit of the reference method.

The concentrations (mg/dscm) of hydrogen chloride for the three tests were below the minimum reporting limit of the reference method. The concentrations of chlorine (mg/dscm) for the three tests showed a range of -7.63% to +6.94% variation from the mean value of 0.384 mg/dscm.

The concentrations (mg/dscm) of hydrogen fluoride and fluorine for the three tests were below the minimum reporting limit of the reference method.

Particulate Matter and Speciated Mercury

The three tests for particulate matter and speciated mercury on the Stack appeared to be an accurate representation of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes indicated no leaks before or after each test. The indicative parameters calculated from the field data were in reasonable agreement. The measured moisture contents for the three runs were within 1.38% of the mean value. The measured flow rates (DSCFM) for the tests were within 1.44% of the mean value. The rates of sampling for the three tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100% isokinetic was 0.9%.

The concentrations (gr/dscf – front Half) of particulate matter for the three tests showed a range of -11.11 percent to +6.17 percent variation from the mean value of 0.0081 gr/dscf – front half.

The calculated emissions (lbs/10¹² Btu) of total mercury for the three tests showed a range of -21.92% to +40.21% deviation from the mean value of 3.745 lbs/10¹² Btu.

DESCRIPTION OF SAMPLING LOCATIONS

The sampling ports on the SDA Inlet Duct are approximately 36 feet 9 1/2 inches above the ground. The sampling ports are located 13 feet 4 inches (1.12 equivalent duct diameters) downstream from a bend in the duct and 56 feet 3 inches (4.75 equivalent duct diameters) upstream from a bend in the duct.

The sampling ports on the Stack are approximately 123 feet 1 1/2 inches above the ground. The sampling ports are located 33 feet 1 1/2 inches (3.64 stack diameters) downstream from the inlet to the stack and > 18 feet 2 3/8 inches (> 2.00 stack diameters) upstream from the outlet to the stack.

SAMPLING LOCATION

Figure 1: SDA Inlet Duct

Not to Scale

SAMPLING LOCATION

Figure 2: Stack

SAMPLING AND ANALYTICAL PROCEDURES

The procedures set forth in 40CFR60, Appendix A, Test Methods 1, 2, 3, 4, 5, 5B, 17, 26A, 202, and Conditional Test Method CTM027; ASTM D6784-02 (Ontario Hydro) Mercury Speciation Test Method; and the National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI) Method 8A were followed during testing.

Four Traverse points were sampled from three ports on the SDA Inlet Duct for a total of twelve traverse points. All traverse points were checked for cyclonic flow and the average angle was equal to 2.4 degrees. The pitot tube lines were checked for leaks before and after each test under a vacuum and a pressure. The lines were also checked for clearance and the manometer was zeroed before each test.

Twelve traverse points were sampled from two ports on the Stack for a total of twenty four traverse points. All traverse points were checked for cyclonic flow and the average angle was equal to 6.0 degrees. The pitot tube lines were checked for leaks before and after each test under a vacuum and a pressure. The lines were also checked for clearance and the manometer was zeroed before each test.

Particulate Matter

Particulate matter samples were taken at the Stack sampling location according to EPA Test Methods 5B and 202. For each run, samples of five minute duration were taken at each of the twenty-four traverse points for a total sampling time of 120 minutes. Data was recorded at five minute intervals.

The sampling train was leak checked at the end of the sampling probe at 15" of mercury vacuum before each test, and again at the conclusion of each test at the highest

vacuum recorded during sampling. This was done to predetermine the possibility of a diluted sample.

The “front half” of the sampling train at the Stack sampling location contained the following components:

Stainless steel nozzle
Heated glass lined probe @ $320^{\circ}\text{F} \pm 25^{\circ}\text{F}$
Heated glass fiber filter @ $320^{\circ}\text{F} \pm 25^{\circ}\text{F}$
Heated Teflon line @ $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$

The “back half” of the sampling train at the Stack sampling location contained the following components:

**Table 8: EPA Test Methods 5B and 202 Sampling Train
Condenser/Absorbing System**

Impinger No.	Impinger Type	Impinger Contents	Amount	Parameter Collected
1	Modified	H.P.L.C. H ₂ O	100 ml	H ₂ O
2	Greenburg-Smith	H.P.L.C. H ₂ O	100 ml	H ₂ O
3	Modified	Empty	-----	H ₂ O
4	Modified	Silica Gel	250 g	H ₂ O

At the completion of each run, the “back half” of the sampling train was purged with nitrogen for 60 minutes at a rate of 20 liters per minute.

Integrated Orsat samples were collected during each test. The samples were analyzed according to EPA Method 3 to determine the stack gas molecular weight.

Figure 3: EPA Test Methods 5B and 202 Sampling Train

Particulate Matter, Hydrogen Halides & Halogens, and Ammonia

Particulate matter, hydrogen halides & halogens, and ammonia samples were taken at the SDA Inlet Duct and Stack sampling locations according to EPA Test Methods 1, 2, 3, 4, 5, 17, 26A, and CTM027. For each run at the SDA Inlet Duct, samples of five minute duration were taken at each of twelve traverse points for a total test time of 60 minutes. Data was recorded at five minute intervals. For each run at the Stack, samples of three minute duration were taken at each of twenty-four traverse points for a total test time of 72 minutes. Data was recorded at three minute intervals.

The sampling trains were leak checked at the end of the sampling probe at 15" of mercury vacuum before each test, and again at the conclusion of each test at the highest vacuum recorded during sampling. This was done to predetermine the possibility of a diluted sample.

The 'front half' of the sampling train at the SDA Inlet Duct contained the following components:

- Glass nozzle
- Fiberglass Thimble
- Heated glass lined probe @ $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$
- Heated glass filter bypass @ $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$

The 'front half' of the sampling train at the Stack contained the following components:

- Glass nozzle
- Heated glass lined probe @ $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$
- Heated fiberglass filter @ $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$
- Heated Teflon line @ $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$

The 'back half' of the sampling trains at both sampling locations contained the following components:

Table 9: EPA Test Method 26A Condenser/Absorbing System

Impinger No.	Impinger Type	Absorbing Solution
1	Greenburg-Smith	100 ml 0.1N H ₂ SO ₄
2	Greenburg-Smith	100 ml 0.1N H ₂ SO ₄
3	Modified	100 ml 0.1N NaOH
4	Modified	100 ml 0.1N NaOH
5	Modified	~200 g silica gel

A 100 milliliter aliquot of the Impinger No. 1 and No. 2 contents was taken from each run at the SDA Inlet Duct for Ion Chromatograph analysis to determine the concentrations of ammonia.

Integrated Orsat samples were collected at each sampling location during each test. The samples were analyzed according to EPA Method 3 to determine the stack gas molecular weight.

Figure 4: EPA Test Methods 17, 26A, and CTM027 SDA Inlet Duct Sampling Train

Figure 5: EPA Test Methods 5 and 26A Stack Sampling Train

Particulate Matter and Speciated Mercury

Speciated mercury and particulate matter samples were taken at the SDA Inlet Duct and Stack sampling locations according to EPA Test Methods 1, 2, 3, 4, 5, and 17; and ASTM D6784-02 (Ontario Hydro) Mercury Speciation Test Method. For each run at the SDA Inlet Duct, samples of ten minute duration were taken at each of twelve traverse points for a total test time of 120 minutes. Data was recorded at five minute intervals. For each run at the Stack, samples of five minute duration were taken at each of twenty-four traverse points for a total test time of 120 minutes. Data was recorded at five minute intervals.

The sampling trains were leak checked at the end of the sampling probe at 15" of mercury vacuum before each test, and again at the conclusion of each test at the highest vacuum recorded during sampling. This was done to predetermine the possibility of a diluted sample.

The 'front half' of the sampling train at the SDA Inlet Duct contained the following components:

- Glass nozzle
- Fiberglass Thimble
- Heated glass lined probe @ $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$
- Heated glass filter bypass @ $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$

The 'front half' of the sampling train at the Stack contained the following components:

- Glass nozzle
- Heated glass lined probe @ $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$
- Heated fiberglass filter @ $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$
- Heated Teflon line @ $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$

The 'back half' of the sampling trains, contained the following components:

**Table 10: ASTM D6784-02 (Ontario Hydro) Speciated Mercury Test Method
Condenser/Absorbing System**

Impinger No.	Impinger Type	Absorbing Solution
1	Modified	100 ml 1 N KCl
2	Modified	100 ml 1 N KCl
3	Greenburg-Smith	100 ml 1 N KCl
4	Modified	100 ml 5% v/v HNO_3 , 10% v/v H_2O_2
5	Modified	100 ml 4% w/v H_2SO_4 , 10% v/v KMnO_4
6	Modified	100 ml 4% w/v H_2SO_4 , 10% v/v KMnO_4
7	Greenburg-Smith	100 ml 4% w/v H_2SO_4 , 10% v/v KMnO_4
8	Modified	~200 g silica gel

Integrated Orsat samples were collected at each sampling location during each test. The samples were analyzed according to EPA Method 3 to determine the stack gas molecular weight.

**Figure 6: ASTM D6784-02 (Ontario Hydro) Mercury Speciation Test Method
Sampling Train - SDA Inlet Duct**

**Figure 7: ASTM D6784-02 (Ontario Hydro) Mercury Speciation Test Method
Sampling Train - Stack**

Sulfur Trioxide

Triplicate samples for sulfur trioxide were taken at the SDA Inlet Duct sampling location according to NCASI Method 8A. For each run, samples of 60 minute duration were taken at a single traverse point. Data was recorded at five minute intervals.

The sampling train was leak checked at the end of the sampling probe at 15" of mercury vacuum before each test, and again at the conclusion of each test at the highest vacuum recorded during sampling. This was done to predetermine the possibility of a diluted sample.

The 'front half' of the sampling train contained the following components:

Glass Sample Probe heated to 500° F

Quartz Filter heated to 500° F

Glass Condenser cooled to 140° F

Teflon tubing connected to Impingers

The 'back half' of the sampling train contained the following components:

Table 11: NCASI Method 8A Condenser/Absorbing System

Impinger No.	Impinger Type	Absorbing Solution
1	Greenburg-Smith	100 ml 3% H ₂ O ₂
2	Modified	100 ml 3% H ₂ O ₂
3	Greenburg-Smith	100 ml DI H ₂ O
4	Modified	~200 g silica gel

The sampling train was purged from the inlet of the condenser with clean ambient air for 15 minutes at the completion of each test run.

Figure 8: NCASI Method 8A SDA Inlet Duct Sampling Train

TEST NARRATIVE

Personnel from Air Sampling Associates, Inc. arrived at the Rocky Mountain Power, Hardin Power Plant, located in Hardin, Montana at 8:30 a.m. on Monday, November 27, 2006. The sampling trailer was placed into position and electrical power was established. The sampling equipment was moved onto the SDA Inlet Duct and the Stack before securing the equipment for the night at 6:30 p.m.

On Tuesday, November 28, 2006, personnel returned to the plant at 7:00 a.m. The preliminary data was collected before the plant ceased to operate at the desired level. Personnel prepared for the next day's testing before departing the plant at 4:15 p.m.

On Wednesday, November 29, 2006, personnel returned to the plant at 7:00 a.m. The sampling equipment was prepared for testing but personnel was informed that the plant was not operating at the desired level. Personnel departed the plant at 9:00 a.m. Personnel returned to the plant at 1:30 p.m. At that time, personnel was informed that the plant was still not operating at the desired level and testing would be postponed until the next day. Personnel departed the plant at 2:45 p.m.

On Thursday, November 30, 2006, personnel returned to the plant at 7:00 a.m. Personnel was informed that the plant was not operating at the desired level. Personnel waited until 10:30 a.m. and then departed the plant. Personnel returned to the plant at 1:00 p.m. The sampling equipment was prepared for testing and the first test on the SDA Inlet Duct using NCASI Method 8A was taken from 1:23 p.m. until 2:23 p.m. The first test on the Stack using EPA Test Methods 5 and 202 began at 1:34 p.m. and was completed at 3:42 p.m. The first test on the SDA Inlet Duct using EPA Test Methods 17, 26A, and CTM027 was taken from 2:54 p.m. until 3:59 p.m. The first test on the Stack using EPA Test Method 26A was taken from 4:42 p.m. until 5:59 p.m. The

second test on the SDA Inlet Duct using NCASI Method 8A was taken from 4:48 p.m. until 5:48 p.m. The samples were recovered and personnel departed the plant at 8:00 p.m.

On Friday, December 1, personnel returned to the plant at 7:00 a.m. The sampling equipment was prepared for testing and the first simultaneous test on the SDA Inlet Duct and the Stack using the ASTM D6784-02 (Ontario Hydro) Speciated Mercury Test Method began at 8:57 a.m. Testing continued until the completion of the test on the stack at 11:05 a.m. The second test on the SDA Inlet Duct using EPA Test Methods 17, 26A, and CTM027 was taken from 12:03 p.m. until 1:05 p.m. The third test on the SDA Inlet Duct using NCASI Method 8A was taken from 2:01 p.m. until 3:01 p.m. The second test on the Stack using EPA Test Method 26A was taken from 3:09 p.m. until 4:26 p.m. The third test on the SDA Inlet Duct using EPA Test Methods 17, 26A, and CTM027 was taken from 4:47 p.m. until 5:49 p.m. The samples were recovered and personnel departed the plant at 6:30 p.m.

On Saturday, December 2, personnel returned to the plant at 7:00 a.m. The sampling equipment was prepared for testing and the second simultaneous test on the SDA Inlet Duct and the Stack using the ASTM D6784-02 (Ontario Hydro) Speciated Mercury Test Method began at 9:19 a.m. Testing continued until the completion of the test on the stack at 11:24 a.m. The third test on the Stack using EPA Test Methods 5 and 202 was taken from 12:15 p.m. until 2:19 p.m. The third simultaneous test on the SDA Inlet Duct and Stack using the ASTM D6784-02 (Ontario Hydro) Speciated Mercury Test Method was delayed due to plant operations. The test began at 5:12 p.m. Testing continued until the completion of the test on the Stack at 7:17 p.m. The third test on the Stack using EPA Test Method 26A was taken from 8:25 p.m. until 9:41 p.m. The samples were recovered and personnel departed the plant at 10:45 p.m.

On Sunday, December 3, 2006, personnel returned to the plant at 7:00 a.m. The sampling equipment was moved off of the SDA Inlet Duct and the Stack and loaded into the sampling trailer. The samples were taken to Air Sampling Associates, Inc.'s office in Lewisville, Texas for analysis and shipment to the subcontracted laboratories.

Operations at the Rocky Mountain Power, Hardin Power Plant, SDA Inlet Duct and Stack, located in Hardin, Montana, were completed at 9:30 a.m. on Sunday, December 3, 2006.

APPENDICES

- Appendix A: Location of Traverse Points**
- Appendix B: Nomenclature and Equations for Calculation of Source Emissions**
- Appendix C: Calibration Data**
- Appendix D: Field Data**
- Appendix E: EPA Test Methods 5B and 202 (Particulate Matter) Analytical Data**
- Appendix F: EPA Test Methods 17, 26A and CTM027 (Particulate Matter, Hydrogen Halides & Halogens, and Ammonia) Analytical Data – SDA Inlet Duct**
- Appendix G: EPA Conditional Test Methods 5 and 26A (Particulate Matter and Hydrogen Halides & Halogens) Analytical Data – Stack**
- Appendix H: EPA Test Methods 5, 17 (Particulate Matter), and ASTM D6784-02 (Ontario Hydro) Mercury Speciation Test Method Analytical Data**
- Appendix I: NCASI Method 8A (Sulfur Trioxide) Analytical Data**
- Appendix J: Chain of Custodies**
- Appendix K: Resumes of Test Personnel**

Appendix A:
Location of Traverse Points

Appendix A

Location of Traverse Points SDA Inlet Duct

The sampling ports are located 13 feet 4 inches (1.12 equivalent duct diameters) downstream from a bend in the duct and 56 feet 3 inches (4.75 equivalent duct diameters) upstream from a bend in the duct. The locations of the traverse points were calculated as follows:

Figure 9: Location of Traverse Points - SDA Inlet Duct

Note: Physical limitations prevented the complete traversing of the SDA Inlet Duct.

Appendix A

Location of Traverse Points Stack

The sampling ports are located 33 feet 1 1/2 inches (3.64 stack diameters) downstream from the inlet to the stack and > 18 feet 2 3/8 inches (> 2.00 stack diameters) upstream from the outlet to the stack. The locations of the traverse points were calculated as follows:

Table 12: Location Traverse Points - Stack

Port & Wall Thickness = 15 1/8 inches		
Inside Stack Diameter = 109 3/16 inches		
Point Number	Percent of Stack Diameter	Distance from Wall
1	2.1	2 5/16"
2	6.7	7 5/16"
3	11.8	12 7/8"
4	17.7	19 5/16"
5	25.0	27 5/16"
6	35.6	38 7/8"
7	64.4	70 5/16"
8	75.0	81 7/8"
9	82.3	89 7/8"
10	88.2	96 5/16"
11	93.3	101 7/8"
12	97.9	106 7/8"

Appendix A

Figure 10: Location of Traverse Points - Stack

Not to scale.

Appendix B:

Nomenclature and Equations for Calculation of Source Emissions

Nomenclature For Flow Rate and Moisture Calculations

<u>Symbol</u>	<u>English Units</u>	<u>Metric Units</u>	<u>Description</u>
A_s	in. ²	m ²	Stack Area
C_{an}	gr/dscf*	g/dscm*	Particulate – probe, cyclone, and filter
C_{ao}	gr/dscf*	g/dscm*	Particulate –total
C_{at}	gr/CF @ stack conditions	g/m ³	Particulate – probe, cyclone, and filter
C_{au}	gr/CF @ stack conditions	g/m ³	Particulate – total
C_{aw}	lbs/hr	kg/hr	Particulate – probe, cyclone, and filter
C_{ax}	lbs/hr	kg/hr	Particulate - total
C_p			Pitot Tube Calibration Factor
D_n	in.	m	Sampling Nozzle Diameter
%EA			Percent Excess Air at Sampling Point
g	32.2 ft/sec ²		Acceleration of gravity
%I			Percent Isokinetic
%M			Percent Moisture in the Stack Gas by Volume
M_d			Mole Fraction of Dry Gas
m_f	mg	mg	Particulate – probe, cyclone, and filter
mt	mg	mg	Particulate -total
M_{water}	18 lb/lb-mole		Molecular Weight of Water
MW	lb/lb-mole	g/g-mole	Molecular Weight of Stack Gas
MW_{air}	28.84 lb/lb-mole		Molecular Weight of Air
MW_d	lb/lb-mole	g/g-mole	Molecular Weight of Dry Stack Gas

<u>Symbol</u>	<u>English Units</u>	<u>Metric Units</u>	<u>Description</u>
P_b	"Hg Absolute	mm Hg	Barometric Pressure
P_m	"H ₂ O	mm H ₂ O	Orifice Pressure drop
P_s	"Hg Absolute	mm Hg	Stack Pressure
ΔP	"H ₂ O	mm H ₂ O	Velocity Head of Stack Gas
P_{std}	29.92" Hg	760 mm Hg	Standard Barometric Pressure
Q_a	ACFM	m ³ /hr	Stack Gas Volume at Actual Stack Conditions
Q_s	DSCFM*	dscm/hr*	Stack Gas Volume at 29.92" Hg, 528° R, dry
R	21.83" Hg- ft ³ /lb-mole °R		Universal Gas Constant
T_m	°F	°C	Average Gas Meter Temperature
T_t	min	min	Net Time of Test
T_s	°F	°C	Stack Temperature
T_{std}	528 °R	293 °K	Standard Temperature
V_m	ft ³	m ³	Volume of Dry Gas Sampled @ Meter Conditions
V_{mstd}	dscf*	dscm*	Volume of Dry Gas Sampled @ Standard Conditions
V_s	fpm	m/sec	Stack Velocity @ Stack Conditions
V_w	ml	ml	Total Water Collected in Impingers and Silica Gel
VW_{gas}	scf*	scm*	Volume of Water Vapor Collected @ Standard Conditions

<u>Symbol</u>	<u>English Units</u>	<u>Metric Units</u>	<u>Description</u>
ρ_{air}	0.0748 lbs/ft ³		Density of Air
ρ_{water}	1 g/ml		Density of Water
ρ_{man}	62.32 lbs/ft ³		Density of Manometer Oil (Inches of Water)

Standard Conditions: 29.92" Hg, 68° F (760 mm Hg, 20 °C)

EXAMPLE CALCULATIONS

1. Volume of dry gas sampled at standard conditions. *

$$V_{mstd} = V_m \left(\frac{T_{std}}{T_m + 460} \right) \left[\frac{P_b + \frac{P_m}{13.6}}{P_{std}} \right]$$

$$V_{mstd} = 17.65 V_m \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = \text{dscf}$$

$$V_{mstd} = \text{dscf} \times 0.028317 = \text{dscm}$$

2. Volume of water vapor collected at standard conditions. *

$$V_{wgas} = \frac{(V_w - \text{gms } SO_2 - \text{gms } H_2S) \rho_{water} RT_{std}}{P_{std} M_{water} 453.6}$$

$$V_{wgas} = 0.0472 (V_w - \text{gms } SO_2 - \text{gms } H_2S) = \text{scf}$$

$$V_{wgas} = \text{scf} \times 0.028317 = \text{scm}$$

3. Percent moisture in stack gas.

$$\%M = \frac{V_{wgas}}{V_{mstd} + V_{wgas}} \times 100 = \%$$

*

29.92" Hg, 68° F (760 mm Hg, 20 °C)

4. Mole fraction of dry gas.

$$M_d = \frac{100 - \%M}{100}$$

5. Average molecular weight of dry stack gas.

$$MW_d = \left[\%CO_2 \times \frac{44}{100} \right] + \left[\%O_2 \times \frac{32}{100} \right] + \left[\%N_2 \times \frac{28}{100} \right] + \left[\%CO \times \frac{28}{100} \right] = lb/lb - mole$$

$$= g/g - mole$$

6. Molecular weight of stack gas.

$$MW = MW_d \times M_d + 18 (1 - M_d) = \frac{lb}{lb - mole} = g/g - mole$$

7. Percent excess air at sampling point.

$$\%EA = \frac{100 [\%O_2 - (0.5 \%CO)]}{0.265 (\%N_2) - [\%O_2 - (0.5 \%CO)]}$$

8. Stack Pressure.

$$P_s = P_b + \frac{\text{Stack Pressure "H}_2\text{O}}{13.6} = \text{"Hg Absolute}$$

$$P_s = \text{"Hg Abs.} \times 25.4 = mm Hg$$

9. Stack velocity at stack conditions.

$$V_s = C_p 60 \left[\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_s + 460) \times \Delta P}{12 \times \rho_{air} \times P_s \times MW \times T_{std}} \right]^{1/2}$$

$$V_s = 5,123.8 C_p \left[\frac{(T_s + 460)}{P_s \times MW} \right]^{1/2} \sqrt{\Delta P} \text{ average} = fpm$$

$$V_s = fpm \times 0.00508 = m/sec$$

10. Dry stack gas volume at standard conditions. *

$$Q_s = \frac{1}{144} V_s \times A_s \times M_d \times \frac{T_{std}}{T_s + 460} \times \frac{P_s}{P_{std}}$$

$$Q_s = \frac{0.123 V_s \times A_s \times M_d \times P_s}{T_s + 460} = DSCFM$$

$$Q_s = DSCFM \times 1.6990 = dscm/hr$$

11. Actual stack gas volume at stack conditions.

$$Q_a = \frac{V_s \times A_s}{144} = ACFM$$

$$Q_a = ACFM \times 1.6990 = m^3/hr$$

12. Percent Isokinetic

$$\%I = \frac{V_{mstd} \times (T_s + 460) \times P_{std} \times 100 \times 144 \text{ in.}^2 / \text{ft}^2}{M_d \times T_{std} \times P_s \times T_t \times V_s \left(\frac{\pi \times D_n^2}{4} \right)}$$

$$\%I = \frac{1039 \times V_{mstd} \times (T_s + 460)}{M_d \times P_s \times T_t \times V_s \times D_n^2}$$

* 29.92" Hg, 68° F (760 mm Hg, 20 °C)

13. Particulate – Probe, cyclone, and filter.

$$C_{an} = \frac{m_f}{V_{mstd}} \times \frac{1 \text{ gr}}{64.8 \text{ mg}}$$

$$C_{an} = 0.0154 \times \frac{m_f}{V_{mstd}} \text{ gr/dscf}^*$$

$$C_{an} = \text{gr/dscf} \times 2.290 = \text{g/dscm}^*$$

14. Particulate total.

$$C_{ao} = 0.0154 \times \frac{m_t}{V_{mstd}} = \text{gr / dscf}^*$$

$$C_{ao} = \text{gr/dscf} \times 2.290 = \text{g/dscm}^*$$

15. Particulate – probe, cyclone, and filter at stack conditions.

$$C_{at} = C_{an} \times \frac{P_s}{P_{std}} \times \frac{(T_{std})}{(T_s + 460)} \times M_d$$

$$C_{at} = \frac{17.65 \times C_{an} \times P_s \times M_d}{T_s + 460} = \text{gr/CF}$$

$$C_{at} = \text{gr/CF} \times 2.290 = \text{g/m}^3$$

16. Particulate – total, at stack conditions.

$$C_{au} = \frac{17.65 \times C_{ao} \times P_s \times M_d}{T_s + 460} = \text{gr/CF}$$

$$C_{au} = \text{gr/CF} \times 2.290 = \text{g/m}^3$$

* 29.92" Hg, 68° F (760 mm Hg, 20 °C)

17. Particulate – probe, cyclone, and filter.

$$C_{aw} = C_{an} \times Q_s \times \frac{60 \text{ min.}}{1 \text{ hr}} \times \frac{1 \text{ lb}}{7,000 \text{ gr}}$$

$$C_{aw} = 0.00857 \times C_{an} \times Q_s = \text{lbs/hr}$$

$$C_{aw} = \text{lbs/hr} \times 0.4536 = \text{kg/hr}$$

18. Particulate – total.

$$C_{ax} = 0.00857 \times C_{ao} \times Q_s = \text{lbs/hr}$$

$$C_{ax} = \text{lbs/hr} \times 0.4536 = \text{kg/hr}$$

19. Mercury - $\mu\text{g/dscm}$

$$\mu\text{g/dscm} = \mu\text{g} \div (V_{\text{mstd}} \times 0.028317 \text{ m}^3/\text{ft}^3)$$

*29.92" Hg, 68° F (760 mm Hg, 20 °C)

Summary of Results
Mercury Speciation Results
Rocky Mountain Power - Hardin Power Plant
SDA Inlet Duct

Run No.	1	2	3	
Test Date:	12/1/2006	12/2/2006	12/2/2006	
Test Time:	0857-1059	0919-1121	1712-1914	Average
Volume of Dry Gas Sampled @ Standard Conditions				
dscm	1.343	1.352	1.383	1.359
dscf	47.420	47.730	48.842	47.997
Oxygen				
% volume	6.4	6.1	6.2	6.2
Particulate Mercury				
µg	0.6100	1.5000	0.6400	0.9167
µg/dscf	0.0129	0.0314	0.0131	0.0191
µg/dscm	0.4542	1.1095	0.4628	0.6755
lbs/10 ¹² Btu	0.400	0.957	0.402	0.586
% of total Hg	10.38%	18.99%	13.37%	14.25%
Oxidized Mercury				
µg	1.6000	1.7000	3.3000	2.2000
µg/dscf	0.0337	0.0356	0.0676	0.0456
µg/dscm	1.1914	1.2574	2.3861	1.6116
lbs/10 ¹² Btu	1.049	1.085	2.072	1.402
% of total Hg	27.24%	21.52%	68.92%	39.23%
Elemental Mercury				
µg	3.6640	4.7000	0.8480	3.0707
µg/dscf	0.0773	0.0985	0.0174	0.0644
µg/dscm	2.7282	3.4763	0.6132	2.2726
lbs/10 ¹² Btu	2.402	2.999	0.532	1.978
% of total Hg	62.38%	59.49%	17.71%	46.53%
Total Mercury				
µg	5.8740	7.9000	4.7880	6.1873
µg/dscf	0.1239	0.1655	0.0980	0.1291
µg/dscm	4.3738	5.8432	3.4620	4.5597
lbs/10 ¹² Btu	3.850	5.040	3.006	3.965
Oxygen based F factor	9,780	9,780	9,780	9,780

Summary of Results
Mercury Speciation Results
Rocky Mountain Power - Hardin Power Plant
Stack

Run No.	1	2	3	
Test Date:	12/1/2006	12/2/2006	12/2/2006	
Test Time:	0857-1105	0919-1124	1712-1917	Average
Volume of Dry Gas Sampled @ Standard Conditions				
dscm	1.983	2.028	1.945	1.985
dscf	70.043	71.627	68.704	70.125
Oxygen				
% volume	6.2	6.4	6.2	6.3
Particulate Mercury				
µg	0.0380	ND	0.0090	<0.0157
µg/dscf	0.0005	ND	0.0001	<0.0002
µg/dscm	0.0192	ND	0.0046	<0.0079
lbs/10 ¹² Btu	0.017	ND	0.004	<0.007
% of total Hg	0.54%	ND	0.14%	0.34%
Oxidized Mercury				
µg	0.1100	ND	0.0800	<0.0633
µg/dscf	0.0016	ND	0.0012	<0.0009
µg/dscm	0.0555	ND	0.0411	<0.0322
lbs/10 ¹² Btu	0.048	ND	0.036	<0.028
% of total Hg	1.57%	ND	1.22%	1.40%
Elemental Mercury				
µg	6.8410	12.1000	6.4640	8.4683
µg/dscf	0.0977	0.1689	0.0941	0.1202
µg/dscm	3.4498	5.9665	3.3234	4.2466
lbs/10 ¹² Btu	2.995	5.251	2.885	3.710
% of total Hg	97.88%	100.00%	98.64%	98.84%
Total Mercury				
µg	6.9890	12.1000	6.5530	8.5473
µg/dscf	0.0998	0.1689	0.0954	0.1214
µg/dscm	3.5245	5.9665	3.3692	4.2867
lbs/10 ¹² Btu	3.059	5.251	2.924	3.745
Oxygen based F factor				
	9,780	9,780	9,780	9,780

Appendix C:
Calibration Data

Appendix C

Table 13: Calibration Data

Pre-Test Calibrations:

<u>Equipment</u>	<u>Calibration Factor</u>	<u>Calibration Date</u>
Dry Gas Meter 1-1	0.985	09/19/06
Digital Temperature Indicator 1-1		09/19/06
Dry Gas Meter 1-1 Orifice		09/19/06
Dry Gas Meter 2-2	0.999	10/24/06
Digital Temperature Indicator 2-2		10/23/06
Dry Gas Meter 2-2 Orifice		10/24/06
Pitot Tube 3-1	0.823	11/21/06
Pitot Tube 3-2	0.824	11/21/06
Pitot Tube 3-3	0.823	10/20/06
Pitot Tube 3-4	0.823	10/20/06
Pitot Tube 4-1	0.824	01/24/06
Nozzle 4-2	0.171	01/25/06
Nozzle 5-2	0.193	11/28/06
Nozzle 5-8	0.154	01/25/06
Nozzle 7-2	0.192	10/27/06
Nozzle 7-8	0.154	09/19/06

Post-Test Calibrations:

<u>Equipment</u>	<u>Calibration Factor</u>	<u>Calibration Date</u>
Dry Gas Meter 1-1	0.984	12/07/06
Digital Temperature Indicator 1-1		12/07/06
Dry Gas Meter 2-2	0.989	12/07/06
Digital Temperature Indicator 2-2		12/07/06
Pitot Tube 3-1	0.825	12/07/06
Pitot Tube 3-2	0.826	12/07/06
Pitot Tube 3-3	0.826	12/07/06
Pitot Tube 3-4	0.826	12/07/06
Pitot Tube 4-1	0.827	12/07/06
Nozzle 4-2	0.171	12/07/06
Nozzle 5-2	0.193	12/07/06
Nozzle 5-8	0.154	12/07/06
Nozzle 7-2	0.192	12/07/06
Nozzle 7-8	0.154	12/07/06

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 1-1
Date Calibration Performed: 09/19/06

ΔH Setting ($" H_2O$)	C_{DG}
0.50	0.984
1.00	0.986
1.50	0.985
2.00	0.987
3.00	0.984
4.00	0.983
Average	0.985

Variation +: 0.20%
Variation -: -0.20%

Certified by: *Gary B. Goldman 09/19/06*
Calibrator (Signature / Date)

Bill Hefley 09/19/06
QA Officer (Signature / Date)

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 1-1
Date Calibration Performed: 09/19/06

Run 1 at 0.5" ΔH Pb = 29.80 " Hg
Wet Test Meter C_f = 1.018 Console Pump Vacuum = -5.0 " Hg

Wet Test Meter No. ASAI-0

		Meter					
	Time	Reading		Temp.	P _m		
End	13:27	5.238	cf	83 °F	-0.1	" H ₂ O	
Start	13:14	0.000	cf	83 °F	-0.1	" H ₂ O	
Average		5.238	cf	83 °F	-0.1	" H ₂ O	

Dry Gas Meter

		Meter		Temperature			
	Reading			In	Out	P _m	
	913.384	cf	82 °F	83 °F	0.50	" H ₂ O	
	907.982	cf	82 °F	81 °F	0.50	" H ₂ O	
	5.402	cf	82 °F	82 °F	0.50	" H ₂ O	

$$\text{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{5.164} \text{ dcsf}$$

$$\text{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{5.249} \text{ dcsf}$$

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{mstd}}{\text{Dry Gas Meter } V_{mstd}} = \underline{0.984}$$

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 1-1
Date Calibration Performed: 09/19/06

Run 1 at 1.0" ΔH Pb = 29.80 " Hg
Wet Test Meter Cf = 1.018 Console Pump Vacuum = -5.0 " Hg

Wet Test Meter No. ASAI-0

		Meter													
	Time	Reading		Temp.		P _m									
End	13:40	5.015	cf	83	°F	-0.4	" H ₂ O								
Start	13:31	0.000	cf	83	°F	-0.4	" H ₂ O								
Average		5.015	cf	83	°F	-0.4	" H ₂ O								

Dry Gas Meter

		Meter		Temperature											
		Reading		In	Out	P _m									
		918.875	cf	86	°F	83	°F	1.00	" H ₂ O						
		913.712	cf	83	°F	82	°F	1.00	" H ₂ O						
		5.163	cf	85	°F	83	°F	1.00	" H ₂ O						

$$\text{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{4.940} \text{ dcsf}$$

$$\text{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{5.009} \text{ dcsf}$$

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{mstd}}{\text{Dry Gas Meter } V_{mstd}} = \underline{0.986}$$

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 1-1
Date Calibration Performed: 09/19/06

Run 1 at 1.5" ΔH Pb = 29.80 " Hg
Wet Test Meter Cf = 1.018 Console Pump Vacuum = -5.0 " Hg

Wet Test Meter No. ASAI-0

		Meter					
	Time	Reading	Temp.	P _m			
End	14:00	10.038 cf	83 °F	-0.6	" H ₂ O		
Start	13:45	0.000 cf	83 °F	-0.6	" H ₂ O		
Average		10.038 cf	83 °F	-0.6	" H ₂ O		

Dry Gas Meter

		Meter		Temperature			
	Reading	In	Out	P _m			
	930.182 cf	91 °F	84 °F	1.50	" H ₂ O		
	919.804 cf	86 °F	83 °F	1.50	" H ₂ O		
	10.378 cf	89 °F	84 °F	1.50	" H ₂ O		

$$\text{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{9.884} \text{ dcsf}$$

$$\text{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{10.034} \text{ dcsf}$$

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{mstd}}{\text{Dry Gas Meter } V_{mstd}} = \underline{0.985}$$

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 1-1
Date Calibration Performed: 09/19/06

Run 1 at 2.0" ΔH Pb = 29.80 " Hg
Wet Test Meter Cf = 1.018 Console Pump Vacuum = -5.0 " Hg

Wet Test Meter No. ASAI-0

		Meter					
	Time	Reading	Temp.	P _m			
End	14:16	10.020 cf	83 °F	-0.7	" H ₂ O		
Start	14:03	0.000 cf	83 °F	-0.7	" H ₂ O		
Average		10.020 cf	83 °F	-0.7	" H ₂ O		

Dry Gas Meter

		Meter		Temperature			
	Reading	In	Out	P _m			
	940.927 cf	94 °F	86 °F	2.00	" H ₂ O		
	930.552 cf	90 °F	85 °F	2.00	" H ₂ O		
	10.375 cf	92 °F	86 °F	2.00	" H ₂ O		

$$\text{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{9.863} \text{ dcsf}$$

$$\text{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{9.993} \text{ dcsf}$$

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{mstd}}{\text{Dry Gas Meter } V_{mstd}} = \underline{0.987}$$

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 1-1
Date Calibration Performed: 09/19/06

Run 1 at 3.0" ΔH Pb = 29.80 " Hg
Wet Test Meter Cf = 1.018 Console Pump Vacuum = -5.0 " Hg

Wet Test Meter No. ASAI-0

		Meter							
	Time	Reading	Temp.	P _m					
End	14:29	10.407 cf	84 °F	-1.0	" H ₂ O				
Start	14:18	0.000 cf	84 °F	-1.0	" H ₂ O				
Average		10.407 cf	84 °F	-1.0	" H ₂ O				

Dry Gas Meter

		Meter		Temperature					
	Reading	In	Out	P _m					
	952.083 cf	97 °F	87 °F	3.00	" H ₂ O				
	941.298 cf	92 °F	86 °F	3.00	" H ₂ O				
	10.785 cf	95 °F	87 °F	3.00	" H ₂ O				

$$\text{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{10.218} \text{ dcsf}$$

$$\text{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{10.381} \text{ dcsf}$$

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{mstd}}{\text{Dry Gas Meter } V_{mstd}} = \underline{0.984}$$

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 1-1
Date Calibration Performed: 09/19/06

Run 1 at 4.0" ΔH Pb = 29.80 " Hg
Wet Test Meter Cf = 1.018 Console Pump Vacuum = -5.0 " Hg

Wet Test Meter No. ASAI-0

		Meter						
	Time	Reading	cf	Temp.	P _m			
End	14:42	10.864	cf	84 °F	-1.3	" H ₂ O		
Start	14:32	0.000	cf	84 °F	-1.3	" H ₂ O		
Average		10.864	cf	84 °F	-1.3	" H ₂ O		

Dry Gas Meter

		Meter		Temperature				
	Reading	In	Out	P _m				
	963.826	98 °F	88 °F	4.00	" H ₂ O			
	952.552	87 °F	96 °F	4.00	" H ₂ O			
	11.274	93 °F	92 °F	4.00	" H ₂ O			

$$\text{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{10.659} \text{ dcsf}$$

$$\text{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{10.843} \text{ dcsf}$$

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{mstd}}{\text{Dry Gas Meter } V_{mstd}} = \underline{0.983}$$

Calibration Data
Digital Temperature Indicator Calibration

DTI Unit No. ASAI 1-1

Date Calibration Performed: 09/19/06

Reference Point	Time	ASTM	DTI
		Reference Thermometer (°F)	(°F)
Ice Bath	<u>11:43</u>	<u>33° F</u>	<u>32° F</u>
Ambient Air	<u>11:39</u>	<u>82° F</u>	<u>82° F</u>
Boiling Water	<u>12:10</u>	<u>210° F</u>	<u>210° F</u>
Oven	<u>11:55</u>	<u>251° F</u>	<u>252° F</u>
Oven	<u>11:58</u>	<u>298° F</u>	<u>299° F</u>
Oven	<u>12:08</u>	<u>348° F</u>	<u>348° F</u>
Oven	<u>12:02</u>	<u>389° F</u>	<u>389° F</u>

Meter Adjusted? No

ASTM Reference Thermometer:

SN: 5963

Range: +18+89°F

SN: 1853

Range: +205+310°F

SN: 992

Range: +295+400°F

Certified by:

Gary B. Goldmax 09/19/06

Calibrator (Signature / Date)

Bill Hefley 09/19/06

QA Officer (Signature / Date)

Orifice Curve ASAI 1-1 09/19/06

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 2-2
Date Calibration Performed: 10/24/06

ΔH Setting (" H ₂ O)	C _{DG}
0.50	1.003
1.00	1.000
1.50	0.996
2.00	0.998
3.00	0.997
4.00	0.997
Average	0.999

Variation +: 0.40%
Variation -: -0.30%

Certified by: *Patrick Selakovich 10/24/06*

Calibrator (Signature / Date)

Bill Hefley 10/24/06

QA Officer (Signature / Date)

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 2-2
Date Calibration Performed: 10/24/06

Run 1 at 0.5" ΔH Pb = 29.79 " Hg
Wet Test Meter Cf = 1.018 Console Pump Vacuum = -5.0 " Hg

Wet Test Meter No. ASAI-0

		Meter						
	Time	Reading	cf	Temp.	P _m			
End	10:50	5.315	cf	67 °F	-0.2	" H ₂ O		
Start	10:37	0.000	cf	67 °F	-0.2	" H ₂ O		
Average		5.315	cf	67 °F	-0.2	" H ₂ O		

Dry Gas Meter

		Meter		Temperature				
	Reading	cf		In	Out	P _m		
	613.712	cf		72 °F	67 °F	0.50	" H ₂ O	
	608.301	cf		72 °F	67 °F	0.50	" H ₂ O	
	5.411	cf		72 °F	67 °F	0.50	" H ₂ O	

$$\text{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{5.396} \text{ dcsf}$$

$$\text{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{5.380} \text{ dcsf}$$

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{mstd}}{\text{Dry Gas Meter } V_{mstd}} = \underline{1.003}$$

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 2-2
Date Calibration Performed: 10/24/06

Run 1 at 1.0" ΔH Pb = 29.79 " Hg
Wet Test Meter Cf = 1.018 Console Pump Vacuum = -5.0 " Hg

Wet Test Meter No. ASAI-0

		Meter					
	Time	Reading	cf	Temp.	P _m		
End	11:02	5.175	cf	67 °F	-0.3	" H ₂ O	
Start	10:53	0.000	cf	67 °F	-0.3	" H ₂ O	
Average		5.175	cf	67 °F	-0.3	" H ₂ O	

Dry Gas Meter

		Meter		Temperature			
	Reading	cf		In	Out	P _m	
	619.692	cf		74 °F	68 °F	1.00	" H ₂ O
	614.407	cf		72 °F	68 °F	1.00	" H ₂ O
	5.285	cf		73 °F	68 °F	1.00	" H ₂ O

$$\text{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{5.252} \text{ dcsf}$$

$$\text{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{5.251} \text{ dcsf}$$

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{mstd}}{\text{Dry Gas Meter } V_{mstd}} = \underline{1.000}$$

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 2-2
Date Calibration Performed: 10/24/06

Run 1 at 1.5" ΔH Pb = 29.79 " Hg
Wet Test Meter C_f = 1.018 Console Pump Vacuum = -5.0 " Hg

Wet Test Meter No. ASAI-0

Meter						
	Time	Reading		Temp.	P _m	
End	11:39	10.245 cf	69	°F	-0.5	" H ₂ O
Start	11:24	0.000 cf	69	°F	-0.5	" H ₂ O
Average		10.245 cf	69	°F	-0.5	" H ₂ O

Dry Gas Meter

Meter		Temperature					
	Reading	In	Out	P _m			
	631.080 cf	76 °F	70 °F	1.50	" H ₂ O		
	620.606 cf	71 °F	69 °F	1.50	" H ₂ O		
	10.474 cf	74 °F	70 °F	1.50	" H ₂ O		

$$\text{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{10.353} \text{ dcsf}$$

$$\text{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{10.400} \text{ dcsf}$$

$$\text{Calibration Factor (C}_{DG}\text{)} = \frac{\text{Wet Test Meter } V_{mstd}}{\text{Dry Gas Meter } V_{mstd}} = \underline{0.996}$$

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 2-2
Date Calibration Performed: 10/24/06

Run 1 at 2.0" ΔH Pb = 29.77 " Hg
Wet Test Meter Cf = 1.018 Console Pump Vacuum = -5.0 " Hg

Wet Test Meter No. ASAI-0

Meter						
	Time	Reading		Temp.	P _m	
End	11:55	10.205 cf	69	°F	-0.7	" H ₂ O
Start	11:42	0.000 cf	69	°F	-0.7	" H ₂ O
Average		10.205 cf	69	°F	-0.7	" H ₂ O

Dry Gas Meter

Meter		Temperature				
	Reading	In	Out	P _m		
	641.943 cf	79 °F	71 °F	2.00	" H ₂ O	
	631.509 cf	75 °F	70 °F	2.00	" H ₂ O	
	10.434 cf	77 °F	71 °F	2.00	" H ₂ O	

$$\text{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{10.301} \text{ dcsf}$$

$$\text{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{10.322} \text{ dcsf}$$

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{mstd}}{\text{Dry Gas Meter } V_{mstd}} = \underline{0.998}$$

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 2-2
Date Calibration Performed: 10/24/06

Run 1 at 3.0" ΔH Pb = 29.77 " Hg
Wet Test Meter Cf = 1.018 Console Pump Vacuum = -5.0 " Hg

Wet Test Meter No. ASAI-0							Dry Gas Meter						
Meter							Temperature						
	Time	Reading		Temp.	P _m		Reading	In	Out	P _m			
End	12:09	10.579 cf	69	°F	-0.9	" H ₂ O	653.948 cf	82	°F	72	°F	3.00	" H ₂ O
Start	11:58	0.000 cf	69	°F	-0.9	" H ₂ O	643.109 cf	79	°F	71	°F	3.00	" H ₂ O
Average		10.579 cf	69	°F	-0.9	" H ₂ O	10.839 cf	81	°F	72	°F	3.00	" H ₂ O

$$\text{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{10.673} \text{ dcsf}$$

$$\text{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{10.704} \text{ dcsf}$$

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{mstd}}{\text{Dry Gas Meter } V_{mstd}} = \underline{0.997}$$

Calibration Data
Dry Gas Meter Calibration

Meter Console No. ASAI 2-2
Date Calibration Performed: 10/24/06

Run 1 at 4.0" ΔH Pb = 29.77 " Hg
Wet Test Meter Cf = 1.018 Console Pump Vacuum = -5.0 " Hg

Wet Test Meter No. ASAI-0							Dry Gas Meter						
Meter							Temperature						
	Time	Reading		Temp.	P _m				In	Out	P _m		
End	12:21	11.051	cf	70 °F	-1.1	" H ₂ O			84 °F	73 °F	4.00	" H ₂ O	
Start	12:11	0.000	cf	70 °F	-1.1	" H ₂ O			81 °F	72 °F	4.00	" H ₂ O	
Average		11.051	cf	70 °F	-1.1	" H ₂ O			83 °F	73 °F	4.00	" H ₂ O	

$$\text{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{11.123} \text{ dcsf}$$

$$\text{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{11.156} \text{ dcsf}$$

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{mstd}}{\text{Dry Gas Meter } V_{mstd}} = \underline{0.997}$$

Calibration Data
Digital Temperature Indicator Calibration

DTI Unit No. ASAI 2-2
Date Calibration Performed: 10/23/06

Reference Point	Time	ASTM	DTI
		Reference Thermometer (°F)	(°F)
Ice Bath	10:04	32° F	32° F
Ambient Air	8:20	60° F	59° F
Boiling Water	9:52	212° F	214° F
Oven	9:20	252° F	258° F
Oven	9:12	302° F	305° F
Oven	9:00	353° F	356° F
Oven	8:45	401° F	404° F

Meter Adjusted? No

ASTM Reference Thermometer:	SN: 5963	Range: +18+89°F
	SN: 1853	Range: +205+310°F
	SN: 992	Range: +295+400°F

Certified by: Patrick Selakovich 10/23/06
Calibrator (Signature / Date)

Bill Hefley 10/23/06
QA Officer (Signature / Date)

Orifice Curve ASAI 2-2 10/24/06

**CALIBRATION DATA
PITOT TUBE CALIBRATION DATA**

Date: 11/21/06
I.D. # ASAI 3-1
C_{pstd}: 0.990

Time: 14:45
T_s: 68 °F
Pb: 29.92 " Hg

fps Mark	Desired Calibration Standard	Calibration Standard		v Standard Average	High	v High	Cal. Factor	Low	v Low	Cal. Factor
20	0.09	0.09	0.09	0.300	0.13	0.361	0.824	0.13	0.361	0.824
30	0.21	0.21	0.21	0.458	0.30	0.548	0.828	0.30	0.548	0.828
40	0.37	0.37	0.37	0.608	0.54	0.735	0.819	0.54	0.735	0.819
50	0.57	0.57	0.57	0.755	0.83	0.911	0.820	0.83	0.911	0.820
60	0.82	0.82	0.82	0.906	1.20	1.095	0.818	1.20	1.095	0.818
70	1.12	1.10	1.10	1.049	1.60	1.265	0.821	1.60	1.265	0.821
80	1.46	1.45	1.45	1.204	2.10	1.449	0.823	2.10	1.449	0.823
90	1.85	1.85	1.85	1.360	2.65	1.628	0.827	2.65	1.628	0.827
50	0.57	0.57	0.57	0.755	0.83	0.911	0.820	0.83	0.911	0.820
50	0.57	0.57	0.57	0.755	0.83	0.911	0.820	0.83	0.911	0.820
Average							0.823			0.823

Summary of Results:

Normal high side calibration factor: 0.823
variation +: 0.61%
variation -: -0.61%
Normal low side calibration factor: 0.823
variation +: 0.61%
variation -: -0.61%

Certification:

I certify that the Type S pitot tube, the standard type pitot tube, and the calibration setup meet or exceed all specifications, criteria and/or applicable design features and hereby assign a pitot tube calibration factor C_p of: 0.823

Certified by:

Patrick Selakovich 11/21/06
Calibrator (Signature/Date)

Bill Hefley 11/21/06

QA Officer (Signature/Date)

**CALIBRATION DATA
PITOT TUBE CALIBRATION DATA**

Date: 11/21/06
I.D. # ASAI 3-2
C_{pstd}: 0.990

Time: 15:15
T_s: 68 °F
Pb: 29.89 " Hg

fps Mark	Desired Calibration Standard	Calibration Standard		v Standard Average	High	v High	Cal. Factor	Low	v Low	Cal. Factor
20	0.09	0.09	0.09	0.300	0.13	0.361	0.824	0.13	0.361	0.824
30	0.21	0.21	0.21	0.458	0.30	0.548	0.828	0.30	0.548	0.828
40	0.37	0.37	0.37	0.608	0.53	0.728	0.827	0.53	0.728	0.827
50	0.57	0.57	0.57	0.755	0.82	0.906	0.825	0.82	0.906	0.825
60	0.82	0.82	0.82	0.906	1.20	1.095	0.818	1.20	1.095	0.818
70	1.12	1.10	1.10	1.049	1.60	1.265	0.821	1.60	1.265	0.821
80	1.46	1.45	1.45	1.204	2.10	1.449	0.823	2.10	1.449	0.823
90	1.85	1.85	1.85	1.360	2.65	1.628	0.827	2.65	1.628	0.827
50	0.57	0.57	0.57	0.755	0.82	0.906	0.825	0.82	0.906	0.825
50	0.57	0.57	0.57	0.755	0.82	0.906	0.825	0.82	0.906	0.825
Average							0.824			0.824

Summary of Results:

Normal high side calibration factor: 0.824
variation +: 0.49%
variation -: -0.73%
Normal low side calibration factor: 0.824
variation +: 0.49%
variation -: -0.73%

Certification:

I certify that the Type S pitot tube, the standard type pitot tube, and the calibration setup meet or exceed all specifications, criteria and/or applicable design features and hereby assign a pitot tube calibration factor C_p of: 0.824

Certified by:

Patrick Selakovich 11/21/06

Calibrator (Signature/Date)

Bill Hefley 11/21/06

QA Officer (Signature/Date)

**CALIBRATION DATA
PITOT TUBE CALIBRATION DATA**

Date: 10/20/06
I.D. # ASAI 3-3
C_{pstd}: 0.990

Time: 14:50
T_s: 76 °F
Pb: 29.52 " Hg

fps Mark	Desired Calibration Standard	Calibration Standard		√ Standard Average	High	√ High	Cal. Factor	Low	√ Low	Cal. Factor
		Start	End							
20	0.09	0.09	0.09	0.300	0.13	0.361	0.824	0.13	0.361	0.824
30	0.20	0.20	0.20	0.447	0.29	0.539	0.822	0.29	0.539	0.822
40	0.36	0.36	0.36	0.600	0.52	0.721	0.824	0.52	0.721	0.824
50	0.56	0.56	0.56	0.748	0.81	0.900	0.823	0.81	0.900	0.823
60	0.80	0.80	0.80	0.894	1.15	1.072	0.826	1.15	1.072	0.826
70	1.09	1.10	1.10	1.049	1.60	1.265	0.821	1.60	1.265	0.821
80	1.42	1.40	1.40	1.183	2.05	1.432	0.818	2.05	1.432	0.818
90	1.80	1.80	1.80	1.342	2.60	1.612	0.824	2.60	1.612	0.824
50	0.56	0.56	0.56	0.748	0.84	0.917	0.808	0.84	0.917	0.808
50	0.56	0.56	0.56	0.748	0.84	0.917	0.808	0.84	0.917	0.808
Average							0.823			0.823

Summary of Results:

Normal high side calibration factor: 0.823
variation +: 0.36%
variation -: -0.61%
Normal low side calibration factor: 0.823
variation +: 0.36%
variation -: -0.61%

Certification:

I certify that the Type S pitot tube, the standard type pitot tube, and the calibration setup meet or exceed all specifications, criteria and/or applicable design features and hereby assign a pitot tube calibration factor C_p of: 0.823

Certified by:

Patrick Selakovich 10/20/06
Calibrator (Signature/Date)

Bill Hefley 10/20/06
QA Officer (Signature/Date)

**CALIBRATION DATA
PITOT TUBE CALIBRATION DATA**

Date: 10/20/06
I.D. # ASAI 3-4
C_{pstd}: 0.990

Time: 15:15
T_s: 76 °F
Pb: 29.52 " Hg

fps Mark	Desired Calibration Standard	Calibration Standard		√ Standard Average	High	√ High	Cal. Factor	Low	√ Low	Cal. Factor
20	0.09	0.09	0.09	0.300	0.13	0.361	0.824	0.13	0.361	0.824
30	0.20	0.20	0.20	0.447	0.29	0.539	0.822	0.29	0.539	0.822
40	0.36	0.36	0.36	0.600	0.52	0.721	0.824	0.52	0.721	0.824
50	0.56	0.56	0.56	0.748	0.82	0.906	0.818	0.82	0.906	0.818
60	0.80	0.80	0.80	0.894	1.15	1.072	0.826	1.15	1.072	0.826
70	1.09	1.10	1.10	1.049	1.60	1.265	0.821	1.60	1.265	0.821
80	1.42	1.45	1.45	1.204	2.10	1.449	0.823	2.10	1.449	0.823
90	1.80	1.80	1.80	1.342	2.60	1.612	0.824	2.60	1.612	0.824
50	0.56	0.56	0.56	0.748	0.82	0.906	0.818	0.82	0.906	0.818
50	0.56	0.56	0.56	0.748	0.82	0.906	0.818	0.82	0.906	0.818
Average							0.823			0.823

Summary of Results:

Normal high side calibration factor: 0.823
variation +: 0.36%
variation -: -0.61%
Normal low side calibration factor: 0.823
variation +: 0.36%
variation -: -0.61%

Certification:

I certify that the Type S pitot tube, the standard type pitot tube, and the calibration setup meet or exceed all specifications, criteria and/or applicable design features and hereby assign a pitot tube calibration factor C_p of: 0.823

Certified by:

Patrick Selakovich 10/20/06
Calibrator (Signature/Date)

Bill Hefley 10/20/06
QA Officer (Signature/Date)

**CALIBRATION DATA
PITOT TUBE CALIBRATION DATA**

Date: 01/24/06
I.D. # ASAI 4-1
C_{pstd}: 0.990

Time: 13:55
T_s: 68 °F
Pb: 29.92 " Hg

fps Mark	Desired Calibration Standard	Calibration Standard		√ Standard Average	High	√ High	Cal. Factor	Low	√ Low	Cal. Factor
20	0.09	0.09	0.09	0.300	0.13	0.361	0.824	0.13	0.361	0.824
30	0.21	0.21	0.21	0.458	0.30	0.548	0.828	0.30	0.548	0.828
40	0.37	0.37	0.37	0.608	0.53	0.728	0.827	0.53	0.728	0.827
50	0.57	0.57	0.57	0.755	0.82	0.906	0.825	0.82	0.906	0.825
60	0.82	0.82	0.82	0.906	1.20	1.095	0.818	1.20	1.095	0.818
70	1.12	1.10	1.10	1.049	1.60	1.265	0.821	1.60	1.265	0.821
80	1.46	1.45	1.45	1.204	2.10	1.449	0.823	2.10	1.449	0.823
90	1.85	1.85	1.85	1.360	2.65	1.628	0.827	2.65	1.628	0.827
50	0.57	0.57	0.57	0.755	0.82	0.906	0.825	0.82	0.906	0.825
50	0.57	0.57	0.57	0.755	0.82	0.906	0.825	0.82	0.906	0.825
Average							0.824			0.824

Summary of Results:

Normal high side calibration factor: 0.824
variation +: 0.49%
variation -: -0.73%
Normal low side calibration factor: 0.824
variation +: 0.49%
variation -: -0.73%

Certification:

I certify that the Type S pitot tube, the standard type pitot tube, and the calibration setup meet or exceed all specifications, criteria and/or applicable design features and hereby assign a pitot tube calibration factor C_p of: 0.824

Certified by:

Patrick Selakovich 01/24/06
Calibrator (Signature/Date)

Bill Hefley 01/24/06
QA Officer (Signature/Date)

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI - 4
Date Calibration Performed: 01/25/06

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1	<u>0.119</u>	<u>0.171</u>	<u>0.232</u>	<u>0.319</u>	<u>0.365</u>	<u>0.399</u>	<u>0.496</u>	<u>0.238</u>
Measurement 2	<u>0.119</u>	<u>0.172</u>	<u>0.233</u>	<u>0.318</u>	<u>0.366</u>	<u>0.399</u>	<u>0.496</u>	<u>0.237</u>
Measurement 3	<u>0.119</u>	<u>0.171</u>	<u>0.234</u>	<u>0.318</u>	<u>0.365</u>	<u>0.399</u>	<u>0.496</u>	<u>0.238</u>
Measurement 4	<u>0.120</u>	<u>0.171</u>	<u>0.233</u>	<u>0.318</u>	<u>0.366</u>	<u>0.398</u>	<u>0.494</u>	<u>0.239</u>
Measurement 5	<u>0.121</u>	<u>0.171</u>	<u>0.233</u>	<u>0.319</u>	<u>0.365</u>	<u>0.399</u>	<u>0.494</u>	<u>0.239</u>
Measurement 6	<u>0.119</u>	<u>0.171</u>	<u>0.235</u>	<u>0.318</u>	<u>0.365</u>	<u>0.399</u>	<u>0.495</u>	<u>0.238</u>
Measurement 7	<u>0.120</u>	<u>0.171</u>	<u>0.233</u>	<u>0.317</u>	<u>0.366</u>	<u>0.399</u>	<u>0.494</u>	<u>0.238</u>
Measurement 8	<u>0.119</u>	<u>0.171</u>	<u>0.233</u>	<u>0.317</u>	<u>0.366</u>	<u>0.399</u>	<u>0.495</u>	<u>0.237</u>
Measurement 9	<u>0.119</u>	<u>0.172</u>	<u>0.233</u>	<u>0.317</u>	<u>0.366</u>	<u>0.398</u>	<u>0.495</u>	<u>0.238</u>
Measurement 10	<u>0.119</u>	<u>0.171</u>	<u>0.235</u>	<u>0.318</u>	<u>0.366</u>	<u>0.400</u>	<u>0.494</u>	<u>0.238</u>
Average	0.119	0.171	0.233	0.318	0.366	0.399	0.495	0.238

Gary B. Goldman 1/25/06

Calibrator (Signature / Date)

Bill Hefley 1/25/06

QA Officer (Signature / Date)

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI - 5
Date Calibration Performed: 11/28/06

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1	<u> </u>	<u>0.195</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 2	<u> </u>	<u>0.194</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 3	<u> </u>	<u>0.192</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 4	<u> </u>	<u>0.192</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 5	<u> </u>	<u>0.193</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 6	<u> </u>	<u>0.194</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 7	<u> </u>	<u>0.193</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 8	<u> </u>	<u>0.194</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 9	<u> </u>	<u>0.193</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 10	<u> </u>	<u>0.194</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Average		0.193						

Bill Mallins 11/28/06

Calibrator (Signature / Date)

Bill Hefley 11/28/06

QA Officer (Signature / Date)

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI - 5
Date Calibration Performed: 01/25/06

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1		<u>0.193</u>	<u>0.255</u>	<u>0.309</u>		<u>0.437</u>	<u>0.488</u>	<u>0.155</u>
Measurement 2		<u>0.192</u>	<u>0.254</u>	<u>0.309</u>		<u>0.437</u>	<u>0.488</u>	<u>0.154</u>
Measurement 3		<u>0.192</u>	<u>0.256</u>	<u>0.310</u>		<u>0.439</u>	<u>0.488</u>	<u>0.153</u>
Measurement 4		<u>0.191</u>	<u>0.254</u>	<u>0.309</u>		<u>0.437</u>	<u>0.490</u>	<u>0.154</u>
Measurement 5		<u>0.193</u>	<u>0.255</u>	<u>0.311</u>		<u>0.437</u>	<u>0.490</u>	<u>0.154</u>
Measurement 6		<u>0.194</u>	<u>0.255</u>	<u>0.312</u>		<u>0.437</u>	<u>0.490</u>	<u>0.153</u>
Measurement 7		<u>0.192</u>	<u>0.254</u>	<u>0.312</u>		<u>0.437</u>	<u>0.489</u>	<u>0.153</u>
Measurement 8		<u>0.193</u>	<u>0.256</u>	<u>0.309</u>		<u>0.438</u>	<u>0.489</u>	<u>0.155</u>
Measurement 9		<u>0.193</u>	<u>0.256</u>	<u>0.310</u>		<u>0.438</u>	<u>0.491</u>	<u>0.154</u>
Measurement 10		<u>0.193</u>	<u>0.253</u>	<u>0.309</u>		<u>0.438</u>	<u>0.489</u>	<u>0.154</u>
Average		0.193	0.255	0.310		0.438	0.489	0.154

Gary B. Goldman 1/25/06

Calibrator (Signature / Date)

Bill Hefley 1/25/06

QA Officer (Signature / Date)

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI - 7
Date Calibration Performed: 10/27/06

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1	_____	<u>0.191</u>	_____	_____	_____	_____	_____	_____
Measurement 2	_____	<u>0.190</u>	_____	_____	_____	_____	_____	_____
Measurement 3	_____	<u>0.192</u>	_____	_____	_____	_____	_____	_____
Measurement 4	_____	<u>0.193</u>	_____	_____	_____	_____	_____	_____
Measurement 5	_____	<u>0.191</u>	_____	_____	_____	_____	_____	_____
Measurement 6	_____	<u>0.193</u>	_____	_____	_____	_____	_____	_____
Measurement 7	_____	<u>0.193</u>	_____	_____	_____	_____	_____	_____
Measurement 8	_____	<u>0.192</u>	_____	_____	_____	_____	_____	_____
Measurement 9	_____	<u>0.192</u>	_____	_____	_____	_____	_____	_____
Measurement 10	=====	<u>0.192</u>	=====	=====	=====	=====	=====	=====
Average		0.192						

Patrick Selakovich 10/27/06

Calibrator (Signature / Date)

Bill Hefley 10/27/06

QA Officer (Signature / Date)

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI - 7
Date Calibration Performed: 09/19/06

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1	<u>0.114</u>	<u>0.192</u>	<u>0.255</u>	<u>0.308</u>	<u>0.375</u>	<u>0.426</u>	<u> </u>	<u>0.154</u>
Measurement 2	<u>0.115</u>	<u>0.193</u>	<u>0.253</u>	<u>0.307</u>	<u>0.378</u>	<u>0.424</u>	<u> </u>	<u>0.155</u>
Measurement 3	<u>0.114</u>	<u>0.192</u>	<u>0.254</u>	<u>0.308</u>	<u>0.375</u>	<u>0.425</u>	<u> </u>	<u>0.155</u>
Measurement 4	<u>0.113</u>	<u>0.194</u>	<u>0.252</u>	<u>0.306</u>	<u>0.375</u>	<u>0.424</u>	<u> </u>	<u>0.155</u>
Measurement 5	<u>0.115</u>	<u>0.193</u>	<u>0.254</u>	<u>0.308</u>	<u>0.377</u>	<u>0.426</u>	<u> </u>	<u>0.153</u>
Measurement 6	<u>0.113</u>	<u>0.192</u>	<u>0.254</u>	<u>0.310</u>	<u>0.376</u>	<u>0.427</u>	<u> </u>	<u>0.153</u>
Measurement 7	<u>0.113</u>	<u>0.193</u>	<u>0.253</u>	<u>0.307</u>	<u>0.375</u>	<u>0.424</u>	<u> </u>	<u>0.152</u>
Measurement 8	<u>0.115</u>	<u>0.192</u>	<u>0.254</u>	<u>0.308</u>	<u>0.377</u>	<u>0.426</u>	<u> </u>	<u>0.153</u>
Measurement 9	<u>0.114</u>	<u>0.193</u>	<u>0.254</u>	<u>0.309</u>	<u>0.376</u>	<u>0.426</u>	<u> </u>	<u>0.155</u>
Measurement 10	<u>0.112</u>	<u>0.192</u>	<u>0.252</u>	<u>0.307</u>	<u>0.377</u>	<u>0.426</u>	<u> </u>	<u>0.153</u>
Average	0.114	0.193	0.254	0.308	0.376	0.425		0.154

Gary B. Goldman 9/19/06

Calibrator (Signature / Date)

Bill Hefley 9/19/06

QA Officer (Signature / Date)

Post-test Calibration Data

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

- 1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
- 2) Record barometric pressure before and after calibration procedure.
- 3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
- 4) Record data and information in the GREEN cells, YELLOW cells are calculated.

ASAI 1-1 12-07-2006

DATE: 12/7/2006	METER SERIAL #: 1508	INITIAL 30.29	FINAL 30.30	AVG (P _{bar}) 30.30
METER PART #: C-5000-SQ	CRITICAL ORIFICE SET SERIAL #: 1426s	BAROMETRIC PRESSURE (in Hg):		

IF Y VARIATION EXCEEDS 2.00%,
ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT ³)				TEMPERATURES °F				ELAPSED TIME (MIN)	DGM ΔH (in H ₂ O)	(1) V _m (STD)	(2) V _{cr} (STD)	(3) Y	Y VARIATION (%)	ΔH _{cr}
				INITIAL	FINAL	NET (V _m)		AMBIENT	DGM INLET	DGM OUTLET	DGM AVG							
17	1	0.4656	18	458.217	463.731	5.514		65	66	66	63	9.00	1.20	5.6405	5.5421	0.983		1.82
	2	0.4656	18	463.731	469.250	5.519		65	66	66	63	9.00	1.20	5.6429	5.5421	0.982		1.82
	3	0.4656	18	469.253	474.765	5.512		65	66	66	64	9.00	1.20	5.6331	5.5421	0.984		1.82
														AVG =		0.983		
24	1	0.6583	15	475.802	480.980	5.178		65	66	67	65	6.00	2.40	5.2995	5.2239	0.986	-0.08	1.82
	2	0.6583	15	480.980	486.190	5.210		65	67	68	65	6.00	2.40	5.3247	5.2239	0.981		1.82
	3	0.6583	15	486.190	491.377	5.187		65	68	69	65	6.00	2.40	5.2961	5.2239	0.986		1.82
														AVG =		0.984	0.08	
														AVG =				

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:

The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

$$(1) Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions
K₁ = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)

$$(2) Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$

= Volume of gas sample passed through the critical orifice, corrected to standard conditions
T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)

$$(3) Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$

K' = Average K' factor from Critical Orifice Calibration
= DGM calibration factor

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = **0.984**

AVERAGE ΔH_{cr} = **1.82**

$$\Delta H_{cr} = \left(\frac{0.75 \theta}{V_{cr}(std)} \right)^2 \Delta H \left(\frac{V_m(std)}{V_m} \right)$$

Calibration Data

Digital Temperature Indicator Calibration

DTI Unit No. ASAI 1-1

Date Calibration Performed: 12/07/06

<u>Reference Point</u>	<u>Time</u>	ASTM Reference Thermometer (°F)	DTI (°F)
Ice Bath	11:22	32° F	32° F
Ambient Air	11:23	68° F	67° F
Boiling Water	11:24	212° F	215° F
Oven	11:25	250° F	254° F
Oven	11:26	300° F	305° F
Oven	11:27	350° F	355° F
Oven	11:28	400° F	405° F

Meter Adjusted? No

NIST Reference Calibrator: SN: 06000047 Range: -0.2°C to 1,360.6°
 _____ Range: _____
 _____ Range: _____

Certified by: Patrick Selakovich 12/07/06
Calibrator (Signature / Date)

Bill Hefley 12/07/06
QA Officer (Signature / Date)

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

ASAI 2-2 12/07/06

- 1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
- 2) Record barometric pressure before and after calibration procedure.
- 3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
- 4) Record data and information in the GREEN cells, YELLOW cells are calculated.

DATE: 12/07/2006		METER SERIAL #: 1509		BAROMETRIC PRESSURE (in Hg):		INITIAL 30.28		FINAL 30.3		AVG (P _{bar}) 30.29		IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED	
METER PART #: C-5000-SO		CRITICAL ORIFICE SET SERIAL #: 1427s		TEMPERATURES °F		DGM READINGS (FT³)		DGM ΔH (in H ₂ O)		V _m (STD)		Y VARIATION (%)	
ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	AMBIENT	DGM INLET	DGM OUTLET	DGM AVG	ELAPSED TIME (MIN)	DGM ΔH (in H ₂ O)	(1) V _m (STD)	(2) V _{cr} (STD)	(3) Y	ΔH _{cr}
15	1	0.4202	18	64	68	67	67.5	10.00	0.9	5.6099	5.5618	0.991	1.66
	2	0.4202	18	64	68	67	67.75	10.00	0.92	5.6014	5.5618	0.993	1.70
	3	0.4202	18	65	69	67	68.25	10.00	0.9	5.6131	5.5565	0.990	1.66
12	1	0.3194	19	64	67	66	66.5	12.00	0.52	5.1385	5.0732	0.987	1.66
	2	0.3194	19	64	67	66	67	12.00	0.52	5.1499	5.0732	0.985	1.66
	3	0.3194	19	64	68	67	67.5	12.00	0.52	5.1420	5.0732	0.987	1.66
										AVG =		0.989	
										AVG =		0.986	
										AVG =		-0.26	

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:

The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

$$(1) V_{m(std)} = K_1 * V_m * \frac{P_{bar} + (\Delta H / 13.6)}{T_m}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions
K₁ = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)
T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

$$(2) V_{cr(std)} = K' * \frac{P_{bar} * \Theta}{\sqrt{T_{amb}}}$$

= Volume of gas sample passed through the critical orifice, corrected to standard conditions
T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)
K' = Average K' factor from Critical Orifice Calibration

$$(3) Y = \frac{V_{cr(std)}}{V_{m(std)}}$$

= DGM calibration factor

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 0.989

AVERAGE ΔH_{cr} = 1.67

$$\Delta H_{cr} = \left(\frac{0.75 \Theta}{V_{cr(std)}} \right)^2 \Delta H \left(\frac{V_m(std)}{V_m} \right)$$

Calibration Data

Digital Temperature Indicator Calibration

DTI Unit No. ASAI 2-2

Date Calibration Performed: 12/07/06

<u>Reference Point</u>	<u>Time</u>	ASTM Reference Thermometer (°F)	DTI (°F)
Ice Bath	11:49	32° F	31° F
Ambient Air	11:48	68° F	67° F
Boiling Water	11:47	212° F	214° F
Oven	11:46	250° F	253° F
Oven	11:45	300° F	303° F
Oven	11:44	350° F	353° F
Oven	11:43	400° F	404° F

Meter Adjusted? No

ASTM Reference Thermometer: SN: 06000047

Range: -0.1°C to 1,360.6°C

Range: _____

Range: _____

Certified by: Patrick Selakovich 12/07/06

Calibrator (Signature / Date)

Bill Hefley 12/07/06

QA Officer (Signature / Date)

CALIBRATION DATA

PITOT TUBE CALIBRATION DATA

Date: 12/07/06
I.D. # ASAI 3-1
C_{pstd}: 0.990

Time: 15:15
T_s: 64 °F
Pb: 30.29 " Hg

fps Mark	Desired Calibration Standard	Calibration Standard		v Standard Average	High	v High	Cal. Factor	Low	v Low	Cal. Factor
		Start	End							
20	0.09	0.09	0.09	0.300	0.13	0.361	0.824	0.13	0.361	0.824
30	0.21	0.21	0.21	0.458	0.30	0.548	0.828	0.30	0.548	0.828
40	0.37	0.37	0.37	0.608	0.54	0.735	0.819	0.54	0.735	0.819
50	0.58	0.58	0.58	0.762	0.84	0.917	0.823	0.84	0.917	0.823
60	0.84	0.84	0.84	0.917	1.20	1.095	0.828	1.20	1.095	0.828
70	1.14	1.15	1.15	1.072	1.65	1.285	0.826	1.65	1.285	0.826
80	1.49	1.50	1.50	1.225	2.15	1.466	0.827	2.15	1.466	0.827
90	1.89	1.90	1.90	1.378	2.75	1.658	0.823	2.75	1.658	0.823
50	0.58	0.58	0.58	0.762	0.84	0.917	0.823	0.84	0.917	0.823
50	0.58	0.58	0.58	0.762	0.84	0.917	0.823	0.84	0.917	0.823
Average							0.825			0.825

Summary of Results:

Normal high side calibration factor:	0.825
variation +:	0.36%
variation -:	-0.73%
Normal low side calibration factor:	0.825
variation +:	0.36%
variation -:	-0.73%

Certification:

I certify that the Type S pitot tube, the standard type pitot tube, and the calibration setup meet or exceed all specifications, criteria and/or applicable design features and hereby assign a pitot tube calibration factor C_p of: 0.825

Certified by:

Patrick Selakovich 12/07/06
Calibrator (Signature/Date)

Bill Hefley 12/07/06

QA Officer (Signature/Date)

**AIR
SAMPLING
ASSOCIATES, INC.**

CALIBRATION DATA

PITOT TUBE CALIBRATION DATA

Date: 12/07/06
I.D. # ASAI 3-2
C_{pstd}: 0.990

Time: 15:30
 T_s : 65 °F
Pb: 30.29 " Hg

fps Mark	Desired Calibration Standard	Calibration Standard		v Standard Average	High	v High	Cal. Factor	Low	v Low	Cal. Factor
		Start	End							
20	0.09	0.09	0.09	0.300	0.13	0.361	0.824	0.13	0.361	0.824
30	0.21	0.21	0.21	0.458	0.30	0.548	0.828	0.30	0.548	0.828
40	0.37	0.37	0.37	0.608	0.53	0.728	0.827	0.53	0.728	0.827
50	0.58	0.58	0.58	0.762	0.83	0.911	0.828	0.83	0.911	0.828
60	0.84	0.84	0.84	0.917	1.20	1.095	0.828	1.20	1.095	0.828
70	1.14	1.15	1.15	1.072	1.65	1.285	0.826	1.65	1.285	0.826
80	1.49	1.50	1.50	1.225	2.15	1.466	0.827	2.15	1.466	0.827
90	1.89	1.90	1.90	1.378	2.75	1.658	0.823	2.75	1.658	0.823
50	0.58	0.58	0.58	0.762	0.83	0.911	0.828	0.83	0.911	0.828
50	0.58	0.58	0.58	0.762	0.83	0.911	0.828	0.83	0.911	0.828
Average							0.826			0.826

Summary of Results:

Normal high side calibration factor:	0.826
variation +:	0.24%
variation -:	-0.36%
Normal low side calibration factor:	0.826
variation +:	0.24%
variation -:	-0.36%

Certification:

I certify that the Type S pitot tube, the standard type pitot tube, and the calibration setup meet or exceed all specifications, criteria and/or applicable design features and hereby assign a pitot tube calibration factor C_p of: 0.826

Certified by:

Patrick Selakovich 12/07/06

Calibrator (Signature/Date)

Bill Hefley 12/07/06

QA Officer (Signature/Date)

CALIBRATION DATA

PITOT TUBE CALIBRATION DATA

Date:	12/07/06
I.D. #	ASAI 3-3
C _{pstd} :	0.990

Time: 15:45
 T_s : 64 °F
Pb: 30.29 " Hg

fps Mark	Desired Calibration Standard	Calibration Standard		v Standard Average	High	v High	Cal. Factor	Low	v Low	Cal. Factor
		Start	End							
20	0.09	0.09	0.09	0.300	0.13	0.361	0.824	0.13	0.361	0.824
30	0.21	0.21	0.21	0.458	0.30	0.548	0.828	0.30	0.548	0.828
40	0.37	0.37	0.37	0.608	0.53	0.728	0.827	0.53	0.728	0.827
50	0.58	0.58	0.58	0.762	0.84	0.917	0.823	0.84	0.917	0.823
60	0.84	0.84	0.84	0.917	1.20	1.095	0.828	1.20	1.095	0.828
70	1.14	1.15	1.15	1.072	1.65	1.285	0.826	1.65	1.285	0.826
80	1.49	1.50	1.50	1.225	2.15	1.466	0.827	2.15	1.466	0.827
90	1.89	1.90	1.90	1.378	2.75	1.658	0.823	2.75	1.658	0.823
50	0.58	0.58	0.58	0.762	0.84	0.917	0.823	0.84	0.917	0.823
50	0.58	0.58	0.58	0.762	0.84	0.917	0.823	0.84	0.917	0.823
Average							0.826			0.826

Summary of Results:

Normal high side calibration factor:	0.826
variation +:	0.24%
variation -:	-0.36%
Normal low side calibration factor:	0.826
variation +:	0.24%
variation -:	-0.36%

Certification:

I certify that the Type S pitot tube, the standard type pitot tube, and the calibration setup meet or exceed all specifications, criteria and/or applicable design features and hereby assign a pitot tube calibration factor C_p of: 0.826

Certified by:

Patrick Selakovich 12/07/06
Calibrator (Signature/Date)

Bill Hefley 12/07/06
QA Officer (Signature/Date)

**CALIBRATION DATA
PITOT TUBE CALIBRATION DATA**

Date: 12/07/06
I.D. # ASAI 3-4
C_{pstd}: 0.990

Time: 16:00
T_s: 65 °F
Pb: 30.30 " Hg

fps Mark	Desired Calibration Standard	Calibration Standard		v Standard Average	High	v High	Cal. Factor	Low	v Low	Cal. Factor
20	0.09	0.09	0.09	0.300	0.13	0.361	0.824	0.13	0.361	0.824
30	0.21	0.21	0.21	0.458	0.30	0.548	0.828	0.30	0.548	0.828
40	0.37	0.37	0.37	0.608	0.53	0.728	0.827	0.53	0.728	0.827
50	0.58	0.58	0.58	0.762	0.84	0.917	0.823	0.83	0.911	0.828
60	0.84	0.84	0.84	0.917	1.20	1.095	0.828	1.20	1.095	0.828
70	1.14	1.15	1.15	1.072	1.65	1.285	0.826	1.65	1.285	0.826
80	1.49	1.50	1.50	1.225	2.15	1.466	0.827	2.15	1.466	0.827
90	1.89	1.90	1.90	1.378	2.75	1.658	0.823	2.75	1.658	0.823
50	0.58	0.58	0.58	0.762	0.84	0.917	0.823	0.83	0.911	0.828
50	0.58	0.58	0.58	0.762	0.84	0.917	0.823	0.83	0.911	0.828
Average							0.826			0.826

Summary of Results:

Normal high side calibration factor: 0.826
variation +: 0.24%
variation -: -0.36%
Normal low side calibration factor: 0.826
variation +: 0.24%
variation -: -0.36%

Certification:

I certify that the Type S pitot tube, the standard type pitot tube, and the calibration setup meet or exceed all specifications, criteria and/or applicable design features and hereby assign a pitot tube calibration factor C_p of: 0.826

Certified by:

Patrick Selakovich 12/07/06
Calibrator (Signature/Date)

Bill Hefley 12/07/06
QA Officer (Signature/Date)

CALIBRATION DATA

PITOT TUBE CALIBRATION DATA

Date: 12/07/06
I.D. # ASAI 4-1
C_{pstd}: 0.990

Time: 14:50
 T_s : 66 °F
 Pb: 30.28 " Hg

fps Mark	Desired Calibration Standard	Calibration Standard		v Standard Average	High	v High	Cal. Factor	Low	v Low	Cal. Factor
		Start	End							
20	0.09	0.09	0.09	0.300	0.13	0.361	0.824	0.13	0.361	0.824
30	0.21	0.21	0.21	0.458	0.30	0.548	0.828	0.30	0.548	0.828
40	0.37	0.37	0.37	0.608	0.53	0.728	0.827	0.53	0.728	0.827
50	0.58	0.58	0.58	0.762	0.83	0.911	0.828	0.83	0.911	0.828
60	0.84	0.84	0.84	0.917	1.20	1.095	0.828	1.20	1.095	0.828
70	1.14	1.15	1.15	1.072	1.65	1.285	0.826	1.65	1.285	0.826
80	1.49	1.50	1.50	1.225	2.15	1.466	0.827	2.15	1.466	0.827
90	1.88	1.90	1.90	1.378	2.70	1.643	0.830	2.70	1.643	0.830
50	0.58	0.58	0.58	0.762	0.83	0.911	0.828	0.83	0.911	0.828
50	0.58	0.58	0.58	0.762	0.83	0.911	0.828	0.83	0.911	0.828
Average							0.827			0.827

Summary of Results:

Normal high side calibration factor:	0.827
variation +:	0.36%
variation -:	-0.36%
Normal low side calibration factor:	0.827
variation +:	0.36%
variation -:	-0.36%

Certification:

I certify that the Type S pitot tube, the standard type pitot tube, and the calibration setup meet or exceed all specifications, criteria and/or applicable design features and hereby assign a pitot tube calibration factor C_p of: 0.827

Certified by:

Patrick Selakovich 12/07/06
Calibrator (Signature/Date)

Bill Hefley 12/07/06
QA Officer (Signature/Date)

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI - 4
Date Calibration Performed: 12/07/06

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1	<u>0.119</u>	<u>0.171</u>	<u>0.232</u>	<u>0.319</u>	<u>0.365</u>	<u>0.399</u>	<u>0.496</u>	<u>0.238</u>
Measurement 2	<u>0.119</u>	<u>0.172</u>	<u>0.233</u>	<u>0.318</u>	<u>0.366</u>	<u>0.399</u>	<u>0.496</u>	<u>0.237</u>
Measurement 3	<u>0.119</u>	<u>0.171</u>	<u>0.234</u>	<u>0.318</u>	<u>0.365</u>	<u>0.399</u>	<u>0.496</u>	<u>0.238</u>
Measurement 4	<u>0.120</u>	<u>0.171</u>	<u>0.233</u>	<u>0.318</u>	<u>0.366</u>	<u>0.398</u>	<u>0.494</u>	<u>0.239</u>
Measurement 5	<u>0.121</u>	<u>0.172</u>	<u>0.233</u>	<u>0.319</u>	<u>0.365</u>	<u>0.399</u>	<u>0.494</u>	<u>0.239</u>
Measurement 6	<u>0.119</u>	<u>0.171</u>	<u>0.235</u>	<u>0.318</u>	<u>0.365</u>	<u>0.399</u>	<u>0.495</u>	<u>0.238</u>
Measurement 7	<u>0.120</u>	<u>0.171</u>	<u>0.233</u>	<u>0.317</u>	<u>0.366</u>	<u>0.399</u>	<u>0.494</u>	<u>0.238</u>
Measurement 8	<u>0.119</u>	<u>0.172</u>	<u>0.233</u>	<u>0.317</u>	<u>0.366</u>	<u>0.399</u>	<u>0.495</u>	<u>0.237</u>
Measurement 9	<u>0.119</u>	<u>0.172</u>	<u>0.233</u>	<u>0.317</u>	<u>0.366</u>	<u>0.398</u>	<u>0.495</u>	<u>0.238</u>
Measurement 10	<u>0.119</u>	<u>0.171</u>	<u>0.235</u>	<u>0.318</u>	<u>0.366</u>	<u>0.400</u>	<u>0.494</u>	<u>0.238</u>
Average	0.119	0.171	0.233	0.318	0.366	0.399	0.495	0.238

Patrick Selakovich 12/07/06

Calibrator (Signature / Date)

Bill Hefley 12/07/06

QA Officer (Signature / Date)

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI - 5
Date Calibration Performed: 12/07/06

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1	<u> </u>	<u>0.192</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 2	<u> </u>	<u>0.193</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 3	<u> </u>	<u>0.194</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 4	<u> </u>	<u>0.192</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 5	<u> </u>	<u>0.192</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 6	<u> </u>	<u>0.193</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 7	<u> </u>	<u>0.193</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 8	<u> </u>	<u>0.194</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 9	<u> </u>	<u>0.192</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 10	<u> </u>	<u>0.193</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Average		0.193						

Patrick Selakovich 12/07/06

Calibrator (Signature / Date)

Bill Hefley 12/07/06

QA Officer (Signature / Date)

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI - 5
Date Calibration Performed: 12/07/06

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1	<u> </u>	<u>0.193</u>	<u>0.255</u>	<u>0.309</u>	<u> </u>	<u>0.437</u>	<u>0.488</u>	<u>0.153</u>
Measurement 2	<u> </u>	<u>0.192</u>	<u>0.254</u>	<u>0.309</u>	<u> </u>	<u>0.437</u>	<u>0.488</u>	<u>0.155</u>
Measurement 3	<u> </u>	<u>0.192</u>	<u>0.256</u>	<u>0.310</u>	<u> </u>	<u>0.439</u>	<u>0.488</u>	<u>0.153</u>
Measurement 4	<u> </u>	<u>0.191</u>	<u>0.254</u>	<u>0.309</u>	<u> </u>	<u>0.437</u>	<u>0.490</u>	<u>0.155</u>
Measurement 5	<u> </u>	<u>0.193</u>	<u>0.255</u>	<u>0.311</u>	<u> </u>	<u>0.437</u>	<u>0.490</u>	<u>0.154</u>
Measurement 6	<u> </u>	<u>0.194</u>	<u>0.255</u>	<u>0.312</u>	<u> </u>	<u>0.437</u>	<u>0.490</u>	<u>0.156</u>
Measurement 7	<u> </u>	<u>0.192</u>	<u>0.254</u>	<u>0.312</u>	<u> </u>	<u>0.437</u>	<u>0.489</u>	<u>0.153</u>
Measurement 8	<u> </u>	<u>0.193</u>	<u>0.256</u>	<u>0.309</u>	<u> </u>	<u>0.438</u>	<u>0.489</u>	<u>0.154</u>
Measurement 9	<u> </u>	<u>0.193</u>	<u>0.256</u>	<u>0.310</u>	<u> </u>	<u>0.438</u>	<u>0.491</u>	<u>0.154</u>
Measurement 10	<u> </u>	<u>0.193</u>	<u>0.253</u>	<u>0.309</u>	<u> </u>	<u>0.438</u>	<u>0.489</u>	<u>0.154</u>
Average		0.193	0.255	0.310		0.438	0.489	0.154

Patrick Selakovich 12/07/06

Calibrator (Signature / Date)

Bill Hefley 12/07/06

QA Officer (Signature / Date)

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI - 7
Date Calibration Performed: 12/07/06

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1	<u> </u>	<u>0.192</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 2	<u> </u>	<u>0.190</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 3	<u> </u>	<u>0.192</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 4	<u> </u>	<u>0.190</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 5	<u> </u>	<u>0.191</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 6	<u> </u>	<u>0.191</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 7	<u> </u>	<u>0.193</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 8	<u> </u>	<u>0.192</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 9	<u> </u>	<u>0.192</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Measurement 10	<u> </u>	<u>0.192</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Average		0.192						

Patrick Selakovich 12/07/06

Calibrator (Signature / Date)

Bill Hefley 12/07/06

QA Officer (Signature / Date)

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI - 7
Date Calibration Performed: 12/07/06

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1	<u>0.114</u>	<u>0.192</u>	<u>0.255</u>	<u>0.308</u>	<u>0.375</u>	<u>0.426</u>	<u> </u>	<u>0.154</u>
Measurement 2	<u>0.115</u>	<u>0.193</u>	<u>0.253</u>	<u>0.307</u>	<u>0.378</u>	<u>0.424</u>	<u> </u>	<u>0.155</u>
Measurement 3	<u>0.114</u>	<u>0.192</u>	<u>0.254</u>	<u>0.308</u>	<u>0.375</u>	<u>0.425</u>	<u> </u>	<u>0.156</u>
Measurement 4	<u>0.113</u>	<u>0.194</u>	<u>0.252</u>	<u>0.306</u>	<u>0.375</u>	<u>0.424</u>	<u> </u>	<u>0.155</u>
Measurement 5	<u>0.115</u>	<u>0.193</u>	<u>0.254</u>	<u>0.308</u>	<u>0.377</u>	<u>0.426</u>	<u> </u>	<u>0.153</u>
Measurement 6	<u>0.113</u>	<u>0.192</u>	<u>0.254</u>	<u>0.310</u>	<u>0.376</u>	<u>0.427</u>	<u> </u>	<u>0.153</u>
Measurement 7	<u>0.113</u>	<u>0.193</u>	<u>0.253</u>	<u>0.307</u>	<u>0.375</u>	<u>0.424</u>	<u> </u>	<u>0.155</u>
Measurement 8	<u>0.115</u>	<u>0.192</u>	<u>0.254</u>	<u>0.308</u>	<u>0.377</u>	<u>0.426</u>	<u> </u>	<u>0.155</u>
Measurement 9	<u>0.114</u>	<u>0.193</u>	<u>0.254</u>	<u>0.309</u>	<u>0.376</u>	<u>0.426</u>	<u> </u>	<u>0.154</u>
Measurement 10	<u>0.112</u>	<u>0.192</u>	<u>0.252</u>	<u>0.307</u>	<u>0.377</u>	<u>0.426</u>	<u> </u>	<u>0.153</u>
Average	0.114	0.193	0.254	0.308	0.376	0.425		0.154

Patrick Selakovich 12/07/06

Calibrator (Signature / Date)

Bill Hefley 12/07/06

QA Officer (Signature / Date)

Appendix D:
Field Data

Job Number
Job Name
Run Number
Unit
Date
Operator
Sample Box No.

06-057
ADA-65 (HARDIN, MT)
1
SDA INLET
11/30/06
SEAKOVICH/JACKSON
2-2

Meter Box No. 2-2

Read and record at the start of each test point.

Purge to:
Purge time:
Pilot Leak Check Initial Final

17/26A / CTM027
Field Data 3

Ambient Temp. °F 44
Assumed Moisture % 12
Probe Length 6'
C Factor 5.37 to reference
Initial Leak @ 15.0 "Hg = 0.001 cfm
Final Leak @ 5.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pilot" H ₂ O	Orifice ΔH H ₂ O Desirad	Orifice ΔH H ₂ O Actual	Pump Vacuum "Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
A-4	1454	914.838	0.90	0.48	0.48	2.0	326	249	230	75	74	72	
3	1459	916.85	0.90	0.48	0.48	2.0	324	248	238	73	74	72	
2	1504	918.96	0.78	0.42	0.42	2.0	321	251	240	61	75	72	
1	1509	920.95	0.48	0.26	0.26	2.0	319	253	241	55	75	72	
END	1514	922.696	-	-	-	-	-	-	-	-	-	-	
B-4	1515	922.696	1.10	0.58	0.58	2.5	320	246	238	45	76	72	
3	1520	925.05	1.05	0.56	0.56	2.5	318	246	239	43	77	73	
2	1525	927.28	0.96	0.52	0.52	3.0	315	250	237	40	78	73	
1	1530	929.44	0.63	0.34	0.34	2.5	313	251	239	38	78	73	
END	1535	931.548	-	-	-	-	-	-	-	-	-	-	
C-4	1539	931.548	0.96	0.52	0.52	3.0	319	240	234	36	77	73	
3	1544	933.90	0.94	0.50	0.50	3.0	318	238	238	36	78	73	
2	1549	936.05	0.88	0.47	0.47	3.0	318	249	235	35	78	74	
1	1554	938.14	0.68	0.36	0.36	3.0	317	248	237	34	79	74	
END	1559	940.051	-	-	-	-	-	-	-	-	-	-	
All													

Pilot Tube Calibration Factor C_p 0.823

Volume Collected V_m 25.188 ft³

Water Collected V_w 57.8 ml

Time of Test T_1 60 min.

Stack Pressure P_s -14.7 "H₂O

Pilot Tube No. 3-4

Baro. Press. P_b 26.93 "Hg

Probe Tip Dia. D_n 0.193 in.

% CO₂ 14.3 % CO 0.0

% O₂ 5.2 % N₂ 80.5

Area Stack A_s 20,235 in²

Barometer No.

Total Volume of Leak Checks After Start: ft³

$V_m \times$ Dry Gas Meter Calibration Factor 25.213 x 0.999 ✓

Probe Tip No. 5-2

[Dry Gas Meter Reading ft³ - (T_1 min. $\times$ Leak Rate cfm)]

Impinger Box No. 2-2

Water Weight Gain

Impinger 1
Final Weight 783.5
Initial Weight 741.4
Increase 42.1

Impinger 2
Final Weight 742.4
Initial Weight 737.1
Increase 5.3

Impinger 3
Final Weight 727.2
Initial Weight 726.0
Increase 1.2

Impinger 4
Final Weight 718.9
Initial Weight 717.4
Increase 1.5

Impinger 5
Final Weight 932.9
Initial Weight 925.2
Increase 7.7

Impinger 6
Final Weight _____
Initial Weight _____
Increase _____

Impinger 7
Final Weight _____
Initial Weight _____
Increase _____

$V_w =$
g SO₂ = _____
 $V_w =$

Thimble No.
59

$P_b = 26.93$ ✓
 $V_m = 25.188$ ✓
 $V_w = 57.8$ ✓
 $P_m = 0.458$ ✓
Avg $\Delta P = 0.855$ ✓
Avg $\sqrt{\Delta P} = 0.919$ ✓
 $C_p = 0.823$ ✓
 $P_s = 75$ ✓
 $T_m = 75$ °F
 $T_s = 319$ °F

Impinger 1 42.1
Impinger 2 5.3
Impinger 3 1.2
Impinger 4 1.5
Impinger 5 7.7
Impinger 6 _____

Impinger 7 _____
Total 57.8 = V_w

%CO₂ = 14.3 ✓
%O₂ = 5.2 ✓
%CO = 0.0 ✓
%N₂ = 80.5 ✓
 $A_s = 24,235$ ✓
 $D_n = 0.193$ ✓
 $T_i = 60$ ✓

25.85 °Hg
535 °R
779 °R

Moisture Content:

%M = 10.85 ✓
 $M_d = 0.8915$ ✓
 $MW_c = 30.496$ ✓
MW = 29.14 ✓

$$V_{m_{std}} = 17.65 V_m \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 25.188 \left[\frac{26.93 + \frac{0.458}{13.6}}{75 + 460} \right] = \frac{22.406}{0.373} \frac{\text{sft}^3}{\text{scfm}}$$

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 57.8 = 2.728 \text{ sft}^3$$

$$\% \text{ Moisture} = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{2.728}{22.406 + 2.728} \times 100 = 10.85\%$$

$$V_s = 5123.8 \times 0.823 \sqrt{\frac{779}{25.85 \times 29.14}} \times 0.919 = 3941 \text{ fpm}$$

ACFM: 553,786 ✓

SCFM: 299,174 ✓

$$\%I = \frac{1.039 \times 22.406 \times 779}{0.8915 \times 25.85 \times 3941 \times 60 \times (0.193)^2} = 89.3\%$$

%EA: 32.2 ✓

Job Number
Job Name
Run Number
Unit
Date
Operator

06-057

ADA-ES (HARDIN, MT)

2

SDA Inlet Duct

12/1/06

SEARATON VICKI JACKSON

Sample Box No. 2-2

Meter Box No. 2-2

ΔP_s

Read and record at the start of each test point.

Purge to: —

Purge time: —

Pilot Leak Check Initial ☒ Final ☒

Field Data

Ambient Temp. °F 33

Assumed Moisture % 10

Probe Length 6

C Factor 6.4 to reference

Initial Leak @ 15.0 °Hg = 0.003 cfm

Final Leak @ 5.0 °Hg = 0.001 cfm

P_m

T_s

T_m

Point	Clock Time	Dry Gas Meter, CF	"Pilot" °H ₂ O	Orifice ΔH °H ₂ O Desired	Orifice ΔH °H ₂ O Actual	Pump Vacuum °Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
A-4	1203	21.638	0.91	0.58	0.58	1.5	317	248	232	33	69	70	
3	1208	23.83	0.89	0.57	0.57	1.5	316	234	233	35	69	70	
2	1213	26.09	0.81	0.52	0.52	2.0	316	240	243	38	71	70	
1	1218	28.27	0.74	0.28	0.28	1.5	310	251	247	38	72	70	
END	1223	29.884	—	—	—	—	—	—	—	—	—	—	
B-4	1224	29.884	1.15	0.75	0.75	2.5	317	248	239	39	73	70	
3	1229	32.77	1.10	0.71	0.71	3.0	317	247	247	41	74	70	
2	1234	35.29	1.10	0.71	0.71	3.5	318	251	245	42	76	70	
1	1239	37.56	0.57	0.36	0.36	3.0	316	252	247	43	76	70	
END	1244	39.706	—	—	—	—	—	—	—	—	—	—	
C-4	1245	39.706	0.92	0.59	0.59	2.5	315	251	240	42	76	71	
3	1250	41.97	0.95	0.62	0.62	3.0	313	247	246	42	77	71	
2	1255	44.33	0.90	0.58	0.58	3.0	316	240	248	41	77	71	
1	1300	46.62	0.68	0.44	0.44	3.0	317	249	247	41	78	71	
END	1305	48.640	—	—	—	—	—	—	—	—	—	—	

Pilot Tube Calibration Factor C_p 0.823

Volume Collected V_m 26.975 ft³

Water Collected V_w 62.0 ml

Time of Test T_t 60 min.

Stack Pressure P_s -13.0 °H₂O

Pilot Tube No. 3-4

Baro. Press. P_b 27.08 °Hg

Probe Tip Dia. D_p 0.193 in.

% CO₂ 13.3 % CO 0.0

% O₂ 6.0 % N₂ 80.7

Area Stack A, 20, 235 in²

Barometer No. —

Total Volume of Leak Checks After Start: — ft³

V_m X Dry Gas Meter Calibration Factor 27.002 X 0.999 ✓

Probe Tip No. 5-2

[Dry Gas Meter Reading — ft³ - (T_s — min. X Leak Rate — cfm)]

Impinger Box No. 2-2

Water Weight Gain

Impinger 1
Final Weight 795.4
Initial Weight 745.6
Increase 49.8

Impinger 2
Final Weight 748.2
Initial Weight 742.3
Increase 5.9

Impinger 3
Final Weight 734.3
Initial Weight 733.2
Increase 1.1

Impinger 4
Final Weight 721.2
Initial Weight 720.8
Increase 0.4

Impinger 5
Final Weight 937.7
Initial Weight 932.9
Increase 4.8

Impinger 6
Final Weight _____
Initial Weight _____
Increase _____

Impinger 7
Final Weight _____
Initial Weight _____
Increase _____

Impinger 1 49.8

Impinger 2 5.9

Impinger 3 1.1

Impinger 4 0.4

Impinger 5 4.8

Impinger 6 _____

Impinger 7 _____

Total 62.0 = V_w

$V_w =$
g SO₂ = _____
 $V_w =$

Filter No.
60

$P_b = 27.08$ ✓
 $V_m = 26.975$ ✓
 $V_w = 62.0$ ✓
 $P_m = 0.559$ ✓
Avg $\Delta P = 0.868$ ✓

Avg $\sqrt{\Delta P} = 0.924$ ✓
 $C_p = 0.823$ ✓
 $P_s = 72$ ✓ °F
 $T_m = 72$ ✓ °F
 $T_s = 316$ ✓ °F

%CO₂ = 13.3 ✓
%O₂ = 6.0 ✓
%CO = 0.0 ✓
%N₂ = 80.7 ✓
 $A_s = 20,235$ ✓
 $D_n = 0.193$ ✓
 $T_i = 60$ ✓

26.12 °Hg
532 °R
776 °R

Moisture Content:

%M = 10.76 ✓ $M_d = 0.8924$ ✓ $MW_c = 30.368$ ✓ $MW = 29.04$ ✓

$$V_{m_{std}} = 17.65 V_m \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 26.975 \left[\frac{27.08 + \frac{0.559}{13.6}}{72 + 460} \right] = \frac{24.272}{0.405} \frac{\text{sft}^3}{\text{scfm}}$$

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 62.0 = 2.926 \text{ sft}^3$$

$$\% \text{ Moisture} = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{2.926}{24.272 + 2.926} \times 100 = 10.76\%$$

$$V_s = 5123.8 \times \frac{0.823}{\sqrt{26.12 \times 29.04}} \times 0.924 = 3941 \text{ fpm}$$

ACFM: 553,797

SCFM: 294,636

$$\%I = \frac{1.039 \times 24.272 \times 776}{0.8924 \times 26.12 \times 3941 \times 60 \times (0.193)^2} = 95.3\%$$

PS
12/7/06

%EA: 39.0

Job Number
Job Name
Run Number
Unit
Date
Operator
Sample Box No.

06-057
ADA-ES (HARDING)
3
SDA NUGET
12/1/06
SEBASTIAN/JACKSON
2-2

Meter Box No.

ΔP_s

17/26A/CTM027 Field Data

Read and record at the start of each test point.

Purge to:

Purge time:

Pilot Leak Check Initial ☒ Final ☒

Ambient Temp. °F 26
Assumed Moisture % 10
Probe Length 6' to reference
C Factor 6.4
Initial Leak @ 15.0 "Hg = 0.003 cfm
Final Leak @ 4.0 "Hg = 0.005 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pilot" H_2O	Orifice ΔH H_2O Desired	Orifice ΔH H_2O Actual	Pump Vacuum Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
A-4	1647	84.701	0.90	0.58	0.58	1.0	321	232	225	24	66	66	INTERRUPTED
3	1652	86.96	0.96	0.63	0.63	1.0	326	227	223	35	66	66	OK SAT
2	1657	89.33	0.80	0.52	0.52	1.5	325	251	228	42	68	66	
1	1702	91.50	0.52	0.34	0.34	1.5	322	254	226	45	69	67	
END	1707	93.419	—	—	—	—	—	—	—	—	—	—	
B-9	1708	93.419	1.10	0.71	0.71	2.0	324	250	236	44	70	67	
3	1713	95.83	1.05	0.68	0.68	2.0	321	248	235	40	71	67	
2	1718	98.29	0.97	0.63	0.63	2.0	319	255	227	36	73	67	
1	1723	100.67	0.63	0.40	0.40	2.0	318	256	234	34	74	68	
END	1728	102.629	—	—	—	—	—	—	—	—	—	—	
C-4	1729	102.629	0.85	0.55	0.55	2.5	319	257	235	33	73	68	
3	1734	104.96	0.93	0.60	0.60	2.5	319	250	229	32	74	68	
2	1739	107.28	1.00	0.65	0.65	2.5	324	256	238	31	75	69	
1	1744	109.67	0.59	0.38	0.38	2.5	320	258	234	31	76	69	
END	1749	111.641	—	—	—	—	—	—	—	—	—	—	

Pilot Tube Calibration Factor C_p 0.823
Volume Collected V_m 26.913 ft^3
Water Collected V_w 60.6 ml
Time of Test T_1 60 min.
Slack Pressure P_1 -13.5 H_2O

Pilot Tube No. 3-4
Baro. Press. P_b 27.20 "Hg
Probe Tip Dia. D_n 0.193 in.
% CO_2 13.8 % CO 0.0
% O_2 5.7 % N_2 80.5
Area Slack A_s 20, 235 in^2

Barometer No. — Probe Tip No. 5-2
Total Volume of Leak Checks After Start: — ft^3
 $V_m \times$ Dry Gas Meter Calibration Factor 26.940 $\times$ 0.999

[Dry Gas Meter Reading — ft^3 - (T_1 — min. $\times$ Leak Rate — cfm)]

Impinger Box No. 2-2

Water Weight Gain

Impinger 1 Final Weight 789.4
 Initial Weight 739.2
 Increase 50.2

Impinger 2 Final Weight 743.4
 Initial Weight 738.4
 Increase 4.0

Impinger 3 Final Weight 737.0
 Initial Weight 736.3
 Increase 0.7

Impinger 4 Final Weight 722.5
 Initial Weight 722.1
 Increase 0.4

Impinger 5 Final Weight 943.0
 Initial Weight 937.7
 Increase 5.3

Impinger 6 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 7 Final Weight _____
 Initial Weight _____
 Increase _____

$V_w =$
 $g\ SO_2 =$
 $V_w =$

THIMBLE
 No. 61

Impinger 1 50.2

Impinger 2 4.0

Impinger 3 0.7

Impinger 4 0.4

Impinger 5 5.3

Impinger 6 _____

Impinger 7 _____

Total 60.6 = V_w

$P_b = 27.20$ ✓
 $V_m = 26.913$ ✓
 $V_w = 60.6$ ✓
 $P_m = 0.556$ ✓
 $Avg\ \Delta P = 0.858$ ✓
 $Avg\ \sqrt{\Delta P} = 0.921$ ✓
 $C_p = 0.823$ ✓
 $P_s = -13.5$ ✓
 $T_m = 69$ ✓
 $T_s = 32.2$ ✓

%CO₂ = 13.8 ✓
 %O₂ = 5.7 ✓
 %CO = 0.0 ✓
 %N₂ = 80.5 ✓
 $A_s = 20,235$ ✓
 $D_n = 0.193$ ✓
 $T_i = 60$ ✓

26.21 °Hg
529 °R
782 °R

Moisture Content:

%M = 10.47 ✓ $M_d = 0.8953$ ✓ $MW_c = 30.436$ ✓ $MW = 29.13$ ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 26.913 \left[\frac{27.20 + \frac{0.556}{13.6}}{69 + 460} \right] = \frac{24.461}{0.408} \frac{stl^3}{scfm}$$

$$Vw_{gas} = 0.0472 \times Vw = 0.0472 \times 60.6 = 2.860\ stl^3$$

$$\% \text{ Moisture} = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{2.860}{24.461 + 2.860} \times 100 = 10.47\ %$$

$$V_s = 5123.8 \times \frac{0.823}{\sqrt{\frac{782}{26.21 \times 29.13}}} \times 0.921 = 3931\ fpm$$

ACFM: 552,322 ✓

SCFM: 293,589 ✓

$$\%I = \frac{1.039 \times 24.461 \times 782}{0.8953 \times 26.21 \times 3931 \times 60 \times (0.193)^2} = 96.4\ %$$

%EA: 36.5 ✓

ORSAT ANALYSIS DATA FORM

Job #: 06-057
 Job Name: AOA-ES
 Location: Hardin, MT
 Date: 11-30-06
 Operator: Hefley

Sample Location: SDA Inlet
 Analytical Method: 3
 Sample Type: Single Point / Multi Point Grab / Integrated
 Leak Check: Time: 5 min (≥ 4 minutes) Rate: 0.0
 Ambient Air Check:

CO ₂ - % Vol.	0.0
O ₂ - % Vol.	20.9
N ₂ - % Vol.	79.1

Run #: 1 (17/26A/17M027)
 Run Time: 1545

CO ₂ - % Vol.	14.3	14.3	14.3	14.3
O ₂ - % Vol.	5.2	5.2	5.2	5.2
CO - % Vol.	0.0 80.5 (BH)	0.0	0.0	0.0
N ₂ - % Vol.	80.5	80.5	80.5	80.5

Run #: 2

Run Time: _____

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO ₂ - % Vol.	13.3	13.3	13.3	13.3
O ₂ - % Vol.	6.0	6.0	6.0	6.0
CO - % Vol.	0.0	0.0	0.0	0.0
N ₂ - % Vol.	80.7	80.7	80.7	80.7

Run #: 3

Run Time: _____

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO ₂ - % Vol.	13.8	13.8	13.8	13.8
O ₂ - % Vol.	5.6	5.7	5.7	5.7
CO - % Vol.	0.0	0.0	0.0	0.0
N ₂ - % Vol.	80.4	80.5	80.5	80.5

06-057 ✓
ADA-ES (HARDIN, MT) ✓
SDA Inlet ✓
12/11/06 ✓
SELAKOVICH/JACKSON ✓
n-2 Meter Box No. 2-2

Ontario Hydro Field Data

Read and record at the start of each test point.

Purge to: _____
Purge time: _____
Pitot Leak Check Initial ☒ Final ☒

Ambient Temp. of 28
Assumed Moisture % 10
Probe Length 6'
C Factor 6.4 to reference
Initial Leak @ 15.0 "Hg = 0.063 cfm
Final Leak @ 5.5 "Hg = 0.000 cfm

[illegible]

Pilot Tube Calibration Factor C. 0.823

Volume Collected V_m 52.763 l^3

Water Collected V_{or} 24.6 mlTime of Test T₁ 720 min.Slack Pressure P₁ 12.0 H₂OPilot Tube No. 3-3

Baro. Press. P_b $\frac{27.05}{27.05}$ $^{\circ}\text{Hg}$

Probe lip Dia. D_n	0.112	in.
% CO	14.2	% CO 0.0

% CO ₂	6.4	% N ₂	79.4
<hr/>			

Area Slack A, 20,235 in²

Barometer No. .

Total Volume of Leak Checks After Start:

$$V_m \times \text{Dry Gas Meter Calibration Factor} \times \frac{24.816}{X} \times \frac{X}{0.797}$$
(Dry Gas Meter Reading $\text{ft}^3 - (T_1 \text{ min.} \times \text{Leak Rate } \text{cfm})$)Probe Tip No. 7-2

Impinger Box No. MZ

Water Weight Gain

Impinger 1	Final Weight	<u>836.7</u>
	Initial Weight	<u>755.1</u>
	Increase	<u>81.6</u>
Impinger 2	Final Weight	<u>749.4</u>
	Initial Weight	<u>733.2</u>
	Increase	<u>16.2</u>
Impinger 3	Final Weight	<u>751.5</u>
	Initial Weight	<u>648.8</u>
	Increase	<u>102.7</u>
Impinger 4	Final Weight	<u>728.8</u>
	Initial Weight	<u>727.0</u>
	Increase	<u>1.8</u>
Impinger 5	Final Weight	<u>757.3</u>
	Initial Weight	<u>757.6</u>
	Increase	<u>-0.3</u>
Impinger 6	Final Weight	<u>749.4</u>
	Initial Weight	<u>750.1</u>
	Increase	<u>-0.7</u>
Impinger 7	Final Weight	<u>761.4</u>
	Initial Weight	<u>762.2</u>
	Increase	<u>-0.8</u>

Imp. 8

Final 963.9

Initial 949.8

14.1

$V_w =$

$g SO_2 =$

$V_w =$

Thimble No.

53

Impinger 1	<u>81.6</u>
Impinger 2	<u>16.2</u>
Impinger 3	<u>102.7</u>
Impinger 4	<u>1.8</u>
Impinger 5	<u>-0.3</u>
Impinger 6	<u>-0.7</u>
Impinger 7	<u>-0.8</u>
Imp. 8	<u>14.1</u>
Total	<u>214.6</u> = V_w

$P_b =$ 27.05 ✓

$V_m =$ 52.763 ✓

$V_w =$ 214.6 ✓

$P_m =$ 0.533 ✓

Avg $\Delta P =$ 0.828 ✓

0.903 ✓

Avg $\sqrt{\Delta P} =$ 0.941 ✓

$C_p =$ 0.823 ✓

$P_s =$ -13.0 ✓

$T_m =$ 72 ✓

$T_s =$ 315 ✓

%CO₂ = 14.2 ✓

%O₂ = 6.4 ✓

%CO = 0.0 ✓

%N₂ = 79.4 ✓

A_s = 20,235 ✓

D_n = 0.192 ✓

T_i = 120 ✓

26.09 ✓

532 ✓

775 ✓

°Hg

°R

°R

Moisture Content:

%M = 17.60 ✓

M_d = 0.8240 ✓

MW_d = 30.528 ✓

MW = 28.32 ✓

$$Vm_{std} = 17.65 Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 52.763 \left[\frac{27.05 + \frac{0.533}{13.6}}{72 + 460} \right] = \frac{47.420}{0.395} \frac{st^3}{scfm}$$

$$VW_{gas} = 0.0472 \times Vw = 0.0472 \times \underline{214.6} = \underline{10.129} \text{ st}^3$$

$$\% \text{ Moisture} = \frac{VW_{gas}}{Vm_{std} + VW_{gas}} \times 100 = \frac{10.129}{47.420 + 10.129} \times 100 = \underline{17.60} \%$$

$$V_s = 5123.8 \times \frac{0.823}{\sqrt{26.09 \times 28.32}} \times \frac{775}{0.903} = \underline{3900} \text{ lpm}$$

ACFM: 548,009 ✓

SCFM: 269,260 ✓

$$\%I = \frac{1.039 \times 47.420 \times 775}{0.8240 \times 26.09 \times 3900 \times 120 \times (0.192)^2} = \underline{103.0} \%$$

%EA: 43.7 ✓

Run Number 1
Unit SDA INLET
Date 12/1/06

SDA INLET

Date 12/1/06

FIELD DATA

D-11

Job Number
Job Name
Run Number
Unit
Date
Operator
Sample Box No.

06-057
ADA-ES (HARDIN, MT)
2
SPA Toilet
12/2/06
SERAKOVICH/JACKSON
M-2 Meter Box No. 2-2

Field Data
Read and record at the start of each test point.
Purge to: —
Purge line: —
Pilot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 20
Assumed Moisture % 10
Probe Length 6'
C Factor 6.4 to reference
Initial Leak @ 15.0 "Hg = 0.002 cfm
Final Leak @ 5.5 "Hg = 0.002 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pilot" H ₂ O	Orifice ΔH H ₂ O Desired	Orifice ΔH H ₂ O Actual	Pump Vacuum "Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
A-4	0919	112.137	0.81	0.52	0.52	1.0	316	261	249	16	65	66	
4	0924	114.26	0.98	0.64	0.64	2.0	322	247	250	23	65	66	
3	0929	116.60	0.86	0.55	0.55	2.0	317	245	255	26	66	66	
3	0934	118.82	0.84	0.54	0.54	2.0	315	253	254	44	67	66	
2	0939	121.00	0.74	0.48	0.48	2.0	313	262	253	46	68	66	
2	0944	123.08	0.78	0.51	0.51	2.5	314	263	256	43	70	66	
1	0949	125.20	0.43	0.27	0.27	2.0	314	262	255	41	70	67	
1	0954	126.80	0.41	0.26	0.26	2.0	314	262	255	40	70	67	
END	0959	128.324	—	—	—	—	—	—	—	—	—	—	
B-4	1000	128.324	1.10	0.71	0.71	3.0	318	245	247	36	72	68	
4	1005	130.74	1.20	0.77	0.77	4.0	321	244	255	38	74	68	
3	1010	133.33	1.10	0.71	0.71	4.0	318	246	256	39	73	69	
3	1015	135.81	1.10	0.71	0.71	4.0	319	252	255	40	76	69	
2	1020	138.30	0.97	0.63	0.63	4.0	316	263	255	41	76	69	
2	1025	140.65	0.99	0.64	0.64	4.0	316	265	256	40	77	70	
1	1030	143.02	0.61	0.39	0.39	4.0	316	265	256	40	77	70	
1	1035	144.95	0.67	0.44	0.44	4.0	316	264	256	40	77	71	
END	1040	146.882	—	—	—	—	—	—	—	—	—	—	

Pilot Tube Calibration Factor C, 0.823
Volume Collected V_m 52.103 ft³
Water Collected V_w 115.6 ml
Time of Test T₁ 120 min.
Stack Pressure P_s -13.8 "H₂O

Pilot Tube No. 3-3
Baro. Press. P_b 27.52 "Hg
Probe Tip Dia. D_n 0.192 in.
% CO₂ 13.9 % CO 0.0
% O₂ 6.1 % N₂ 80.0
Area Stack A_s 20,235 in²

Barometer No. — Probe Tip No. 7-2
Total Volume of Leak Checks After Start: — ft³
V_m X Dry Gas Meter Calibration Factor 52.155 X 0.999
[Dry Gas Meter Reading — ft³ - (T₁ — min. X Leak Rate — cfm)]

Impinger Box No. M-2

Water Weight Gain

Impinger 1
Final Weight 840.9
Initial Weight 758.2
Increase 82.7

Impinger 2
Final Weight 748.8
Initial Weight 731.3
Increase 17.5

Impinger 3
Final Weight 756.7
Initial Weight 752.9
Increase 3.8

Impinger 4
Final Weight 731.6
Initial Weight 729.2
Increase 2.4

Impinger 5
Final Weight 742.5
Initial Weight 742.1
Increase 0.4

Impinger 6
Final Weight 754.1
Initial Weight 754.6
Increase -0.5

Impinger 7
Final Weight 747.1
Initial Weight 747.6
Increase -0.5

Imp 8
Final 973.4
Initial 963.6
9.8

$V_w =$
 $g SO_2 =$
 $V_w =$

Thimble Filter
No. 54

$P_b = 27.52$ ✓
 $V_m = 52.103$ ✓
 $V_w = 115.6$ ✓
 $P_m = 0.542$ ✓
Avg $\Delta P = 0.840$ ✓
Avg $\sqrt{\Delta P} = 0.909$ ✓
 $C_p = 0.823$ ✓
 $P_s = -13.8$ ✓
 $T_m = 71$ ✓
 $T_s = 317$ ✓

Impinger 1 82.7
Impinger 2 17.5
Impinger 3 3.8
Impinger 4 2.4
Impinger 5 0.4
Impinger 6 -0.5
Impinger 7 -0.5
Imp 8 9.8
Total 115.6 = V_w

%CO₂ = 13.9 ✓
%O₂ = 6.1 ✓
%CO = 6.0 ✓
%N₂ = 80.0 ✓
 $A_s = 20,235$ ✓
 $D_n = 0.192$ ✓
 $T_i = 120$ ✓

26.51 ✓ °Hg
531 ✓ °R
777 ✓ °R

Moisture Content:

%M = 10.26 ✓ $M_d = 0.8974$ ✓ $MW_d = 30.468$ ✓ $MW = 29.19$ ✓

$$Vm_{std} = 17.65 Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 52.103 \left[\frac{27.52 + \frac{0.542}{13.6}}{71 + 460} \right] = \frac{47.730}{0.398} \frac{stf^3}{scfm}$$

$$Vw_{gas} = 0.0472 \times Vw = 0.0472 \times 115.6 = 5.456 \text{ stf}^3$$

$$\% \text{ Moisture} = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{5.456}{47.730 + 5.456} \times 100 = 10.26 \%$$

$$V_s = 5123.8 \times 0.823 \sqrt{\frac{777}{26.51 \times 29.19}} \times 0.909 = 3841 \text{ fpm}$$

ACFM: 539,741 ✓

SCFM: 292,703 ✓

$$\%I = \frac{1.039 \times 47.730 \times 777}{0.8974 \times 26.51 \times 3841 \times 120 \times (0.192)^2} = 95.3 \%$$

%EA: 40.4 ✓

✓ (B)
12/7/06

2

Unit SDA WLET

Date 12/2/06

H0

FIELD DATA

13.9

61

50.0

[illegible]

Job Number
Job Name
Run Number
Unit
Date
Operator
Sample Box No. M-2

06-057
ADA-ES HARDIN, MT
3
SDA INLET
12-2-06
SELA KOVICH/JACKSON
Meter Box No. 2-2

Field Data

Read and record at the start of each test point.

Purge to:
Purge time:
Pilot Leak Check Initial ☒ Final ☒

Ambient Temp. °F 26
Assumed Moisture % 10
Probe Length 6'
C Factor 6.4 to reference
Initial Leak @ 15.0 "Hg = 0.003 cfm
Final Leak @ 7.0 "Hg = 0.002 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pilot" "H ₂ O"	Orifice ΔH "H ₂ O" Desired	Orifice ΔH "H ₂ O" Actual	Pump Vacuum "Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
A 4	1712	164.701	0.90	0.58	0.58	1.0	327	257	253	27	65	44	
4	1717	167.25	0.95	0.61	0.61	1.5	326	242	253	30	65	66	
3	1722	169.58	0.85	0.55	0.55	2.0	322	241	249	31	66	66	
3	1727	171.82	0.85	0.55	0.55	2.0	320	261	252	31	67	66	
2	1732	173.975	0.73	0.50	0.50	2.0	320	264	253	32	69	66	
2	1737	176.085	0.82	0.52	0.52	2.0	321	263	254	32	70	67	
1	1742	178.22	0.50	0.32	0.32	2.0	313	265	255	33	71	67	
1	1747	180.07	0.49	0.31	0.31	2.0	317	266	255	33	71	67	
End	1752	181.749	—	—	—	—	—	—	—	—	—	—	
B 4	1753	181.749	1.0	0.65	0.65	3.0	320	260	249	33	72	68	
4	1758	184.32	1.1	0.70	0.70	4.0	321	254	254	33	74	68	
3	1803	186.79	1.1	0.70	0.70	4.0	323	258	254	36	75	69	
3	1808	189.25	1.1	0.70	0.70	4.5	325	264	255	40	76	69	
2	1813	191.71	1.0	0.65	0.65	4.5	326	265	253	39	76	70	
2	1818	194.11	1.1	0.70	0.70	4.5	323	263	255	40	77	70	
1	1823	196.59	0.72	0.47	0.47	4.5	319	264	255	43	78	70	
1	1828	198.78	0.65	0.42	0.42	4.5	318	264	256	42	77	71	
End	1833	200.601	—	—	—	—	—	—	—	—	—	—	

Pilot Tube Calibration Factor C_p 0.823
Volume Collected V_m 53.255 ft³
Water Collected V_w 115.5 ml
Time of Test T_i 120 min.
Stack Pressure P_s -14.0 "H₂O

Pilot Tube No. 3-4
Baro. Press. P_b 27.55 "Hg
Probe Tip Dia. D_p 0.192 in.
% CO₂ 13.1 % CO 0.0
% O₂ 6.2 % N₂ 80.7
Area Stack A_s 20.235 in²

Barometer No. — Probe Tip No. 7-2
Total Volume of Leak Checks After Start: — ft³
V_m X Dry Gas Meter Calibration Factor 53.312 X 0.999
[Dry Gas Meter Reading — ft³ - (T_i — min. X Leak Rate — cfm)]

Impinger Box No. M-2

Water Weight Gain

Impinger 1	Final Weight	<u>839.1</u>	Imp 8 Final <u>891.7</u> Initial <u>881.4</u> 10.3	Impinger 1	<u>82.1</u>
	Initial Weight	<u>757.0</u>		Impinger 2	<u>16.6</u>
	Increase	<u>82.1</u>		Impinger 3	<u>3.1</u>
Impinger 2	Final Weight	<u>749.9</u>		Impinger 4	<u>2.9</u>
	Initial Weight	<u>733.3</u>		Impinger 5	<u>0.5</u>
	Increase	<u>16.6</u>		Impinger 6	<u>0.4</u>
Impinger 3	Final Weight	<u>756.6</u>	V _w = g SO ₂ = V _w =	Impinger 7	<u>-0.4</u>
	Initial Weight	<u>753.5</u>		Imp 8	<u>10.3</u>
	Increase	<u>3.1</u>		Total	<u>115.5</u> = V _w
Impinger 4	Final Weight	<u>732.5</u>	Thimble No. <u>55</u>		
	Initial Weight	<u>729.6</u>			
	Increase	<u>2.9</u>			
Impinger 5	Final Weight	<u>757.1</u>	P _b = <u>27.55</u> ✓ V _m = <u>53.259</u> ✓ V _w = <u>115.5</u> ✓ P _m = <u>10.541</u> 0.542 ✓ Avg ΔP = <u>0.844</u> ✓ Avg √ΔP = <u>0.913</u> ✓ C _p = <u>0.823</u> ✓ P _s = <u>-14.0</u> °H ₂ O ✓ T _m = <u>71</u> °F ✓ T _s = <u>320</u> °F ✓	%CO ₂ = <u>13.1</u> ✓	
	Initial Weight	<u>756.6</u>		%O ₂ = <u>4.2</u> ✓	
	Increase	<u>0.5</u>		%CO = <u>0.0</u> ✓	
Impinger 6	Final Weight	<u>745.5</u>		%N ₂ = <u>80.7</u> ✓	
	Initial Weight	<u>745.1</u>		A _n = <u>20.235</u> ✓	
	Increase	<u>0.4</u>		D _n = <u>0.192</u> ✓	
Impinger 7	Final Weight	<u>758.9</u>		T _i = <u>120</u> ✓	
	Initial Weight	<u>759.3</u>			
	Increase	<u>-0.4</u>			

Moisture Content:

%M = 10.04 ✓ M_s = 0.8996 ✓ MW_c = 30.344 ✓ MW = 29.10 ✓

$$Vm_{std} = 17.65 Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 53.259 \left[\frac{27.55 + \frac{10.541}{13.6}}{71 + 460} \right] = \frac{48.842}{0.407} \frac{ft^3}{scfm}$$

VW_{gas} = 0.0472 x Vw = 0.0472 x 115.5 = 5.452 ✓ ft³

% Moisture = $\frac{VW_{gas}}{Vm_{std} + VW_{gas}} \times 100 = \frac{5.452}{48.842 + 5.452} \times 100 = \underline{10.04} \%$ ✓

V_s = 5123.8 x 0.823 / $\sqrt{\frac{780}{26.52 \times 29.10}}$ x 0.913 = 3871 ✓ tpm

ACFM: 543898 ✓

SCFM: 294684 ✓

%I = $\frac{1.039 \times 780 \times 48.842}{0.8996 \times 26.52 \times 3871 \times 120 \times (0.192)^2}$ = 96.89 ✓ %

%EA: 40.83 ✓

ORSAT ANALYSIS DATA FORM

Job #: 06-057
 Job Name: ADA-ES
 Location: Hardin, MT
 Date: 12-1-06
 Operator: Hefley

Sample Location: SDA Inlet
 Analytical Method: 3
 Sample Type: Single Point / Multi Point Grab / Integrated
 Leak Check: Time: 5 min (≥ 4 minutes) Rate: 0.0
 Ambient Air Check:

CO ₂ - % Vol.	0.0
O ₂ - % Vol.	20.9
N ₂ - % Vol.	79.1

Run #: 1 (OH)

Run Time: _____

CO ₂ - % Vol.				
O ₂ - % Vol.				
CO - % Vol.				
N ₂ - % Vol.				

Run #: 2

Run Time: _____

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO ₂ - % Vol.	13.9	13.9	13.9	13.9
O ₂ - % Vol.	6.1	6.0	6.1	6.1
CO - % Vol.	0.0	0.0	0.0	0.0
N ₂ - % Vol.	80.0	80.1	80.0	80.0

Run #: 3

Run Time: _____

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO ₂ - % Vol.	13.1	13.1	13.1	13.1 $\checkmark$
O ₂ - % Vol.	6.2	6.2	6.2	6.2
CO - % Vol.	0.0	0.0	0.0	0.0
N ₂ - % Vol.	80.7	80.7	80.7	80.7

Job Number
Job Name
Run Number
Unit
Date
Operator
Sample Box No. 3-1

06-057
ADA-ES (HARDIN, MT)
SDA INLET
11/30/06
SELA KOVICH/JACKSON

8A Field Data

Read and record at the start of each test point.

Purge to: 914.605
Purge time: 1425-1440
Pilot Leak Check Initial - Final -

Ambient Temp. °F 32
Assumed Moisture % 12.0
Probe Length 9'
C Factor - to reference
Initial Leak @ 15.0 °Hg = 0.006 cfm
Final Leak @ 5.0 °Hg = 0.009 cfm

Point	Clock Time	Dry Gas Meter, CF	Pilot °H ₂ O	Orifice ΔH °H ₂ O Desired	Orifice ΔH °H ₂ O Actual	Pump Vacuum °Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
D-1	1323	887.217	-	0.35	0.35	4.0	114	315	504	40	68	68	WATER BATH 174
	1328	888.70	-	0.35	0.35	4.0	121	335	504	42	67	68	174
	1333	890.53	-	0.35	0.35	4.0	137	344	504	41	68	68	175
	1338	882.33	-	0.35	0.35	4.0	136	349	506	38	69	68	176
	1343	894.13	-	0.35	0.35	4.0	141	350	504	37	69	68	177
	1348	895.94	-	0.35	0.35	4.0	141	346	506	36	71	68	176
	1353	877.73	-	0.35	0.35	4.5	139	349	505	36	72	69	176
	1358	879.55	-	0.35	0.35	4.5	140	352	502	37	73	69	175
	1403	901.35	-	0.35	0.35	4.5	140	346	507	36	73	69	175
	1408	903.17	-	0.35	0.35	5.0	142	343	506	38	74	70	176
	1413	904.97	-	0.35	0.35	5.0	142	342	505	40	74	70	176
	1418	906.80	-	0.35	0.35	5.0	140	344	506	42	75	71	177
END	1423	908.810	-	-	-	-	-	-	-	-	-	-	-
All													

Pilot Tube Calibration Factor C_p -
Volume Collected V_m 21.571 ft³
Water Collected V_w 45.9 ml
Time of Test T₁ 60 min.
Stack Pressure P_s -14.7 °H₂O

Pilot Tube No. -
Baro. Press. P_b 26.94 °Hg
Probe Tip Dia. D_p 0.25 in.
% CO₂ 14.3 % CO 0.0
% O₂ 5.2 % N₂ 80.5
Area Stack A_s 20, 235 in²

Barometer No. -
Total Volume of Leak Checks After Start: - ft³
V_m X Dry Gas Meter Calibration Factor 21.573 X 0.999
[Dry Gas Meter Reading - (T₁ - T₂) min. X Leak Rate - cfm]

Impinger Box No. 3-1

Water Weight Gain

Impinger 1 Final Weight 772.7
 Initial Weight 733.4
 Increase 39.3

Impinger 2 Final Weight 735.0
 Initial Weight 734.1
 Increase 0.9

Impinger 3 Final Weight 737.9
 Initial Weight 737.8
 Increase 0.1

Impinger 4 Final Weight 903.7
 Initial Weight 898.1
 Increase 5.6

Impinger 5 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 6 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 7 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 1 39.3

Impinger 2 0.9

Impinger 3 0.1

Impinger 4 5.6

Impinger 5 _____

Impinger 6 _____

Impinger 7 _____

Total 45.9 = V_w

Thimble No. _____

62
 $P_b = \underline{26.94}$ ✓
 $V_m = \underline{21.571}$ ✓
 $V_w = \underline{45.9}$ ✓
 $P_m = \underline{0.350}$ ✓

Avg $\Delta P = \underline{\quad}$

Avg $\sqrt{\Delta P} = \underline{\quad}$

$C_p = \underline{\quad}$

$P_s = \underline{-14.7}$ ✓ $^{\circ}\text{H}_2\text{O}$

$T_m = \underline{70}$ $^{\circ}\text{F}$

$T_s = \underline{\quad}$ $^{\circ}\text{F}$

%CO₂ = 14.3

%O₂ = 5.2

%CO = 0.0

%N₂ = 80.5

$A_s = \underline{20,235}$ ✓

$D_n = \underline{\quad}$

$T_1 = \underline{60}$ ✓

25.86 ✓ $^{\circ}\text{Hg}$

530 ✓ $^{\circ}\text{R}$

— $^{\circ}\text{R}$

Moisture Content:

%M = 10.06 ✓

$M_d = \underline{0.8994}$ ✓

$MW_d = \underline{\quad}$

$MW = \underline{\quad}$

$$Vm_{std} = 17.65 Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 21.571 \left[\frac{26.94 + \frac{0.350}{13.6}}{70 + 460} \right] = \frac{19.371}{0.323} \frac{\text{ft}^3}{\text{scfm}}$$

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 45.9 = 2.166 \text{ ft}^3$$

$$\% \text{ Moisture} = \frac{V_{w_{gas}}}{Vm_{std} + V_{w_{gas}}} \times 100 = \frac{2.166}{19.371 + 2.166} \times 100 = 10.06 \%$$

$$V_s = 5123.8 \times \frac{\quad}{\quad} \times \frac{\quad}{\quad} = \quad \text{tpm}$$

ACFM: _____

SCFM: _____

$$\%I = \frac{1.039 \times \quad \times \quad \times \quad \times \quad}{\quad} = \quad \%$$

%EA: _____

12/6/06

Job Number
Job Name
Run Number
Unit
Date
Operator
Sample Box No.

06-057
ADA-ES (HARDIN, MT)
2
SDA INLET
11/30/06
SEAKOVICH/JACKSON
3-1 Meter Box No. 2-2

8A Field Data
Read and record at the start of each test point.
Purge to: 968-107
Purge time: 1852-1807
Pilot Leak Check Initial — Final —

Ambient Temp. °F 35
Assumed Moisture % 10
Probe Length 9' to reference
C Factor —
Initial Leak @ 15.0 "Hg = 0.000 cfm
Final Leak @ 16.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	*Pilot* "H ₂ O"	Orifice ΔH "H ₂ O" Desired	Orifice ΔH "H ₂ O" Actual	Pump Vacuum "Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T _m			Remarks
											Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Water Bath	
D-1	1648	940.249	—	0.35	0.35	5.0	175	315	514	35	72	72	172	
	1653	942.26	—	0.35	0.35	4.0	117	316	514	37	72	72	175	
	1658	944.06	—	0.35	0.35	4.0	137	338	516	37	72	72	176	
	1703	945.88	—	0.35	0.35	4.0	144	339	518	34	73	72	177	
	1708	947.70	—	0.35	0.35	4.0	144	333	519	33	74	72	176	
	1713	949.52	—	0.35	0.35	4.5	141	332	519	32	75	72	176	
	1718	951.34	—	0.35	0.35	4.5	143	332	521	33	76	72	176	
	1723	953.18	—	0.35	0.35	4.5	142	330	527	32	76	73	176	
	1728	955.00	—	0.35	0.35	4.5	140	331	526	32	77	73	175	
	1733	956.83	—	0.35	0.35	4.5	140	328	527	32	77	73	176	
	1738	958.67	—	0.35	0.35	5.0	142	331	525	32	78	73	175	
	1743	960.49	—	0.35	0.35	5.0	141	332	527	32	78	74	176	
END	1748	962.350	—	—	—	—	—	—	—	—	—	—	—	
All														
									</					

Pilot Tube Calibration Factor C_v —
Volume Collected V_m 22.079 ft³
Water Collected V_w 50.0 ml
Time of Test T_i 60 min.
Slack Pressure P_s -14.9 "H₂O

Pilot Tube No. —
Baro. Press. P_b 26.96 "Hg
Probe Tip Dia. D_n — in.
% CO₂ 14.3 % CO 0.0
% O₂ 5.2 % N₂ 82.5
Area Slack A_s 20.235 in²

Barometer No. —
Total Volume of Leak Checks After Start: — ft³
V_m X Dry Gas Meter Calibration Factor 22.101 X 0.999 ✓
[Dry Gas Meter Reading — ft³ - (T_i — min. X Leak Rate — cfm)]

Impinger Box No. 3-1

Water Weight Gain

Impinger 1 Final Weight 783.0
 Initial Weight 738.1
 Increase 44.9

Impinger 2 Final Weight 738.2
 Initial Weight 738.2
 Increase 0.0

Impinger 3 Final Weight 737.9
 Initial Weight 737.9
 Increase 0.0

Impinger 4 Final Weight 908.8
 Initial Weight 903.7
 Increase 5.1

Impinger 5 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 6 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 7 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 1 44.9

Impinger 2 0.0

Impinger 3 0.0

Impinger 4 5.1

Impinger 5 _____

Impinger 6 _____

Impinger 7 _____

Total 50.0 = V_w

$V_w =$
 $g\ SO_2 =$
 $V_w =$

Thimble No.
63

$P_b = \underline{26.96}$ ✓
 $V_m = \underline{22.079}$ ✓
 $V_w = \underline{50.0}$ ✓
 $P_m = \underline{0.350}$

Avg $\Delta P =$ _____

Avg $\sqrt{\Delta P} =$ _____

$C_p =$ _____

$P_s = \underline{-14.9}$ ✓

$T_m = \underline{74}$ ✓

$T_s =$ _____

%CO₂ = 14.3

%O₂ = 5.2

%CO = 0.0

%N₂ = 80.5

$A_s = \underline{20,235}$ ✓

$D_n =$ _____

$T_i = \underline{60}$ ✓

$\underline{25.86}$ ✓

$\underline{534}$ ✓

Moisture Content:

%M = 10.70 ✓

$M_d = \underline{0.8793}$ ✓

$MW_c =$ _____

$MW =$ _____

$$Vm_{std} = 17.65 Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 22.079 \left[\frac{26.96 + \frac{0.350}{13.6}}{74 + 460} \right] = \frac{19.693}{0.328} \frac{sft^3}{scfm}$$

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times \underline{50.0} = \underline{2.360} \text{ sft}^3$$

$$\% \text{ Moisture} = \frac{V_{w_{gas}}}{Vm_{std} + V_{w_{gas}}} \times 100 = \frac{2.360}{19.693 + 2.360} \times 100 = \underline{10.70} \%$$

$$V_s = 5123.8 \times \frac{\sqrt{\text{_____}}}{\text{_____}} \times \text{_____} = \text{_____} \text{ lpm}$$

ACFM: _____

SCFM: _____

$$\%I = \frac{1.039 \times \text{_____} \times \text{_____} \times \text{_____} \times \text{_____}}{\text{_____}} = \text{_____} \%$$

%EA: _____

Job Number 06-057
 Job Name ADA-ES (HARDIN, MT)
 Run Number 3
 Unit SDA INLET
 Date 12/1/06
 Operator SENAKOVICH/JACKSON
 Sample Box No. 3-1 Meter Box No. 2-2

8A Field Data

Ambient Temp. °F Cold
 Assumed Moisture % 10
 Probe Length 9'
 C Factor — to reference
 Initial Leak @ 15.0 "Hg = 0.002 cfm
 Final Leak @ 15.0 "Hg = 0.002 cfm

Read and record at the start of each test point.

Purge to: 83.907

Purge time: 1005-1520

Pilot Leak Check Initial — Final —

Point	Clock Time	Dry Gas Meter, CF	"Pilot" "H ₂ O"	Orifice ΔH "H ₂ O" Desired	Orifice ΔH "H ₂ O" Actual	Pump Vacuum "Hg Gauge	Slack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Water Bath Remarks
D-1	1401	49.004	—	0.35	0.35	4.5	104	313	507	24	69	70	170
	1402	50.96	—	0.35	0.35	4.5	111	319	504	27	69	69	178
	1411	52.75	—	0.35	0.35	4.5	114	339	511	27	70	69	175
	1416	54.56	—	0.35	0.35	4.5	119	355	511	27	71	70	176
	1421	56.36	—	0.35	0.35	4.0	119	367	512	27	72	70	175
	1426	58.17	—	0.35	0.35	4.0	116	369	512	27	73	70	176
	1431	59.95	—	0.35	0.35	4.5	115	365	512	27	74	70	173
	1436	61.75	—	0.35	0.35	4.5	112	365	512	27	74	70	174
	1441	63.57	—	0.35	0.35	4.5	114	366	514	27	75	71	175
	1446	65.37	—	0.35	0.35	4.5	113	366	513	27	75	71	176
	1451	67.17	—	0.35	0.35	5.0	113	366	511	27	76	71	175
	1456	68.00	—	0.35	0.35	5.0	112	366	513	27	76	71	174
END	1501	70.851	—	—	—	—	—	—	—	—	—	—	—

Pilot Tube Calibration Factor C_p —
 Volume Collected V_m 21.825 ft³
 Water Collected V_w 49.8 ml
 Time of Test T_1 60 min.
 Slack Pressure P_s -13.4 "H₂O

Pilot Tube No. —
 Baro. Press. P_b 27.14 "Hg
 Probe Tip Dia. D_n — in.
 % CO₂ — % CO
 % O₂ — % N₂
 Area Slack A_s 20.235 in²

Barometer No. — Probe Tip No. —
 Total Volume of Leak Checks After Start: — ft³
 $V_m \times \text{Dry Gas Meter Calibration Factor}$ 21.847 x 0.999 ✓
 [Dry Gas Meter Reading — ft³ - (T_1 min. x Leak Rate — cfm)]

Impinger Box No. 3-1

Water Weight Gain

Impinger 1

Final Weight	187.1
Initial Weight	740.4 743.3
Increase	45.8

Impinger 1 45.8

Impinger 2 -0.1

Impinger 2

Final Weight	743.3
Initial Weight	738.8 743.4
Increase	-0.1

Impinger 3 -0.1

Impinger 4 4.2

Impinger 3

Final Weight	745.5	g S
Initial Weight	<u>737.9</u>	
Increase	<u>-0.1</u>	

$V_w =$
 $g\ SO_2 =$
 $V_w =$

Impinger 5 _____

Impinger 6 _____

Impinger 4	Final Weight	<u>913.0</u>
	Initial Weight	<u>908.8</u>
	Increase	4.2

Impinger 7 _____

Total 49.8 = V₁

Impinger 5 Final Weight _____
 Initial Weight _____
 Increase _____

$P_b = 27.14 \checkmark$
 $V_m = 21.825 \checkmark$
 $V_w = 49.8 \checkmark$
 $P_m = 0.350 \checkmark$

%CO₂ = _____

$$\%O_2 = \underline{\hspace{2cm}}$$
$$\%CO = \underline{\hspace{2cm}}$$
$$\%N_2 = \underline{\hspace{2cm}}$$

Impinger 6 Final Weight _____
 Initial Weight _____
 Increase _____

Avg $\Delta P =$

$$A_0 = \underline{\underline{20,2354}}$$
$$D_0 = \frac{1}{\dots}$$
$$T_1 = \underline{\underline{60 \checkmark}}$$

Impinger 7 Final Weight _____
 Initial Weight _____
 Increase _____

$$C_p = \underline{\quad 1 \quad}$$

$C_p =$ _____

$$P = -13.4 \text{ V}$$
$$\frac{12}{72} \checkmark$$

15

$$T_0 = \underline{\hspace{2cm}}$$

26.15 ✓

572 ✓

552

Moisture Content:

$\%M = 10.68$ ✓ $M_d = 0.8932$ ✓ $MW_c =$ _____ $MW =$ _____

$$Vm_{std} = 17.65 Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 21.825 \left[\frac{27.14 + \frac{0.350}{13.6}}{72 + 460} \right] = \frac{19.670}{0.328} \frac{\text{ft}^3}{\text{scfm}}$$

$$V_{W_{0.3}} = 0.0472 \times V_W = 0.0472 \times \frac{49.8}{1} = \frac{2.351}{1} \text{ sft}^3$$

$$\% \text{ Moisture} = \frac{V_{w_{gas}}}{V_{m_{air}} + V_{w_{gas}}} \times 100 = \frac{2.351}{18.670 + 2.351} \times 100 = 10.68 \%$$

$$V_s = 5123.8 \times \frac{\text{ } \checkmark \text{ } }{\text{ } x \text{ } } \times \text{ } = \text{ } \text{ fpm}$$

ACFM: _____

$$\%I = \frac{1.039 \times \frac{x}{x} \times \frac{x}{x} \times \frac{x}{x} \times \frac{x}{x}}{\left(\frac{x}{x}\right)^2} = \frac{1.039}{1} = 1.039 \%$$

SCFM: _____

%EA: _____

PRELIMINARY VELOCITY TRAVERSE DATA
AND
SAMPLING LOCATION DATA

Job Number 06-057
Job Name ADA ES (HARDIN, MT)
Sampling Location INLET (SDA)
Date 11/28/06 Time 0915-0940

Stack Height 92' 9 3/4" ft.
Sampling Port Height Above Ground 36' 9 1/2" ft.

	Port A	Port B	Port C	Port D	Average
Port & Inside Diameter (in.)	<u>160.75</u>	<u>160.75</u>	<u>160.75</u>	X	<u>160.75</u>
Port & Wall Thickness (in.)	<u>18.50</u>	<u>18.50</u>	<u>18.50</u>	X	<u>18.50</u>
Inside Stack Diameter (in.)	<u>142.25</u>	<u>142.25</u>	<u>142.25</u>	X	<u>142.25</u>

Sampling Ports are 13 ft. 4 in.

1.12 ~~EQ. DUCT~~ stack diameters) downstream from disturbance
(inlet, constriction, bend, expansion)

Sampling Ports are 56 ft. 3 in.

4.75 ~~EQ. DUCT~~ stack diameters) upstream from disturbance
(outlet, constriction, bend, expansion)

Point Number	Percent Diameter	Distance from Ref. Point (decimal in.)	Distance from Ref. Point (fractional in.)	Port A $\Delta P/T_s/\alpha$	Port B $\Delta P/T_s/\alpha$	Port C $\Delta P/T_s/\alpha$	Port D $\Delta P/T_s/\alpha$
1			<u>7 7/8"</u>	<u>0.81309 0</u>	<u>0.41304 5</u>	<u>0.38307 7</u>	X
2			<u>23 11/16"</u>	<u>0.42301 0</u>	<u>0.55309 0</u>	<u>0.49310 5</u>	X
3			<u>39 1/2"</u>	<u>0.49309 0</u>	<u>0.59310 2</u>	<u>0.56310 5</u>	X
4			<u>55 5/16"</u>	<u>0.51310 5</u>	<u>0.63310 0</u>	<u>0.55308 0</u>	X
5				/ /	/ /	/ /	/ /
6				/ /	/ /	/ /	/ /
7				/ /	/ /	/ /	/ /
8				/ /	/ /	/ /	/ /
9				/ /	/ /	/ /	/ /
10				/ /	/ /	/ /	/ /
11				/ /	/ /	/ /	/ /
12				/ /	/ /	/ /	/ /
13				/ /	/ /	/ /	/ /
14				/ /	/ /	/ /	/ /
15				/ /	/ /	/ /	/ /
16				/ /	/ /	/ /	/ /
17				/ /	/ /	/ /	/ /
18				/ /	/ /	/ /	/ /
19				/ /	/ /	/ /	/ /
20				/ /	/ /	/ /	/ /
21				/ /	/ /	/ /	/ /
22				/ /	/ /	/ /	/ /
23				/ /	/ /	/ /	/ /
24				/ /	/ /	/ /	/ /

Pitot Tube No. 3-3

$C_p =$ 0.823

$P_b =$ 26.99 "Hg

$P_s =$ _____ "H₂O _____ "Hg

$A_s =$ 20,235 in.²

Average ΔP 0.533

Average $\Delta P^{1/2}$ 0.726

Average T_s 309 °F

Average α 2.4 degrees

Job Number 06-057
 Job Name APA-ES Harding, MT
 Run Number 1
 Unit Stack
 Date 30 November 2006
 Operator Mullins, Goldman
 Sample Box No. 1-1 Meter Box No. 1-1

M5/202 Field Data
 Read and record at the start of each test point.
 Purge to: 65m
 Purge time: 11/30/06
 Pilot Leak Check Initial 1648 Final 1748

Ambient Temp. °F 37
 Assumed Moisture % 10.5
 Probe Length 9"
 C Factor 5.5 to reference
 Initial Leak @ 15.0 "Hg = 0.805 cfm
 Final Leak @ 8.0 "Hg = 0.002 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pilot" H ₂ O	Orifice ΔH Desired	Orifice ΔH Actual	Pump Vacuum "Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Heated Line	Remarks
8-10	1334	758.601	4.05	2.25	2.25	7.0	211	305	298	35	66	64	209	
9	1339	763.00	3.80	2.10	2.10	6.0	221	294	302	38	66	64	203	
8	1344	767.16	3.70	2.05	2.05	6.0	229	290	300	39	68	65	193	
7	1349	771.23	3.75	2.10	2.10	6.0	219	289	300	42	70	66	191	
6	1354	775.37	3.65	2.00	2.00	6.0	215	285	302	45	73	67	192	
5	1359	779.45	3.75	2.10	2.10	6.5	214	277	300	47	75	68	191	
4	1404	783.60	3.75	2.10	2.10	6.5	212	268	300	48	76	69	188	
3	1409	787.76	3.80	2.10	2.10	7.0	212	255	300	49	78	71	185	
2	1414	791.95	3.55	1.95	1.95	6.5	211	247	300	50	80	72	181	
2	1419	796.00	3.60	1.95	1.95	6.5	210	247	300	51	81	73	182	
1	1424	800.02	3.25	1.80	1.80	6.5	209	247	301	52	82	74	182	
1	1429	803.95	3.25	1.80	1.80	6.5	209	250	300	54	83	75	185	
End	1434	807.845	—	—	—	—	—	—	—	—	—	—	—	
A-10	1442	807.845	3.85	2.10	2.10	7.0	209	278	299	44	81	77	187	
9	1447	812.02	3.85	2.10	2.10	7.0	208	262	301	47	82	77	186	
8	1452	816.25	3.80	2.10	2.10	7.0	208	278	300	51	83	78	186	
7	1457	820.48	3.70	2.05	2.05	7.0	208	293	300	53	85	78	191	
6	1502	824.69	3.70	2.05	2.05	7.0	209	300	300	55	85	79	191	

Pilot Tube Calibration Factor C_p 0.823
 Volume Collected V_m 97.698 ft³
 Water Collected V_w 317.3 ml
 Time of Test T_1 120 min.
 Stack Pressure P_s -1.60 "H₂O
 Pilot Tube No. 3-1
 Baro. Press. P_b 26.94 "Hg
 Probe Tip Dia. D_n 0.171 in.
 % CO₂ 12.1 % CO 0.0
 % O₂ 7.9 % N₂ 80.0
 Area Stack A_s 9363 in²
 Barometer No. —
 Total Volume of Leak Checks After Start: 0 ft³
 $V_m \times \text{Dry Gas Meter Calibration Factor } 0.823 \times 99.186$
 [Dry Gas Meter Reading — ft³ - (T_1 — min. $\times$ Leak Rate — cfm)]
 Probe Tip No. 4-2

Impinger Box No. ASB-1-1

Water Weight Gain

Impinger 1 Final Weight 930.3
 Initial Weight 734.8
 Increase 195.5

Impinger 2 Final Weight 826.0
 Initial Weight 758.0
 Increase 68.0

Impinger 3 Final Weight 741.2
 Initial Weight 726.6
 Increase 14.6

Impinger 4 Final Weight 946.6
 Initial Weight 907.4
 Increase 39.2

Impinger 5 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 6 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 7 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 1 195.5

Impinger 2 68.0

Impinger 3 14.6

Impinger 4 39.2

Impinger 5 _____

Impinger 6 _____

Impinger 7 _____

$V_w =$
 $g\ SO_2 =$
 $V_w =$

Filter No.
A114

Total 317.3 = V_w

$P_b =$ 26.94 ✓

%CO₂ = 12.1 ✓

$V_m =$ 97.698 ✓

%O₂ = 7.9 ✓

$V_w =$ 317.3 ✓

%CO = 0.0 ✓

$P_m =$ 2.029 ✓

%N₂ = 80.0 ✓

Avg $\Delta P =$ 3.677 ✓

$A_s =$ 9363 ✓

Avg $\sqrt{\Delta P} =$ 1.917 ✓

$D_n =$ 0.171 ✓

$C_p =$ 0.823 ✓

$T_1 =$ 120 ✓

$P_s =$ 71.60 °H₂O

26.82 °Hg

$T_m =$ 77 °F

537 °R

$T_s =$ 210 °F

670 °R

Moisture Content:

%M = 14.69 ✓

$M_d =$ 0.8531 ✓

$MW_d =$ 30.252 ✓

$MW =$ 28.45 ✓

$$Vm_{std} = 17.65 \ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 97.698 \left[\frac{26.94 + \frac{2.029}{13.6}}{77 + 460} \right] = \frac{86.987}{0.725} \frac{sft^3}{scfm}$$

$$VW_{gas} = 0.0472 \times Vw = 0.0472 \times 317.3 = 14.977 \ sft^3$$

$$\% \text{ Moisture} = \frac{VW_{gas}}{Vm_{std} + VW_{gas}} \times 100 = \frac{14.977}{86.987 + 14.977} \times 100 = 14.69 \%$$

$$V_s = 5123.8 \times 0.823 \sqrt{\frac{670}{26.82 \times 28.45}} \times 1.917 = 7575 \ tpm$$

ACFM: 492,531 ✓

$$\%I = \frac{1.039 \times 86.987 \times 670}{0.8531 \times 26.82 \times 7575 \times 120 \times (0.171)^2} = 99.6 \%$$

12/6/06

SCFM: 297,911 ✓

%EA: 59.4 ✓

Date 30 November 2006

5/202

FIELD DATA

FIELD DATA

[illegible]

Job Number
Job Name
Run Number
Unit
Date
Operator
Sample Box No.

06-057
ADA-ES Hardin, MT
2
STACK
1 December 2006
Mullins, Goldman
1-1

05/202 Field Data

Ambient Temp. °F 31
Assumed Moisture % 15.3
Probe Length 9'
C Factor 3555.5 to reference
Initial Leak @ 15.0 °Hg = 0.003 cfm
Final Leak @ 7.0 °Hg = 0.001 cfm

Read and record at the start of each test point.

Purge to: 1458-1558
Purge time: 1458-1558
Pilot Leak Check Initial Final

Point	Clock Time	Dry Gas Meter, CF	"Pilot" °H ₂ O	Orifice ΔH °H ₂ O Desired	Orifice ΔH °H ₂ O Actual	Pump Vacuum °Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Notes	Remarks
A-10	1204	989.400	3.50	1.90	1.90	5.0	209	277	298	31	74	72	175	
9	1209	993.41	3.35	1.85	1.85	5.0	208	258	299	33	75	72	181	
8	1214	997.36	3.60	2.00	2.00	5.5	209	254	298	36	77	73	185	
7	1219	1001.39	3.60	2.00	2.00	5.5	209	265	299	37	79	74	187	
6	1224	1005.45	3.95	2.15	2.15	6.5	209	263	300	39	80	74	187	
5	1229	1009.65	3.60	2.00	2.00	6.0	209	257	300	39	81	75	187	
4	1234	1013.74	3.60	2.00	2.00	6.0	211	255	301	40	82	76	189	
3	1239	1017.84	4.00	2.20	2.20	7.0	211	252	300	40	83	76	190	
2	1244	1022.12	3.60	2.00	2.00	6.5	210	247	301	39	84	77	190	
2	1249	1026.30	3.45	1.90	1.90	6.0	206	244	301	38	84	78	190	
1	1254	1030.32	3.05	1.70	1.70	5.5	202	244	300	37	85	78	190	
1	1259	1034.15	3.00	1.65	1.65	5.5	202	243	300	36	85	79	190	
End	1304	1037.874	—	—	—	—	—	—	—	—	—	—	—	
B-10	1309	1037.874	3.75	2.05	2.05	6.5	206	260	302	32	84	79	186	
9	1314	1042.00	3.75	2.05	2.05	6.5	204	262	301	32	85	80	183	
8	1319	1046.14	3.95	2.15	2.15	7.0	203	267	300	31	85	80	178	
7	1324	1050.40	3.70	2.05	2.05	7.0	202	271	302	31	86	80	178	
6	1329	1054.62	3.35	1.85	1.85	6.5	203	268	301	31	86	81	176	

Pilot Tube Calibration Factor C, 0.823
Volume Collected V_m 95.513 ft³
Water Collected V_w 320.5 ml
Time of Test T_i 120 min.
Stack Pressure P_s -1.30 °H₂O

Pilot Tube No. 3-1
Baro. Press. P_b 27.08 °Hg
Probe Tip Dia. D_n 0.171 in.
% CO₂ 13.0 % CO 0.0
% O₂ 6.2 % N₂ 80.8
Area Stack A_s 9363 in²

Barometer No. — Probe Tip No. 4-2
Total Volume of Leak Checks After Start: 0 ft³
V_m X Dry Gas Meter Calibration Factor 0.985 X 96.968
[Dry Gas Meter Reading ft³ - (T_i min. X Leak Rate cfm)]

Impinger Box No. 1-1

Water Weight Gain

Impinger 1 Final Weight 969.7
 Initial Weight 739.6
 Increase 230.1

Impinger 2 Final Weight 818.8
 Initial Weight 763.5
 Increase 55.3

Impinger 3 Final Weight 739.0
 Initial Weight 731.6
 Increase 7.4

Impinger 4 Final Weight 938.9
 Initial Weight 911.2
 Increase 27.7

Impinger 5 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 6 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 7 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 1 230.1

Impinger 2 55.3

Impinger 3 7.4

Impinger 4 27.7

Impinger 5 _____

Impinger 6 _____

Impinger 7 _____

$V_w =$
 $g\ SO_2 =$
 $V_w =$

FILTER#:
A115

Total 320.5 = V_w

$P_b =$ 27.08 ✓
 $V_m =$ 95.513 ✓
 $V_w =$ 320.5 ✓
 $P_m =$ 1.927 ✓
 $Avg\ \Delta P =$ 3.500 ✓
 $Avg\ \sqrt{\Delta P} =$ 1.869 ✓
 $C_p =$ 0.823 ✓
 $P_s =$ -1.30 ✓
 $T_m =$ 81 °F
 $T_s =$ 206 °F

%CO₂ = 13.0 ✓
 %O₂ = 6.2 ✓
 %CO = 0.0 ✓
 %N₂ = 80.8 ✓
 $A_s =$ 9363 ✓
 $D_n =$ 0.171 ✓
 $T_i =$ 120 ✓

H_2O 26.98 ✓ °Hg
541 ✓ °R
666 ✓ °R

Moisture Content:

%M = 15.13 ✓ $M_d =$ 0.8487 ✓ $MW_c =$ 30.328 ✓ $MW =$ 28.46 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 95.513 \left[\frac{27.08 + \frac{1.927}{13.6}}{81 + 460} \right] = \frac{84.825}{0.707} \frac{sft^3}{scfm}$$

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times \frac{320.5}{84.825} = \frac{15.128}{12/1/06} \text{ sft}^3$$

$$\% \text{ Moisture} = \frac{V_{w_{gas}}}{Vm_{std} + V_{w_{gas}}} \times 100 = \frac{15.128}{84.825 + 15.128} \times 100 = 15.13\% \text{ ✓}$$

$$V_s = 5123.8 \times \frac{0.823}{\sqrt{26.98 \times 28.46}} \times \frac{1.869}{206} = 7340 \text{ fpm}$$

ACFM: 477,257 ✓

SCFM: 290,628 ✓

$$\%I = \frac{1.039 \times 84.825 \times 666}{0.8487 \times 26.98 \times 7340 \times 120 \times (0.171)^2} = 99.5\% \text{ ✓}$$

Check by: 15
10/6/06

%EA: 40.8 ✓

Run Number:

Stack

Date 1 December 2006

MS/202

FIELD DATA

[illegible]

Job Number 06-057
 Job Name 40A-ES Hardin, MT
 Run Number 3
 Unit Stack
 Date 2 December 2006
 Operator Mullins, Goldman
 Sample Box No. 1-1 Meter Box No. 1-1

5/202 Field Data
 Read and record at the start of each test point.

Ambient Temp. °F 25
 Assumed Moisture % 15
 Probe Length 9'
 C Factor 5.5 to reference
 Initial Leak @ 15.0 "Hg = 0.002 cfm
 Final Leak @ 7.5 "Hg = 0.000 cfm

Purge to: —
 Purge time: 1514-1614
 Pilot Leak Check Initial ✓ Final ✓

Point	Clock Time	Dry Gas Meter, CF	"Pilot" H ₂ O	Orifice ΔH H ₂ O Desired	Orifice ΔH H ₂ O Actual	Pump Vacuum "Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Handled Lane	Remarks
A-10	1215	214.444	3.65	2.00	2.00	5.5	204	269	300	30	73	71	176	
9	1220	218.61	3.65	2.00	2.00	5.5	204	273	300	34	75	72	190	
8	1225	222.67	3.60	1.95	1.95	5.0	205	278	300	37	77	73	200	
7	1230	226.65	3.55	1.90	1.90	5.0	203	286	300	38	79	73	206	
6	1235	230.60	3.40	1.85	1.85	5.0	202	292	300	39	81	74	210	
5	1240	234.52	3.60	1.95	1.95	5.0	205	293	301	39	82	75	211	
4	1245	238.50	3.70	2.00	2.00	5.5	208	288	300	40	83	75	208	
3	1250	242.58	3.60	1.95	1.95	5.5	207	283	301	40	84	76	209	Orsat
2	1255	246.61	3.45	1.90	1.90	5.5	204	280	300	40	85	77	208	
1	1300	250.58	3.45	1.90	1.90	5.5	204	276	300	40	85	77	207	
End	1315	262.212	—	—	—	—	—	—	—	—	—	—	—	
B-10	1319	262.212	3.85	2.10	2.10	5.5	204	290	301	36	84	79	207	
9	1324	266.32	3.80	2.05	2.05	6.0	204	285	300	39	85	79	207	
8	1329	270.43	3.75	2.05	2.05	6.0	204	289	300	41	86	80	207	
7	1334	274.55	3.70	2.00	2.00	6.0	204	296	299	42	87	80	209	
6	1339	278.62	3.40	1.85	1.85	5.5	205	301	300	43	87	80	209	

Pilot Tube Calibration Factor C_p 0.823
 Volume Collected V_m 94.604 ft³
 Water Collected V_w 309.1 ml
 Time of Test T_i 120 min.
 Slack Pressure P_s -1.45 "H₂O

Pilot Tube No. 3-1
 Baro. Press. P_b 27.52 "Hg
 Probe Tip Dia. D_n 0.171 in.
 % CO₂ 13.3 % CO 0.0
 % O₂ 6.2 % N₂ 80.5
 Area Stack A_s 9363 in²

Barometer No. — Probe Tip No. 4-2
 Total Volume of Leak Checks After Start: 0 ft³
 V_m X Dry Gas Meter Calibration Factor 0.935 X 96.045

[Dry Gas Meter Reading — ft³ - (T_i — min. X Leak Rate — cfm)]

Impinger Box No. 1-1

Water Weight Gain

Impinger 1 Final Weight 928.9
 Initial Weight 737.1
 Increase 191.8

Impinger 2 Final Weight 824.0
 Initial Weight 758.0
 Increase 66.0

Impinger 3 Final Weight 748.2
 Initial Weight 733.7
 Increase 14.5

Impinger 4 Final Weight 986.9
 Initial Weight 950.1
 Increase 36.8

Impinger 5 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 6 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 7 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 1 191.8

Impinger 2 66.0

Impinger 3 14.5

Impinger 4 36.8

Impinger 5 _____

Impinger 6 _____

Impinger 7 _____

Total 309.1 = V_w

$V_w =$
 $g\ SO_2 =$
 $V_w =$

Filter No. 116

$P_b = 27.52$
 $V_m = 94.604$
 $V_w = 309.1$
 $P_m = 1.927$
 $Avg\ \Delta P = 3.542$
 $Avg\ \sqrt{\Delta P} = 1.881$
 $C_p = 0.823$
 $P_s = -1.45$
 $T_m = 81$
 $T_s = 205$

$\%CO_2 = 13.3$
 $\%O_2 = 6.2$
 $\%CO = 0.0$
 $\%N_2 = 80.5$
 $A_s = 9363$
 $D_n = 0.171$
 $T_i = 120$
 27.41
 541
 665

Moisture Content:

$\%M = 14.59$ $M_d = 0.8541$ $MW_c = 30.376$ $MW = 28.57$

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 94.604 \left[\frac{27.52 + \frac{1.927}{13.6}}{81 + 460} \right] = \frac{85.376}{0.711} \frac{sft^3}{scfm}$$

$$Vw_{gas} = 0.0472 \times Vw = 0.0472 \times 309.1 = 14.590\ sft^3$$

$$\% \text{ Moisture} = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{14.590}{85.376 + 14.590} \times 100 = 14.59\%$$

$$V_s = 5123.8 \times \frac{0.823}{\sqrt{27.41 \times 28.57}} \times \frac{665}{1.881} = 7309\ lpm$$

ACFM: 475,264

SCFM: 296,329

$$\%I = \frac{1.039 \times 85.376 \times 665}{0.8541 \times 27.41 \times 7309 \times 120 \times (0.171)^2} = 98.2\%$$

$\%EA: 41.0$

Run Number 3
Unit Stack
Date 2 December 2006

D-35

ORSAT ANALYSIS DATA FORM

Job #: 06-057
 Job Name: ADA-ES
 Location: Hardin, MT
 Date: 11-30-06
 Operator: Hefley

Sample Location: Stack
 Analytical Method: 3
 Sample Type: Single Point / Multi Point Grab / Integrated
 Leak Check: Time: 5 min (≥ 4 minutes) Rate: 0.0
 Ambient Air Check:

CO ₂ - % Vol.	0.0
O ₂ - % Vol.	20.9
N ₂ - % Vol.	79.1

Run #: 1 (MS/202) 11/30/06
 Run Time: 1525

CO ₂ - % Vol.	12.1	12.1	12.2	12.1
O ₂ - % Vol.	7.9	7.9	7.8	7.9
CO - % Vol.	0.0	0.0	0.0	0.0
N ₂ - % Vol.	80.0	80.0	80.0	80.0

Run #: 2
 Run Time: 1210-1255 12/1/06

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO ₂ - % Vol.	13.0	13.0	13.0	13.0
O ₂ - % Vol.	6.2	6.2	6.2	6.2
CO - % Vol.	0.0	0.0	0.0	0.0
N ₂ - % Vol.	80.8	80.8	80.8	80.8

Run #: 3
 Run Time: 1250 12/2/06

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO ₂ - % Vol.	13.3	13.3	13.3	13.3
O ₂ - % Vol.	6.2	6.2	6.2	6.2
CO - % Vol.	0.0	0.0	0.0	0.0
N ₂ - % Vol.	80.5	80.5	80.5	80.5

Job Number
Job Name
Run Number
Unit
Date
Operator
Sample Box No.

06-057
ADA-ES (HARDIN, MT.)
1
STACK
1 December 2006
Mullins, Goldman
Meter Box No. 1-1

0H Field Data
Read and record at the start of each test point.
Purge to:
Purge time:
Pilot Leak Check Initial ☒ Final ☒

Ambient Temp. °F 27
Assumed Moisture % 15.3
Probe Length 91
C Factor 3.55 to reference
Initial Leak @ 15.0 °Hg = 0.005 cfm
Final Leak @ 6.0 °Hg = 0.001 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pilot" °H ₂ O	Orifice ΔH °H ₂ O Desired	Orifice ΔH °H ₂ O Actual	Pump Vacuum °Hg Gauge	Slack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Heated Line	Remarks
B-10	0850	909.834	3.75	1.35	1.35	4.5	209	251	250	26	64	62	189	
9	0902	913.26	3.70	1.35	1.35	4.5	210	250	250	31	64	63	189	
8	0907	916.64	3.75	1.35	1.35	4.5	210	251	250	32	66	63	187	
7	0912	920.00	3.85	1.35	1.35	4.5	210	251	250	33	68	64	183	
6	0917	923.31	3.80	1.35	1.35	4.5	211	251	250	33	70	65	183	
5	0922	926.61	3.60	1.30	1.30	4.5	212	252	250	34	71	65	184	
4	0927	929.91	3.60	1.30	1.30	4.5	211	252	249	36	73	67	189	
3	0932	933.19	3.65	1.30	1.30	4.5	211	252	252	36	74	67	190	
2	0937	936.47	3.50	1.25	1.25	4.5	210	253	251	37	75	68	191	
2	0942	939.68	3.80	1.35	1.35	5.0	211	253	250	39	76	70	196	
1	0947	943.00	3.10	1.10	1.10	4.5	212	252	251	39	77	70	200	
1	0952	946.09	3.30	1.15	1.15	4.5	213	253	250	41	78	71	203	Drat
End	0957	949.154	—	—	—	—	—	—	—	—	—	—	—	
A-10	1005	949.154	3.60	1.30	1.30	5.0	215	253	250	36	77	73	201	
9	1010	952.45	3.60	1.30	1.30	5.0	214	253	250	38	77	73	192	
8	1015	955.77	3.75	1.35	1.35	5.0	213	255	252	38	78	74	188	
7	1020	959.10	3.75	1.35	1.35	5.0	212	253	248	38	79	74	184	
6	1025	962.47	3.60	1.30	1.30	5.0	212	252	249	38	80	74	183	

Pilot Tube Calibration Factor C, 0.824
Volume Collected V_m 77.921 ft³
Water Collected V_w 257.1 ml
Time of Test T_i 120 min.
Slack Pressure P_s -1.55 °H₂O
Pilot Tube No. 3-2
Baro. Press. P_b 27.05 °Hg
Probe Tip Dia. D_n 0.154 in.
% CO₂ 12.8 % CO 0.0
% O₂ 6.2 % N₂ 81.0
Area Slack A_s 9363 in²
Barometer No.
Total Volume of Leak Checks After Start: 0 ft³
V_m X Dry Gas Meter Calibration Factor 0.985 X 77.908
Probe Tip No. 7-8 7-8
[Dry Gas Meter Reading — ft³ - (T_i — min. X Leak Rate — cfm)]

Impinger Box No. M-3

Water Weight Gain

Impinger 1 Final Weight 943.6
 Initial Weight 738.6
 Increase 205.0

Impinger 2 Final Weight 782.5
 Initial Weight 752.5
 Increase 30.0

Impinger 3 Final Weight 754.9
 Initial Weight 750.6
 Increase 4.3

Impinger 4 Final Weight 740.7
 Initial Weight 739.0
 Increase 1.7

Impinger 5 Final Weight 735.0
 Initial Weight 735.4
 Increase -0.4

Impinger 6 Final Weight 743.6
 Initial Weight 744.2
 Increase -0.6

Impinger 7 Final Weight 741.5
 Initial Weight 741.6
 Increase -0.1

Imp 8 942.3
- 945.1
17.2

$V_w =$
 $g SO_2 =$
 $V_w =$

Impinger 1 205.0

Impinger 2 30.0

Impinger 3 4.3

Impinger 4 1.7

Impinger 5 -0.4

Impinger 6 -0.6

Impinger 7 -0.1

Impinger 8 17.2

Total 257.1 = V_w

FILTER 4:
A117

$P_b =$ 27.05 ✓ $\%CO_2 =$ 12.8 ✓
 $V_m =$ 77.921 ✓ $\%O_2 =$ 6.2 ✓
 $V_w =$ 257.1 ✓ $\%CO =$ 0.0 ✓
 $P_m =$ 1.294 ✓ $\%N_2 =$ 81.0 ✓
 $Avg \Delta P =$ 3.606 ✓ $A_s =$ 9363 ✓
 $Avg \sqrt{\Delta P} =$ 1.898 ✓ $D_n =$ 0.154 ✓
 $C_p =$ 0.8234 ✓ $T_1 =$ 120 ✓
 $P_s =$ -1.55 ✓ H_2O 12.1/02 26.94 ✓ °Hg
 $T_m =$ 73 ✓ °F 533 ✓ °R
 $T_s =$ 212 ✓ °F 672 ✓ °R

Moisture Content:

$\%M =$ 14.77 ✓ $M_d =$ 0.8523 ✓ $MW_d =$ 30.296 ✓ $MW =$ 28.48 ✓

$$Vm_{std} = 17.65 Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 77.921 \left[\frac{27.05 + \frac{1.294}{13.6}}{73 + 460} \right] = \frac{70.043}{0.584} \frac{sft^3}{scfm}$$

$$Vw_{gas} = 0.0472 \times Vw = 0.0472 \times 257.1 = 12.135 \text{ sft}^3$$

$$\% \text{ Moisture} = \frac{Vw_{gas}}{Vm_{std} + Vw} \times 100 = \frac{12.135}{70.043 + 12.135} \times 100 = 14.77 \%$$

$$V_s = 5123.8 \times \frac{0.823}{26.94 \times 28.48} \times \frac{672}{1.898} = 7499 \text{ tpm}$$

$$\%I = \frac{1.039 \times 70.043 \times 672}{0.8523 \times 26.94 \times 7499 \times 120 \times (0.154)^2} = 99.8 \%$$

ACFM: 487623 ✓

SCFM: 295,083 ✓

$\%EA:$ 40.6 ✓

FIELD DATA

Unit Stack

Date 1 December 2006

P³

 T^g Γ^E [illegible]

Job Number

Job Name

Run Number

Unit

Date

Operator

Sample Box No.

Meter Box No.

 ΔP_s

06-057

ADA-ES Harding, MT

2

Stack

2 December 2006

Mullins, Goldman

1-1

 P_m

0H

Field Data

Read and record at the start of each test point.

Purge to:

Purge time:

Pilot Leak Check Initial

Final

 T_m

Ambient Temp. °F

Assumed Moisture %

Probe Length

C Factor

Initial Leak @ 15.0 °Hg = 0.003 cfm

Final Leak @ 6.0 °Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pilot" H_2O	Orifice ΔH H_2O Desired	Orifice ΔH H_2O Actual	Pump Vacuum Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Headed Line	Remarks
6-10	0919	135.354	3.70	1.30	1.30	3.0	205	261	250	16	53	52	226	
9	0924	138.66	3.85	1.35	1.35	3.0	206	261	250	22	53	52	226	
8	0929	141.94	3.80	1.35	1.35	3.0	206	261	248	26	54	52	224	
7	0934	145.200	3.65	1.30	1.30	3.0	205	260	250	28	56	53	223	
6	0939	148.46	3.60	1.30	1.30	3.0	205	260	250	29	57	54	222	
5	0944	151.71	3.60	1.30	1.30	3.0	208	261	250	31	59	54	222	
4	0949	154.93	3.70	1.30	1.30	3.0	210	261	250	32	60	54	221	
3	0954	158.13	3.70	1.30	1.30	3.0	210	261	250	34	61	55	222	
2	0959	161.34	3.45	1.25	1.25	3.0	208	258	250	35	62	56	224	
2	1004	164.50	3.55	1.25	1.25	3.0	208	260	250	35	63	56	220	
1	1009	167.68	3.05	1.10	1.10	3.0	206	260	249	36	64	57	221	
1	1014	170.65	3.20	1.15	1.15	3.0	206	259	250	35	64	57	222	
End	1019	173.597	—	—	—	—	—	—	—	—	—	—	—	
A-10	1024	173.597	3.80	1.35	1.35	3.5	210	261	250	32	64	58	230	
9	1029	176.94	3.85	1.35	1.35	4.0	210	260	251	37	65	59	232	
8	1034	180.31	4.10	1.45	1.45	4.5	208	260	251	40	67	60	234	Orsat
7	1039	183.75	3.85	1.35	1.35	4.0	207	262	250	40	68	60	235	
6	1044	187.14	3.60	1.30	1.30	4.0	208	261	250	42	69	61	232	

Pilot Tube Calibration Factor C_p Volume Collected V_m Water Collected V_w Time of Test T_1 Slack Pressure P_s
 ΔP_s

Pilot Tube No.

Baro. Press. P_b Probe Tip Dia. D_n % CO_2 % O_2 Area Slack A_s

Barometer No.

Total Volume of Leak Checks After Start:

 $V_m \times$ Dry Gas Meter Calibration Factor

[Dry Gas Meter Reading

min. $\times$ Leak Rate

cfm)]

Probe Tip No.

Total Volume of Leak Checks After Start:

 $V_m \times$ Dry Gas Meter Calibration Factor

[Dry Gas Meter Reading

min. $\times$ Leak Rate

cfm)]

Impinger Box No. M-3

Water Weight Gain

Impinger 1	Final Weight	<u>931.3</u>
	Initial Weight	<u>741.1</u>
	Increase	<u>190.2</u>
Impinger 2	Final Weight	<u>796.8</u>
	Initial Weight	<u>747.7</u>
	Increase	<u>49.1</u>
Impinger 3	Final Weight	<u>766.8</u>
	Initial Weight	<u>756.5</u>
	Increase	<u>10.3</u>
Impinger 4	Final Weight	<u>752.3</u>
	Initial Weight	<u>749.4</u>
	Increase	<u>2.9</u>
Impinger 5	Final Weight	<u>742.0</u>
	Initial Weight	<u>742.4</u>
	Increase	<u>-0.4</u>
Impinger 6	Final Weight	<u>751.4</u>
	Initial Weight	<u>751.9</u>
	Increase	<u>-0.5</u>
Impinger 7	Final Weight	<u>747.9</u>
	Initial Weight	<u>748.6</u>
	Increase	<u>-0.7</u>

Imp. 8

Final 975.9
Initial 961.6
14.3

Impinger 1	<u>190.2</u>
Impinger 2	<u>49.1</u>
Impinger 3	<u>2.9</u> ^(P5) <u>10.3</u>
Impinger 4	<u>2.9</u>
Impinger 5	<u>-0.4</u>
Impinger 6	<u>-0.5</u>
Impinger 7	<u>-0.7</u>
Imp 8	<u>14.3</u>
Total	<u>265.2</u> = V_w

$V_w =$
 $g SO_2 =$
 $V_w =$

Filter No.
A118

$P_b = 27.52$
 $V_m = 76.711$
 $V_w = 265.2$
 $P_m = 1.292$
Avg $\Delta P = 3.644$
Avg $\sqrt{\Delta P} = 1.908$
 $C_p = 0.824$
 $P_s = -1.40$ H_2O
 $T_m = 62$ $^{\circ}F$
 $T_s = 207$ $^{\circ}F$

$\%CO_2 = 13.2$ $\checkmark$
 $\%O_2 = 6.4$ $\checkmark$
 $\%CO = 0.0$ $\checkmark$
 $\%N_2 = 80.4$ $\checkmark$
 $A_n = 936.3$ $\checkmark$
 $D_n = 0.154$ $\checkmark$
 $T_1 = 120$ $\checkmark$
 27.42 $^{\circ}Hg$
 522 $^{\circ}R$
 667 $^{\circ}R$

Moisture Content:

$\%M = 14.88$ $\checkmark$ $M_d = 0.8512$ $\checkmark$ $MW_c = 30.368$ $\checkmark$ $MW = 28.53$ $\checkmark$

$$Vm_{std} = 17.65 Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 76.711 \left[\frac{27.52 + \frac{1.292}{13.6}}{62 + 460} \right] = \frac{71.627}{0.597} \frac{ft^3}{scfm}$$

$$Vw_{gas} = 0.0472 \times Vw = 0.0472 \times 265.2 = 12.517 \text{ ft}^3$$

$$\% \text{ Moisture} = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{12.517}{71.627 + 12.517} \times 100 = 14.88 \%$$

$$V_s = 5123.8 \times \frac{0.824}{27.42 \times 28.53} \times \frac{667}{1.908} = 7438 \text{ tpm}$$

$$\%I = \frac{1.039 \times 71.627 \times 667}{0.8512 \times 27.42 \times 7438 \times 120 \times (0.154)^2} = 100.5 \%$$

ACFM: 483,647 $\checkmark$
SCFM: 299,743 $\checkmark$
 $\%EA: 42.9$ $\checkmark$
(P5)
12/6/06

FIELD DATA
04

Run Number	2
Unit	Stack

Date 2 December 2006

[illegible]

Job Number
Job Name
Run Number
Unit

06-057
ADA-ES (HARDIN, MT)
3
STACK

Date

2 December 2006

Operator

Mullins, ~~Stack~~ Jackson

Sample Box No.

M-3

Meter Box No.

1-1

Read and record at the start of each test point.

Purge to:

Purge time:

Pilot Leak Check Initial

Final

Field Data

08

Ambient Temp. °F

Assumed Moisture %

Probe Length

C Factor

Initial Leak @ 15.0 °Hg = 0.006 cfm

Final Leak @ 5.0 °Hg = 0.000 cfm

ΔP_s

P_n

T_s

T_m

Point	Clock Time	Dry Gas Meter, CF	"Pilot" H_2O	Orifice ΔH H_2O Desired	Orifice ΔH H_2O Actual	Pump Vacuum Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Heat exchanger Line	Remarks
8-10	1712	312.200	4.20	1.50	1.50	5.0	218	256	250	18	77	77	172	
9	1717	315.76	3.85	1.35	1.35	4.5	218	256	250	22	77	77	175	
8	1722	319.16	3.50	1.25	1.25	4.0	216	256	250	23	78	77	178	
7	1727	322.42	3.50	1.25	1.25	4.0	213	258	249	24	79	77	183	
6	1732	325.63	3.65	1.30	1.30	4.0	212	259	250	24	80	77	195	
5	1737	328.88	3.75	1.35	1.35	4.0	214	257	250	26	81	77	200	
4	1742	332.25	3.50	1.25	1.25	4.0	213	257	250	26	82	77	204	
3	1747	335.50	3.45	1.25	1.25	4.0	212	258	250	26	83	78	206	
2	1752	338.74	3.35	1.20	1.20	4.0	211	256	251	27	83	78	205	Orsat
2	1757	341.95	3.35	1.20	1.20	4.0	211	252	250	27	84	78	201	
1	1802	345.12	2.95	1.05	1.05	4.0	213	252	250	27	84	78	201	
1	1807	348.13	2.95	1.05	1.05	4.0	216	257	250	27	84	78	203	
End	1812	351.073	-	-	-	-	-	-	-	-	-	-	-	
A-10	1817	351.073	3.60	1.30	1.30	4.5	216	259	250	26	82	79	216	
9	1822	354.37	3.45	1.25	1.25	4.5	215	258	250	29	83	79	220	
8	1827	357.61	3.50	1.25	1.25	4.5	213	258	251	30	83	79	222	
7	1832	360.85	3.65	1.30	1.30	4.5	212	260	250	33	84	79	225	
6	1837	364.14	3.40	1.20	1.20	4.5	211	260	251	35	85	79	229	

Pilot Tube Calibration Factor C_p

0.824

Volume Collected V_m

76.188

Water Collected V_w

247.2

Time of Test T_1

120

Stack Pressure P_s

-1.35

Pilot Tube No.

3-2

Baro. Press. P_b

27.55

Probe Tip Dia. D_n

0.154

% CO_2

13.3

% CO

0.0

% O_2

6.2

% N_2

80.5

Area Stack A_s

9363

Barometer No.

-

Total Volume of Leak Checks After Start:

0

$V_m \times \text{Dry Gas Meter Calibration Factor}$

0.985

$\times$

77.348

Probe Tip No.

5-8

[Dry Gas Meter Reading $\text{ft}^3 \cdot (T_1 \text{ min.} \times \text{Leak Rate cfm})$]

Impinger Box No. M-3

Water Weight Gain

Impinger 1	Final Weight	<u>930.4</u>		Impinger 1	<u>189.0</u>
	Initial Weight	<u>741.4</u>	#3 FINAL <u>937.7</u>	Impinger 2	<u>37.1</u>
	Increase		INITIAL <u>924.9</u>	Impinger 3	<u>6.8</u>
Impinger 2	Final Weight	<u>785.5</u>	INC.	Impinger 4	<u>2.1</u>
	Initial Weight	<u>748.4</u>		Impinger 5	<u>0.0</u>
	Increase			Impinger 6	<u>-0.2</u>
Impinger 3	Final Weight	<u>771.6</u>	$V_w =$	Impinger 7	<u>-0.4</u>
	Initial Weight	<u>764.8</u>	g SO ₂ =	Total	<u>247.2</u> = V _w
	Increase		$V_w =$		
Impinger 4	Final Weight	<u>739.1</u>	FILTER #		
	Initial Weight	<u>737.0</u>	A119		
	Increase				
Impinger 5	Final Weight	<u>742.6</u>	P _b = <u>27.55</u> ✓	%CO ₂ = <u>13.3</u> ✓	
	Initial Weight	<u>742.6</u>	V _m = <u>76.188</u> ✓	%O ₂ = <u>6.2</u> ✓	
	Increase		V _w = <u>247.2</u> ✓	%CO = <u>0.0</u> ✓	
Impinger 6	Final Weight	<u>749.3</u>	P _m = <u>1.235</u> ✓	%N ₂ = <u>80.5</u> ✓	
	Initial Weight	<u>749.5</u>	Avg ΔP = <u>3.452</u> ✓	A _s = <u>9363</u> ✓	
	Increase		Avg √ΔP = <u>1.856</u> ✓	D _n = <u>0.154</u> ✓	
Impinger 7	Final Weight	<u>744.3</u>	C _p = <u>0.824</u> ✓	T _i = <u>120</u> ✓	
	Initial Weight	<u>744.7</u>	P _s = <u>-1.35</u> ✓		
	Increase		T _m = <u>81</u> ✓		
			T _s = <u>212</u> ✓		

Moisture Content:

%M = 14.52✓ M_d = 0.8548✓ MW_c = 30.376✓ MW = 28.58✓

$$V_{m_{std}} = 17.65 V_m \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 76.188 \left[\frac{27.55 + \frac{1.235}{13.6}}{81 + 460} \right] = \frac{68.704}{0.573} \frac{\text{ft}^3}{\text{scfm}}$$

V_{w_{gas}} = 0.0472 x V_w = 0.0472 x 247.2 = 11.668✓ ft³

% Moisture = $\frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{11.668}{68.704 + 11.668} \times 100 = \underline{14.52}\%$ ✓

V_s = 5123.8 x 0.824✓ $\sqrt{\frac{672}{27.45 \times 28.58}}$ x 1.856✓ = 7252✓ tpm

ACFM: 471.355✓

SCFM: 291.619✓

%I = $\frac{1.039 \times 68.704 \times 672}{7252 \times 27.45 \times 0.8548 \times 120 \times (0.154)^2}$ = 99.1✓% (B)✓

%EA: 41.0✓

074

Date 2 December 2006

2 December 2006

2 December 2006

2 December 2006

D-45

ORSAT ANALYSIS DATA FORM

Job #: 06-057
 Job Name: ADA-ES
 Location: Hardin, MT
 Date: 11-30-06
 Operator: Hefley

Sample Location: Stack
 Analytical Method: 3
 Sample Type: Single Point / Multi Point Grab / Integrated
 Leak Check: Time: 5 min (≥ 4 minutes) Rate: 0.0
 Ambient Air Check:

CO ₂ - % Vol.	0.0
O ₂ - % Vol.	20.9
N ₂ - % Vol.	79.1

Run #: 1 (24A)

Run Time: 1745

CO ₂ - % Vol.	11.6	11.7	11.5	11.6
O ₂ - % Vol.	7.6	7.6	7.5	7.6
CO - % Vol.	0.0	0.0	0.0	0.0
N ₂ - % Vol.	80.8	80.7	81.0	80.8

Run #: 2

Run Time: 1645

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO ₂ - % Vol.	12.8	12.8	12.8	12.8
O ₂ - % Vol.	6.7	6.7	6.7	6.7
CO - % Vol.	0.0	0.0	0.0	0.0
N ₂ - % Vol.	80.5	80.5	80.5	80.5

Run #: 3

Run Time: 2120

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO ₂ - % Vol.	13.2	13.2	13.2	13.2
O ₂ - % Vol.	6.3	6.3	6.3	6.3
CO - % Vol.	0.0	0.0	0.0	0.0
N ₂ - % Vol.	80.5	80.5	80.5	80.5

Job Number
Job Name
Run Number
Unit
Date
Operator
Sample Box No.

26-057
ADA-ES Hardin, MT
Stack
30 November 2006
Mullins, Goldmark
2-1 Meter Box No. 1-1

Field Data

Read and record at the start of each test point.

Purge to:
Purge line:
Pilot Leak Check Initial ☒ Final ☒

Ambient Temp. °F 34
Assumed Moisture % 0.5
Probe Length 9' to reference
C Factor 3.9
Initial Leak @ 15.0 "Hg = 0.004 cfm
Final Leak @ 6.0 "Hg = 0.001 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pilot" H ₂ O	Orifice ΔH H ₂ O Desired	Orifice ΔH H ₂ O Actual	Pump Vacuum "Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Heated Line	Remarks
A-10	1642	859.212	3.45	1.35	1.35	4.0	213	225	249	33	76	77	199	
9	1645	861.22	3.85	1.50	1.50	4.5	214	225	251	33	76	77	200	
8	1648	863.34	3.85	1.50	1.50	4.5	216	225	251	34	76	77	203	
7	1651	865.46	3.70	1.45	1.45	4.5	217	250	249	34	77	76	205	
6	1654	867.56	3.85	1.50	1.50	4.5	218	255	251	35	78	76	207	
5	1657	869.67	3.70	1.45	1.45	4.5	219	255	251	36	79	76	207	
4	1700	871.80	3.60	1.40	1.40	4.5	218	249	251	36	80	76	209	
3	1703	873.86	3.75	1.45	1.45	4.5	216	254	250	37	80	76	211	
2	1706	875.96	3.65	1.45	1.45	4.5	216	253	250	38	81	76	212	
1	1709	878.06	3.65	1.45	1.45	4.5	215	254	250	39	81	76	214	
1	1712	880.15	3.20	1.35	1.35	4.5	214	255	250	40	81	76	215	
1	1715	882.20	3.20	1.35	1.35	4.5	213	252	250	40	81	76	216	
End	1718	884.205	—	—	—	—	—	—	—	—	—	—	—	
B-10	1723	884.205	3.90	1.55	1.55	4.5	212	254	250	35	79	76	217	
9	1726	886.34	3.95	1.55	1.55	5.0	211	248	250	38	80	76	217	
8	1729	888.50	3.90	1.55	1.55	5.0	210	255	249	39	81	76	216	
7	1732	890.69	3.70	1.45	1.45	5.0	210	257	250	39	81	77	217	
6	1735	892.83	3.65	1.45	1.45	5.0	208	258	250	39	82	77	217	

Pilot Tube Calibration Factor C_p 0.824

Volume Collected V_m 49.389 ft³

Water Collected V_w 167.5 ml

Time of Test T_i 72 min.

Stack Pressure P_s -1.60 "H₂O

Pilot Tube No. 4-1

Baro. Press. P_b 26.94 "Hg

Probe Tip Dia. D_n 0.154 in.

% CO₂ 11.6 % CO 0.0

% O₂ 7.6 % N₂ 80.8

Area Stack A_s 9363 in²

Barometer No. —

Total Volume of Leak Checks After Start: 0 ft³

V_m X Dry Gas Meter Calibration Factor 0.985 X 50.141

[Dry Gas Meter Reading ft³ - (T_i min. X Leak Rate cfm)]

Probe Tip No. 5-8

Impinger Box No. 2-1

Water Weight Gain

Impinger 1 Final Weight 883.7
 Initial Weight 765.5
 Increase 118.2

Impinger 2 Final Weight 761.8
 Initial Weight 731.5
 Increase 30.3

Impinger 3 Final Weight 742.2
 Initial Weight 737.0
 Increase 5.2

Impinger 4 Final Weight 729.6
 Initial Weight 728.4
 Increase 1.2

Impinger 5 Final Weight 849.7
 Initial Weight 937.1
 Increase 12.6

Impinger 6 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 7 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 1 118.2

Impinger 2 30.3

Impinger 3 5.2

Impinger 4 1.2

Impinger 5 12.6

Impinger 6 _____

Impinger 7 _____

$V_w =$
 $g\ SO_2 =$
 $V_w =$

Filter No. A092

Total 167.5 = V_w

$P_b =$ 26.94 ✓
 $V_m =$ 49.389 ✓
 $V_w =$ 167.5 ✓
 $P_m =$ 1.433 ✓
 $Avg\ \Delta P =$ 3.631 ✓

%CO₂ = 11.6 ✓
 %O₂ = 7.6 ✓
 %CO = 0.0 ✓
 %N₂ = 80.8 ✓
 $A_s =$ 9363 ✓
 $D_n =$ 0.154 ✓
 $T_i =$ 72 ✓

$Avg\ \sqrt{\Delta P} =$ 1.905 ✓
 $C_p =$ 0.824 ✓
 $P_s =$ -1.60 °H₂O
 $T_m =$ 79 °F
 $T_s =$ 211 °F

26.82 °Hg
539 °R
671 °R

Moisture Content:

%M = 15.31 ✓ $M_d =$ 0.8469 ✓ $MW_c =$ 30.160 ✓ $MW =$ 28.30 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 49.389 \left[\frac{26.94 + \frac{1.433}{13.6}}{79 + 460} \right] = \frac{43.740}{0.607} \frac{sft^3}{scfm}$$

$$Vw_{gas} = 0.0472 \times Vw = 0.0472 \times \underline{167.5} = \underline{7.906} \text{ sft}^3 \checkmark$$

$$\% \text{ Moisture} = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{7.906}{43.740 + 7.906} \times 100 = \underline{15.31} \% \checkmark$$

$$V_s = 5123.8 \times \underline{0.824} \sqrt{\frac{671}{26.82 \times 28.30}} \times \underline{1.905} = \underline{7562} \text{ fpm} \checkmark$$

$$\%I = \frac{1.039 \times 43.740 \times 671}{0.8469 \times 26.82 \times 7562 \times 72 \times (0.154)^2} = \underline{104.0} \% \text{ (P5) } \checkmark$$

ACFM: 491,706 ✓

SCFM: 294,798 ✓

%EA: 55.0 ✓

Run Number 1Unit Stack

Date 30 November 2006

FIELD DATA

[illegible]

Job Number
Job Name
Run Number
Unit
Date
Operator
Sample Box No.

06-057
APA-ES Hardin, MT
2
STACK
1 December 2006
Mullins, Goldman
1-2 Meter Box No. J-1

26A Field Data
Read and record at the start of each test point.
Purge to: _____
Purge time: _____
Pilot Leak Check Initial ☒ Final ☒

Ambient Temp. °F 29
Assumed Moisture % 14.8
Probe Length 9' to reference
C Factor 3.55
Initial Leak @ 15.0 "Hg = 0.004 cfm
Final Leak @ 6.0 "Hg = 0.001 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pilot" "H ₂ O	Orifice ΔH "H ₂ O Desired	Orifice ΔH "H ₂ O Actual	Pump Vacuum "Hg Gauge	Slack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Heated Line	Remarks
B-10	1509	86.726	3.65	1.30	1.30	4.0	202	230	248	25	74	74	172	
9	1512	88.80	3.55	1.25	1.25	4.0	201	235	250	27	74	74	170	
8	1515	90.85	3.60	1.25	1.25	4.0	201	238	251	27	74	74	171	
7	1518	92.79	3.65	1.30	1.30	4.0	201	238	250	27	75	74	169	
6	1521	94.78	3.60	1.25	1.25	4.0	201	238	250	27	76	74	168	
5	1524	96.77	3.70	1.30	1.30	4.5	202	238	250	27	76	74	167	
4	1527	98.78	3.70	1.30	1.30	4.5	203	238	250	29	77	74	166	
3	1530	100.77	3.60	1.25	1.25	4.0	202	239	251	28	77	74	167	
2	1533	102.72	3.60	1.25	1.25	4.0	201	241	252	28	78	74	167	Orsat
2	1536	104.65	3.70	1.30	1.30	4.0	202	245	251	29	78	74	168	
1	1539	106.60	3.20	1.15	1.15	4.0	201	248	250	29	79	74	170	
1	1542	108.50	3.45	1.25	1.25	4.0	201	247	251	30	79	74	169	
End	1545	110.439	—	—	—	—	—	—	—	—	—	—	—	
A-10	1550	110.439	3.50	1.25	1.25	4.0	202	231	249	26	77	74	170	
9	1553	112.42	3.50	1.25	1.25	4.0	202	223	250	27	77	75	169	
8	1556	114.38	3.60	1.25	1.25	4.0	202	225	251	27	77	75	170	
7	1559	116.35	3.90	1.40	1.40	5.0	205	225	249	27	77	75	171	
6	1602	118.38	3.75	1.35	1.35	4.5	207	230	250	28	78	74	167	

Pilot Tube Calibration Factor C_p 0.824
Volume Collected V_m 47.095 ft³
Water Collected V_w 157.8 ml
Time of Test T_1 72 min.
Slack Pressure P_s -1.80 "H₂O

Pilot Tube No. 4-1
Baro. Press. P_b 27.17 "Hg
Probe Tip Dia. D_r 0.154 in.
% CO₂ 12.8 % CO 0.0
% O₂ 6.7 % N₂ 80.5
Area Slack A_s 9363 in²

Barometer No. —
Total Volume of Leak Checks After Start: 0 ft³
 $V_m \times$ Dry Gas Meter Calibration Factor 0.985 $\times$ 47.812
[Dry Gas Meter Reading ft³ - (T_1 min. $\times$ Leak Rate cfm)]

Impinger Box No. 1-2

Water Weight Gain

Impinger 1 Final Weight 902.0
Initial Weight 765.2
Increase 136.8 12/1/06

Impinger 2 Final Weight 745.4
Initial Weight 733.2
Increase 12.2

Impinger 3 Final Weight 752.4
Initial Weight 751.1
Increase 1.5

Impinger 1 136.8
Impinger 2 12.2
Impinger 3 1.5
Impinger 4 0.2
Impinger 5 7.1
Impinger 6

Impinger 4 Final Weight 734.8
Initial Weight 734.6
Increase 0.2

Impinger 5 Final Weight 956.7
Initial Weight 949.6
Increase 7.1

Impinger 6 Final Weight
Initial Weight
Increase

Impinger 7 Final Weight
Initial Weight
Increase

$V_w =$
 $g SO_2 =$
 $V_w =$

FILTER # A112

$P_b = 27.17$ ✓
 $V_m = 47.095$ ✓
 $V_w = 157.8$ ✓
 $P_m = 1.281$ ✓
Avg $\Delta P = 3.615$ ✓
Avg $\sqrt{\Delta P} = 1.900$ ✓
 $C_p = 0.824$ ✓
 $P_s = -1.80$ ✓
 $T_m = 76$ °F ✓
 $T_s = 204$ °F ✓

Total 157.8 = V_w
%CO₂ = 12.8 ✓
%O₂ = 6.57 12/1/06 ✓
%CO = 0.0 ✓
%N₂ = 80.5 ✓
 $A_s = 9363$ ✓
 $D_n = 0.154$ ✓
 $T_i = 72$ ✓
27.04 °Hg ✓
536 °R ✓
664 °R ✓

Moisture Content:

%M = 14.98 ✓ $M_d = 0.8502$ ✓ $MW_d = 30.316$ ✓ $MW = 28.47$ ✓

$$Vm_{std} = 17.65 Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 47.095 \left[\frac{27.17 + \frac{1.281}{13.6}}{76 + 460} \right] = \frac{42.281}{0.587} \frac{ft^3}{scfm}$$

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 157.8 = 7.448 \text{ ft}^3$$

$$\% \text{ Moisture} = \frac{V_{w_{gas}}}{Vm_{std} + V_{w_{gas}}} \times 100 = \frac{7.448}{42.281 + 7.448} \times 100 = 14.98 \%$$

$$V_s = 5123.8 \times \frac{0.824}{22.04 \times 28.47} \times \frac{664}{1.900} = 7450 \text{ tpm}$$

$$\%I = \frac{1.039 \times 42.281 \times 664}{0.8502 \times 27.04 \times 7450 \times 72 \times (0.154)^2} = 99.7 \%$$

ACFM: 484,409 ✓
SCFM: 297,054 ✓
%EA: 45.8 ✓

2.

Unit Stack

Date 1 December 2006

26A FIELD DATA

FIELD DATA

[illegible]

Job Number
Job Name
Run Number
Unit
Date
Operator
Sample Box No. 2-

06-057
APA-ES Hardin, MT
3
Stack
2 December 2006
Mullins, Jackson

2617 Field Data
Read and record at the start of each test point.
Purge to:
Purge time:
Pilot Leak Check Initial ☒ Final ☒

Ambient Temp. °F 13
Assumed Moisture % 15
Probe Length 9' to reference
C Factor 3.55
Initial Leak @ 15.0 "Hg = 0.004 cfm
Final Leak @ 5.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pilot" "H ₂ O"	Orifice ΔH "H ₂ O" Desired	Orifice ΔH "H ₂ O" Actual	Pump Vacuum "Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Heated Line	Remarks
A-10	2025	389.900	3.50	1.25	1.25	4.0	212	226	250	16	74	75	107	
9	2028	391.87	3.45	1.25	1.25	4.0	213	233	250	21	74	75	94	
8	2031	393.84	3.50	1.25	1.25	4.0	213	245	250	22	75	75	92	
7	2034	395.77	3.60	1.30	1.30	4.0	213	248	251	24	75	74	124	
6	2037	397.73	3.50	1.25	1.25	4.0	213	247	250	24	76	74	141	
5	2040	399.69	3.50	1.25	1.25	4.0	212	249	250	26	77	74	154	
4	2043	401.61	3.50	1.25	1.25	3.5	212	248	250	26	78	74	166	
3	2046	403.55	3.60	1.30	1.30	3.5	212	247	250	27	78	74	177	
2	2049	405.48	3.50	1.25	1.25	3.5	213	246	250	27	79	74	186	
2	2052	407.43	3.45	1.25	1.25	3.5	212	246	251	27	79	74	195	
1	2055	409.35	2.90	1.05	1.05	3.5	211	246	250	28	80	74	201	
1	2058	411.18	2.90	1.05	1.05	3.5	211	248	250	28	80	75	207	
End	2101	412.983	—	—	—	—	—	—	—	—	—	—	—	
B-10	2105	412.983	3.65	1.30	1.30	4.0	213	247	251	26	78	75	220	
9	2108	414.96	3.60	1.30	1.30	4.0	214	246	250	28	79	75	223	
8	2111	416.95	3.60	1.30	1.30	4.0	214	247	251	29	79	75	225	
7	2114	418.94	3.60	1.30	1.30	4.0	214	246	249	30	80	75	227	
6	2117	420.92	3.60	1.30	1.30	4.0	215	246	250	31	80	75	229	Onsat

Pilot Tube Calibration Factor C_p 0.824
Volume Collected V_m 45.665 ft³
Water Collected V_w 154.3 ml
Time of Test T_i 72 min.
Stack Pressure P_s -1.25 "H₂O

Pilot Tube No. 4-1
Baro. Press. P_b 27.55 "Hg
Probe Tip Dia. D_n 0.154 in.
% CO₂ 13.2 % CO 0.0
% O₂ 6.3 % N₂ 80.5
Area Stack A_s 9363 in²

Barometer No.
Total Volume of Leak Checks After Start: 0 ft³
V_m X Dry Gas Meter Calibration Factor 0.985 X 46.360
Probe Tip No. 5-8

[Dry Gas Meter Reading ft³ - (T_i min. X Leak Rate cfm)]

Impinger Box No. 2-1

Water Weight Gain

Impinger 1 Final Weight 884.7
 Initial Weight 769.7
 Increase 115.0

Impinger 2 Final Weight 753.6
 Initial Weight 729.1
 Increase 24.5

Impinger 3 Final Weight 752.3
 Initial Weight 748.4
 Increase 3.9

Impinger 4 Final Weight 737.2
 Initial Weight 736.5
 Increase 0.7

Impinger 5 Final Weight 948.4
 Initial Weight 958.2
 Increase 10.2

Impinger 6 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 7 Final Weight _____
 Initial Weight _____
 Increase _____

Impinger 1 115.0

Impinger 2 24.5

Impinger 3 3.9

Impinger 4 0.7

Impinger 5 10.2

Impinger 6 _____

Impinger 7 _____

$V_w =$
 $g\ SO_2 =$
 $V_w =$

Filter No. A113

Total 154.3 = V_w

$P_b = 27.55$ ✓
 $V_m = 45.665$ ✓
 $V_w = 154.3$ ✓
 $P_m = 1.234$ ✓
 $Avg\ \Delta P = 3.431$ ✓
 $Avg\ \sqrt{\Delta P} = 1.851$ ✓
 $C_p = 0.824$ ✓
 $P_s = -1.25$ °H₂O ✓
 $T_m = 77$ °F ✓
 $T_s = 213$ °F ✓

$\%CO_2 = 13.2$ ✓
 $\%O_2 = 6.3$ ✓
 $\%CO = 0.0$ ✓
 $\%N_2 = 80.5$ ✓
 $A_s = 9363$ ✓
 $D_n = 0.154$ ✓
 $T_i = 72$ ✓

27.46 °Hg ✓
537 °R ✓
673 °R ✓

Moisture Content:

$\%M = 14.93$ ✓ $M_d = 0.8507$ ✓ $MW_c = 30.364$ ✓ $MW = 28.52$ ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = 17.65 \times 45.665 \left[\frac{27.55 + \frac{1.234}{13.6}}{77 + 460} \right] = \frac{41.486}{0.576} \frac{sft^3}{scfm}$$

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 154.3 = 7.283\ sft^3$$

$$\% \text{ Moisture} = \frac{V_{w_{gas}}}{Vm_{std} + V_{w_{gas}}} \times 100 = \frac{7.283}{41.486 + 7.283} \times 100 = 14.93\ \%$$

$$V_s = 5123.8 \times 0.824 \sqrt{\frac{673}{27.46 \times 28.52}} \times 1.851 = 7244\ tpm$$

$$\%I = \frac{1.039 \times 41.486 \times 673}{0.8507 \times 27.46 \times 7244 \times 72 \times (0.154)^2} = 100.4\ \%$$

ACFM: 471,043 ✓

SCFM: 289,575 ✓

$\%EA: 41.9$ ✓

26A FIELD DATA

Unit StockDate 2 December 2006D-55

ORSAT ANALYSIS DATA FORM

Job #: 06-057
 Job Name: ADA-ES
 Location: Hardin, MT
 Date: 12-1-06
 Operator: Hefley

Sample Location: Stack
 Analytical Method: 3
 Sample Type: Single Point / Multi Point Grab / Integrated
 Leak Check: Time: 5 min (≥ 4 minutes) Rate: 0.0
 Ambient Air Check:

CO ₂ - % Vol.	0.0
O ₂ - % Vol.	20.9
N ₂ - % Vol.	79.1

Run #: 1 (OH)

Run Time: _____

CO ₂ - % Vol.	12.8	12.8	12.8	12.8
O ₂ - % Vol.	6.2	6.2	6.3	6.2
CO - % Vol.	0.0	0.0	0.0	0.0
N ₂ - % Vol.	81.0	81.0	80.9	80.9

Run #: 2

Run Time: _____

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO ₂ - % Vol.	13.2	13.3	13.2	13.2
O ₂ - % Vol.	6.4	6.3	6.4	6.4
CO - % Vol.	0.0	0.0	0.0	0.0
N ₂ - % Vol.	80.4	80.4	80.4	80.4

Run #: 3

Run Time: 1755

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO ₂ - % Vol.	13.3	13.3	13.3	13.3
O ₂ - % Vol.	6.2	6.2	6.2	6.2
CO - % Vol.	0.0	0.0	0.0	0.0
N ₂ - % Vol.	80.5	80.5	80.5	80.5

PRELIMINARY VELOCITY TRAVERSE DATA
AND
SAMPLING LOCATION DATA

Job Number 06-057

Job Name ADA-ES

Stack Height _____ ft.

Sampling Location Stack

Sampling Port Height Above Ground 123'-1 1/2" ft.

Date 11/28/06 Time 0845-0900

	Port A	Port B	Port C	Port D	Average
Port & Inside Diameter (in.)					<u>124 5/16"</u>
Port & Wall Thickness (in.)	<u>15 1/8"</u>	<u>15 1/8"</u>			<u>15 1/8"</u>
Inside Stack Diameter (in.)					<u>109 3/16"</u>

Sampling Ports are 30³ ft. 1 1/2 in.

(3.64 stack diameters) downstream from disturbance
(inlet, constriction, bend, expansion)

Sampling Ports are _____ ft. _____ in.

(72.00 stack diameters) upstream from disturbance
(outlet, constriction, bend, expansion)

Point Number	Percent Diameter	Distance from Ref. Point (decimal in.)	Distance from Ref. Point (fractional in.)	Port A $\Delta P/T_x/\alpha$	Port B $\Delta P/T_x/\alpha$	Port C $\Delta P/T_x/\alpha$	Port D $\Delta P/T_x/\alpha$
1	<u>2.1</u>	<u>2.293</u>	<u>2 1/16"</u>	<u>2.40 R14.5</u>	<u>3.00 R12.0</u>	<u>1 1</u>	<u>1 1</u>
2	<u>6.7</u>	<u>7.316</u>	<u>7 5/16"</u>	<u>2.80 R15</u>	<u>3.45 R13.1</u>	<u>1 1</u>	<u>1 1</u>
3	<u>11.8</u>	<u>12.884</u>	<u>12 7/8"</u>	<u>2.80 R16.3</u>	<u>3.50 R14.0</u>	<u>1 1</u>	<u>1 1</u>
4	<u>17.7</u>	<u>19.326</u>	<u>19 5/16"</u>	<u>2.80 R16.3</u>	<u>3.25 R13.3</u>	<u>1 1</u>	<u>1 1</u>
5	<u>25.0</u>	<u>27.297</u>	<u>27 5/16"</u>	<u>2.80 R16.0</u>	<u>3.20 R13.7</u>	<u>1 1</u>	<u>1 1</u>
6	<u>35.6</u>	<u>38.871</u>	<u>38 7/8"</u>	<u>3.00 R16.0</u>	<u>3.30 R13.9</u>	<u>1 1</u>	<u>1 1</u>
7	<u>64.4</u>	<u>70.317</u>	<u>70 5/16"</u>	<u>3.10 R15.9</u>	<u>3.20 R13.1</u>	<u>1 1</u>	<u>1 1</u>
8	<u>75.0</u>	<u>81.891</u>	<u>81 7/8"</u>	<u>3.45 R15.9</u>	<u>3.25 R13.1</u>	<u>1 1</u>	<u>1 1</u>
9	<u>82.3</u>	<u>89.861</u>	<u>89 7/8"</u>	<u>3.40 R15.10</u>	<u>3.30 R13.10</u>	<u>1 1</u>	<u>1 1</u>
10	<u>88.2</u>	<u>96.303</u>	<u>96 5/16"</u>	<u>3.50 R15.8</u>	<u>3.30 R12.13</u>	<u>1 1</u>	<u>1 1</u>
11	<u>93.3</u>	<u>101.872</u>	<u>101 7/8"</u>	<u>3.20 R12.8</u>	<u>3.10 R12.11</u>	<u>1 1</u>	<u>1 1</u>
12	<u>97.9</u>	<u>106.895</u>	<u>106 7/8"</u>	<u>2.80 R11.5</u>	<u>3.10 R11.4</u>	<u>1 1</u>	<u>1 1</u>
13				<u>1 1</u>	<u>1 1</u>	<u>1 1</u>	<u>1 1</u>
14				<u>1 1</u>	<u>1 1</u>	<u>1 1</u>	<u>1 1</u>
15				<u>1 1</u>	<u>1 1</u>	<u>1 1</u>	<u>1 1</u>
16				<u>1 1</u>	<u>1 1</u>	<u>1 1</u>	<u>1 1</u>
17				<u>1 1</u>	<u>1 1</u>	<u>1 1</u>	<u>1 1</u>
18				<u>1 1</u>	<u>1 1</u>	<u>1 1</u>	<u>1 1</u>
19				<u>1 1</u>	<u>1 1</u>	<u>1 1</u>	<u>1 1</u>
20				<u>1 1</u>	<u>1 1</u>	<u>1 1</u>	<u>1 1</u>
21				<u>1 1</u>	<u>1 1</u>	<u>1 1</u>	<u>1 1</u>
22				<u>1 1</u>	<u>1 1</u>	<u>1 1</u>	<u>1 1</u>
23				<u>1 1</u>	<u>1 1</u>	<u>1 1</u>	<u>1 1</u>
24				<u>1 1</u>	<u>1 1</u>	<u>1 1</u>	<u>1 1</u>

Pitot Tube No. 3-Z

$C_p =$ 0.824

$P_b =$ 26.99 "Hg

$P_a =$ -2.20 "H₂O 26.83 "Hg

$A_s =$ 9363 in.²

Average ΔP 3.125

Average $\Delta P^{1/2}$ 1.766

Average T_x 214 °F

Average α 6 degrees

$$\begin{array}{r} \text{A} \\ 15 \frac{5}{8}'' \\ - 1 \frac{1}{2}'' \\ \hline 15 \frac{1}{8}'' \end{array}$$

$$\begin{array}{r} \text{B} \\ 15 \frac{5}{8}'' \\ - 1 \frac{1}{2}'' \\ \hline 15 \frac{1}{8}'' \end{array}$$

$$95$$

$$109$$

$$101$$

$$100$$

$$OC = 405''$$

$$OD = 128.916$$

$$- 19.750$$

$$OD = 109.166 = 109 \frac{3}{16}''$$

Wall

$$15.125$$

$$- 5.250$$

$$9.875$$

$$\times 2$$

$$19.750 = 2 \text{ walls}$$

$$123 \frac{1}{2}''$$

Appendix E:

EPA Test Methods 5B and 202 (Particulate Matter) Analytical Data

Air Sampling Associates, Inc.

Particulate Analysis Summary

Project Number: 06-057

Date Analysis Completed: 12/12/06

Project Name: ADA-ES

Unit Tested: Stack

Project Location: Hardin, MT

EPA Method 5/202

Run Number:

1 2 3

Particulate Matter on Filter (mg):

20.6 29.1 31.9

Particulate Matter in Front Wash (mg):

12.2 11.6 11.4

Total Particulate Matter in "Front-Half" – MF (mg):

32.8 40.7 43.3

Particulate Matter in "Back-Half" (mg):

43.4 37.2 12.2

Total Particulate Matter in Sample – MT (mg):

76.2 81.4 55.5

Billy J. Mullins, Jr.
Analyst

Bill [Signature] Date: 1-17-07
Data Checked By

Particulate Analysis EPA Method 5

Stack Filters

Project No. 06-057
Project Name ADA-ES

Location Hardin, MT
Unit Tested Stack

Desiccator Time In	<u>12/05/06 1530</u>	<u>12/07/06 0855</u>			
Desiccator Time Out	<u>12/07/06 0855</u>	<u>12/07/06 1500</u>			

Run No.	<u>1</u>	Filter No.	<u>A114</u>	Sample I.D.	
Filter & Particulate (g)	<u>0.4018</u>	<u>0.4018</u>	<u>✓</u>		

Filter & Particulate Average (g) 0.4018
Initial Filter Weight (g) 0.3812
Total Particulate (mg) 20.6

Run No.	<u>2</u>	Filter No.	<u>A115</u>	Sample I.D.	
Filter & Particulate (g)	<u>0.3993</u>	<u>0.3991</u>	<u>✓</u>		

Filter & Particulate Average (g) 0.3991
Initial Filter Weight (g) 0.3700
Total Particulate (mg) 29.1

Run No.	<u>3</u>	Filter No.	<u>A116</u>	Sample I.D.	
Filter & Particulate (g)	<u>0.3999</u>	<u>0.3998</u>	<u>✓</u>		

Filter & Particulate Average (g) 0.3998
Initial Filter Weight (g) 0.3679
Total Particulate (mg) 31.9

Billy J. Mullins, Jr.
Analyst

**Filter Weight Log
EPA Method 5**

Filter No.	Into Desicator	Weight	Weight	Weight	Weight	Weight	Weight Used
	Date	Date	Date	Date	Date	Date	
	Time	Time	Time	Time	Time	Time	
A105		0.3801	0.3801				0.3801
	10/2/06	10/12/06	10/13/06				
	0800	1000	0826				
A106		0.3827	0.3825				0.3825
	10/2/06	10/12/06	10/13/06				
	0822	1001	0827				
A107		0.3808	0.3810				0.3810
	10/2/06	10/12/06	10/13/06				
	0800	1002	0828				
A108		0.3843	0.3845				0.3845
	10/2/06	10/12/06	10/13/06				
	0800	1003	0829				
A109		0.3872	0.3873				0.3873
	10/2/06	10/12/06	10/13/06				
	0800	1004	0830				
A110		0.3885	0.3886				0.3886
	10/2/06	10/12/06	10/13/06				
	0800	1005	0831				
A112		0.3833	0.3832				0.3832
	10/2/06	10/12/06	10/13/06				
	0800	1006	0832				
A113		0.3781	0.3778				0.3778
	10/2/06	10/12/06	10/13/06				
	0800	1007	0833				
A114		0.3814	0.3812				0.3812
	10/2/06	10/12/06	10/13/06				
	0800	1008	0834				
A115		0.3701	0.3700				0.3700
	10/2/06	10/12/06	10/13/06				
	0800	1009	0835				
A116		0.3678	0.3679				0.3679
	10/2/06	10/12/06	10/13/06				
	0800	1010	0836				
A117		0.3644	0.3644				0.3644
	10/2/06	10/12/06	10/13/06				
	0800	1011	0837				
A118		0.3636	0.3635				0.3635
	10/2/06	11/20/06	11/21/06				
	0800	1245	0807				
A119		0.3655	0.3655				0.3655
	10/2/06	11/20/06	11/21/06				
	0800	1246	0808				
A120		0.3616	0.3615				0.3615
	10/2/06	11/20/06	11/21/06				
	0800	1247	0809				

Particulate Analysis EPA Method 5
Front Wash

Project No. 06-057
Project Name ADA-ES

Location Hardin, MT
Unit Tested Stack

Desiccator Time In	<u>12/08/06 1650</u>	<u>12/11/06 0820</u>	<u>12/12/06 0810</u>		
Desiccator Time Out	<u>12/11/06 0815</u>	<u>12/12/06 0810</u>	<u>12/12/06 1525</u>		

Run No.	<u>1</u>	Volume (ml)	<u>125</u>	Sample I.D.	
Final Weight (g)	<u>104.2832</u>	<u>104.2788</u>	<u>104.2783</u> ✓		
Initial Weight (g)	<u>104.2651</u>	<u>104.2651</u>	<u>104.2651</u>		
Particulate Weight (g)					

Particulate Average (mg) 13.2
Less Acetone Blank (mg) 1.0
Total Particulate (mg) 12.2

Run No.	<u>2</u>	Volume (ml)	<u>145</u>	Sample I.D.	
Final Weight (g)	<u>91.3758</u>	<u>91.3716</u>	<u>91.3715</u> ✓		
Initial Weight (g)	<u>91.3588</u>	<u>91.3588</u>	<u>91.3588</u>		
Particulate Weight (g)					

Particulate Average (mg) 12.7
Less Acetone Blank (mg) 1.1
Total Particulate (mg) 11.6

Run No.	<u>3</u>	Volume (ml)	<u>175</u>	Sample I.D.	
Final Weight (g)	<u>104.3077</u>	<u>104.3031</u>	<u>104.3027</u> ✓		
Initial Weight (g)	<u>104.2899</u>	<u>104.2899</u>	<u>104.2899</u>		
Particulate Weight (g)					

Particulate Average (mg) 12.8
Less Acetone Blank (mg) 1.4
Total Particulate (mg) 11.4

Acetone Blank		Volume (ml)	<u>200</u>	Sample I.D.	
Final Weight (g)	<u>103.5041</u>	<u>103.5043</u> ✓			
Initial Weight (g)	<u>103.5020</u>	<u>103.5020</u>			
Particulate Weight (g)					

Average (mg) 2.3
* mg/l 11.5

* Note: if greater than 7.9 mg/l, use 7.9 mg/l

Billy J. Mullins, Jr. Date: 12/12/06
Analyst

Particulate Analysis EPA Method 5

Front Half Tare Weights

Project No. 06-057
Project Name APA-ES

Location Hardin, MT
Unit Tested Stack

Desiccator Time In	12/05/06 1530	12/06/06 1640	12/07/06 0835		
Desiccator Time Out	12/06/06 1635	12/07/06 0835	12/08/06 0815		

Run No.	1			Sample I.D.	
Weight (g)	104.2659	104.2649	104.2651	✓	

Run No.	2			Sample I.D.	
Weight (g)	91.3596	91.3585	91.3588	✓	

Run No.	3			Sample I.D.	
Weight (g)	104.2909	104.2899	104.2899	✓	

Acetone Blank				Sample I.D.	
Weight (g)	103.5029	103.5019	103.5020	✓	

Billy J. Mullins, Jr.
Analyst

ADA-ES
Hardin, MT
202 – Back Half Particulate Analyses

<u>Run No.</u>	<u>MeCl (mg)</u>	<u>MeCl Blank Correction (mg)</u>	<u>DI Water (mg)</u>	<u>DI Water Blank Correction (mg)</u>	<u>Less Chlorides (mg)</u>	<u>Less Sulfates (mg)</u>	<u>Total (mg)</u>
1	0.4	0.0	80.0	60.5	0.3	16.8	43.4
2	1.0	0.2	73.5	54.3	0.3	17.0	37.2
3	0.5	0.0	38.9	19.7	0.3	7.2	12.2
Blank	0.8		15.1				

Methylene Chloride Rinse

Job Number 06-4108
Client Name Air Sampling Associates
Unit Name Hardin Stack

Run Date 11/30/2006
Method: 202

RUN 1	BEAKER	9612	VOLUME	ml	243	AVERAGE
Beaker + Particulate (g)		120.9275	120.9270			120.9273
Beaker Tare (g)		120.9269	120.9268			120.9269
Particulate Weight (g)		0.0006	0.0002			0.0004

RUN 2	BEAKER	9614	VOLUME	ml	252	AVERAGE
Beaker + Particulate (g)		109.5722	109.5717			109.5720
Beaker Tare (g)		109.5710	109.5710			109.5710
Particulate Weight (g)		0.0012	0.0007			0.0010

RUN 3	BEAKER	9616	VOLUME	ml	249	AVERAGE
Beaker + Particulate (g)		116.7404	116.7403			116.7404
Beaker Tare (g)		116.7400	116.7398			116.7399
Particulate Weight (g)		0.0004	0.0005			0.0005

Blank	BEAKER	9610	VOLUME	ml	266	AVERAGE
Beaker + Particulate (g)		108.6839	108.6834			108.6837
Beaker Tare (g)		108.6829	108.6829			108.6829
Particulate Weight (g)		0.0010	0.0005			0.0008

Analyst LB

FINAL REPORT

Started 12/4/2006
Completed 12/12/2006

DI Water Analysis (Back)

Job Number 06-4108
Client Name Air Sampling Associates
Unit Name Hardin Stack

Run Date 11/30/2006
Method: 202

RUN 1	BEAKER	9611	VOLUME	ml	770	AVERAGE
Beaker + Particulate (g)		106.7603	106.7608			106.7606
Beaker Tare (g)		106.6806	106.6805			106.6806
Particulate Weight (g)		0.0797	0.0803			0.0800

RUN 2	BEAKER	9613	VOLUME	ml	760	AVERAGE
Beaker + Particulate (g)		114.2443	114.2447			114.2445
Beaker Tare (g)		114.1712	114.1708			114.1710
Particulate Weight (g)		0.0731	0.0739			0.0735

RUN 3	BEAKER	9615	VOLUME	ml	760	AVERAGE
Beaker + Particulate (g)		108.6769	108.6774			108.6772
Beaker Tare (g)		108.6385	108.6380			108.6383
Particulate Weight (g)		0.0384	0.0394			0.0389

Blank	BEAKER	9609	VOLUME	ml	598	AVERAGE
Beaker + Particulate (g)		97.7328	97.7330			97.7329
Beaker Tare (g)		97.7179	97.7177			97.7178
Particulate Weight (g)		0.0149	0.0153			0.0151

Analyst LB

FINAL REPORT

Started 12/4/2006
Completed 12/12/2006

Chloride

06-4108

		Lab Results, ug	Blank, ug	Final Results, mg Corrected to NH4Cl
Sample No.				
Run 1	9611	7.29	202	-0.294
Run 2	9613	8.84	202	-0.291
Run 3	9615	0.842	202	-0.304
Blank	9609	202		

Sulfate**06-4108**

		Sample Volume, ml	Lab Volume, ml	Lab Results, ug/ml	Blank, ug/ml	Final Results, mg
	Sample No.					
Run 1	4108-1	770	20	61.8	0.115	16.814
Run 2	4108-2	760	20	63.3	0.115	16.999
Run 3	4108-3	760	20	27	0.115	7.233
Blank	4108-4	598	20	0.115		0.024

Appendix F:

EPA Test Methods 17, 26A, and CTM027 (Particulate Matter, Hydrogen Halides & Halogens, and) Analytical Data – SDA Inlet Duct

Air Sampling Associates, Inc.

Particulate Analysis Summary

Project Number: 06-057 Date Analysis Completed: 12/8/06
 Project Name: ADA-ES Unit Tested: SDA Inlet
 Project Location: Hardin, MT

EPA Method 17

Run Number:	<u>1</u>	<u>2</u>	<u>3</u>
Particulate Matter on Filter (mg):	<u>4,554.7</u>	<u>5,056.9</u>	<u>4,302.8</u>
Particulate Matter in Front Wash (mg):	<u>1,450.0</u>	<u>2,170.0</u>	<u>2,060.0</u>
Total Particulate Matter in "Front-Half" – MF (mg):	<u>6,004.7</u>	<u>7,226.9</u>	<u>6,362.8</u>
Particulate Matter in "Back-Half" (mg):	<u>—</u>	<u>—</u>	<u>—</u>
Total Particulate Matter in Sample – MT (mg):	<u>—</u>	<u>—</u>	<u>—</u>

Billy J. Mullins, Jr.
Analyst

Bill Wynn Date: 1-17-07
Data Checked By

Particulate Analysis EPA Method 17
Stack Filters

 Project No. 06-057
 Project Name ADA-ES

 Location Hardin, MT
 Unit Tested SDA Inlet

Desiccator Time In	12/05/06 1530	12/07/06 0905	12/07/06 1505	12/08/06 0835
Desiccator Time Out	12/07/06 0900	12/07/06 1505	12/08/06 0830	12/08/06 1510

Run No.	<u>1</u>	Filter No.	<u>60 59</u>	Sample I.D.
Filter & Particulate (g)	<u>7.6861</u>	<u>7.6821</u>	<u>7.6707</u>	<u>7.6707</u> ✓

 Filter & Particulate Average (g) 7.6707
 Initial Filter Weight (g) 3.1160
 Total Particulate (mg) 4,554.7

Run No.	<u>2</u>	Filter No.	<u>60</u>	Sample I.D.
Filter & Particulate (g)	<u>7.7854</u>	<u>7.7825</u>	<u>7.7784</u>	<u>7.7779</u> ✓

 Filter & Particulate Average (g) 7.7779
 Initial Filter Weight (g) 2.7210
 Total Particulate (mg) 5,056.9

Run No.	<u>3</u>	Filter No.	<u>61</u>	Sample I.D.
Filter & Particulate (g)	<u>7.0722</u>	<u>7.0680</u>	<u>7.0563</u>	<u>7.0558</u> ✓

 Filter & Particulate Average (g) 7.0558
 Initial Filter Weight (g) 2.7530
 Total Particulate (mg) 4,302.8

Billy J. Mullins, Jr.
 Analyst

**Thimble Tare Weight Log
EPA Method 17**

Filter No.	Into Desicator	Weight	Weight	Weight	Weight	Weight	Weight Used
	Date	Date	Date	Date	Date	Date	
	Time	Time	Time	Time	Time	Time	
45		2.7941	2.7944				2.7944
	9/29/06	10/2/06	10/3/06				
	1200	1635	1100				
46		2.7987	2.7990				2.7990
		10/2/06	10/3/06				
		1636	1101				
47		2.5514	2.5514				2.5514
		10/2/06	10/3/06				
		1637	1102				
48		2.7781	2.7785				2.7785
		10/2/06	10/3/06				
		1638	1103				
49		2.7795	2.7799				2.7799
		10/2/06	10/3/06				
		1639	1104				
50		2.6485	2.6487				2.6487
		10/2/06	10/3/06				
		1640	1105				
51		2.8600	2.8605				2.8605
		10/2/06	10/3/06				
		1641	1106				
52		2.8470	2.8474				2.8474
		10/2/06	10/3/06				
		1642	1107				
53		2.7349	2.7352				2.7352
		10/2/06	10/3/06				
		1643	1108				
54		3.5794	3.5795				3.5795
	11/20/06	11/21/06	11/22/06				
	1360	1350	0745				
55		2.8785	2.8788				2.8788
		11/21/06	11/22/06				
		1351	0746				
56		2.4725	2.4724				2.4724
		11/21/06	11/22/06				
		1352	0747				
57		2.9916	2.9911				2.9911
		11/21/06	11/22/06				
		1353	0748				
58		3.4660	3.4656				3.4656
		11/21/06	11/22/06				
		1354	0749				
59		3.1165	3.1160				3.1160
		11/21/06	11/22/06				
		1355	0750				

**Thimble Tare Weight Log
EPA Method 17**

Filter No.	Into Desicator	Weight	Weight	Weight	Weight	Weight	Weight Used
	Date	Date	Date	Date	Date	Date	
	Time	Time	Time	Time	Time	Time	
60		2.7215	2.7210	✓			2.7210
	11/20/06	11/21/06	11/22/06				
	1300	1358	0752				
61		2.7531	2.7530	✓			2.7530
	11/20/06	11/21/06	11/22/06				
	1300	1359	07531				
62		2.7516	2.7514	✓			2.7514
	11/20/06	11/21/06	11/22/06				
	1300	1400	0754				
63		2.7846	2.7848	✓			2.7848
	11/20/06	11/21/06	11/22/06				
	1300	1401	0755				
64		2.9993	2.9992	✓			2.9992
	11/20/06	11/21/06	11/22/06				
	1300	1402	0756				
65		2.6385	2.6381	✓			2.6381
	11/20/06	11/21/06	11/22/06				
	1300	1403	0757				
66		2.8663	2.8660	✓			2.8660
	11/20/06	11/21/06	11/22/06				
	1300	1404	0800				
67		2.9442	2.9439	✓			2.9439
	11/20/06	11/21/06	11/22/06				
	1300	1404	0801				
68		2.5183	2.5182	✓			2.5182
	11/20/06	11/21/06	11/22/06				
	1300	1405	0802				
69		2.7293	2.7291	✓			2.7291
	11/20/06	11/21/06	11/22/06				
	1300	1406	0803				
70		2.5250	2.5248	✓			2.5248
	11/20/06	11/21/06	11/22/06				
	1300	1407	0804				
71		2.4725	2.4721	✓			2.4721
	11/20/06	11/21/06	11/22/06				
	1300	1408	0805				
72		2.7991	2.7988	✓			2.7988
	11/20/06	11/21/06	11/22/06				
	1300	1409	0806				
73		3.1339	3.1336	✓			3.1336
	11/20/06	11/21/06	11/22/06				
	1300	1410	0807				
74		2.8562	2.8561	✓			2.8561
	11/20/06	11/21/06	11/22/06				
	1300	1410	0808				

H6L110106 Analytical Report.....	1
Sample Receipt Documentation	27
Wet Chemistry	33
Sample Summary	34
QC Summary	47
Raw Data	53
Subcontract STL- North Canton	180
General Chemistry Data	181
Sample Data	182
Supportive Raw Data	195
Sample Receipt Documentation	199
Total Number of Pages	206

STL

STL Knoxville
5815 Middlebrook Pike
Knoxville, TN 37921

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www.stl-inc.com

ANALYTICAL REPORT

REVISED

PROJECT NO. 06-057

Hardin, Montana SDA Inlet Duct

Lot #: H6L110106

Bill Hefley

Air Sampling Associates, Inc.
407-2B Holford's Prairie Road
Lewisville, TX 75056

SEVERN TRENT LABORATORIES, INC.

Terry Wasmund
Project Manager

January 22, 2007

ANALYTICAL METHODS SUMMARY

H6L110106

<u>PARAMETER</u>	<u>ANALYTICAL METHOD</u>
Ammonia Nitrogen	MCAWW 350.3
Bromine Emissions	KNOX 0050/26A Mod
Chlorine Emissions	KNOX 0050/26A Mod
Hydrogen Bromide Emissions	KNOX 0050/26A Mod
Hydrogen Chloride Emissions	KNOX 0050/26A Mod
Hydrogen Fluoride Emissions	KNOX 0050/26A Mod
Particulate Emissions	CFR60A 5

References:

CFR60A "Test Methods", 40 CFR, Part 60, Appendix A, July 1, 1993.

KNOX Severn Trent Laboratories Knoxville, Facility Standard
 Operating Procedure.

MCAWW "Methods for Chemical Analysis of Water and Wastes",
 EPA-600/4-79-020, March 1983 and subsequent revisions.

QC DATA ASSOCIATION SUMMARY

H6L110106

Sample Preparation and Analysis Control Numbers

<u>SAMPLE#</u>	<u>MATRIX</u>	<u>ANALYTICAL METHOD</u>	<u>LEACH BATCH #</u>	<u>PREP BATCH #</u>	<u>MS RUN#</u>
001	AIR	CFR60A 5		6349313	
002	AIR	KNOX 0050/26A Mod		6361375	6362029
	AIR	KNOX 0050/26A Mod		6363147	6363102
	AIR	KNOX 0050/26A Mod		6361376	6362031
003	WATER	MCAWW 350.3		6348460	6348277
004	AIR	KNOX 0050/26A Mod		6356347	6356196
	AIR	KNOX 0050/26A Mod		6356350	6356197
	AIR	KNOX 0050/26A Mod		6356352	6356198
005	AIR	CFR60A 5		6349313	
006	AIR	KNOX 0050/26A Mod		6361375	
	AIR	KNOX 0050/26A Mod		6363147	
	AIR	KNOX 0050/26A Mod		6361376	
007	WATER	MCAWW 350.3		6348460	6348277
008	AIR	KNOX 0050/26A Mod		6356347	6356196
	AIR	KNOX 0050/26A Mod		6356350	6356197
	AIR	KNOX 0050/26A Mod		6356352	6356198
009	AIR	CFR60A 5		6349313	
010	AIR	KNOX 0050/26A Mod		6361375	
	AIR	KNOX 0050/26A Mod		6363147	
	AIR	KNOX 0050/26A Mod		6361376	
011	WATER	MCAWW 350.3		6348460	6348277
012	AIR	KNOX 0050/26A Mod		6356347	6356196
	AIR	KNOX 0050/26A Mod		6356350	6356197
	AIR	KNOX 0050/26A Mod		6356352	6356198
013	AIR	KNOX 0050/26A Mod		6361375	
	AIR	KNOX 0050/26A Mod		6363098	
	AIR	KNOX 0050/26A Mod		6361376	
014	WATER	MCAWW 350.3		6348460	6348277

(Continued on next page)

QC DATA ASSOCIATION SUMMARY

H6L110106

Sample Preparation and Analysis Control Numbers

<u>SAMPLE#</u>	<u>MATRIX</u>	<u>ANALYTICAL METHOD</u>	<u>LEACH BATCH #</u>	<u>PREP BATCH #</u>	<u>MS RUN#</u>
015	AIR	KNOX 0050/26A Mod		6356347	6356196
	AIR	KNOX 0050/26A Mod		6356350	6356197
	AIR	KNOX 0050/26A Mod		6356352	6356198
016	AIR	KNOX 0050/26A Mod		6361375	
	AIR	KNOX 0050/26A Mod		6363098	
	AIR	KNOX 0050/26A Mod		6361376	

SAMPLE SUMMARY

H6L110106

WO #	SAMPLE#	CLIENT SAMPLE ID	SAMPLED DATE	SAMP TIME
JK7J5	001	HARDIN SDA INLET DUCT RUN 1 ACE FW	11/30/06	17:18
JK7J7	002	HARDIN SDA INLET DUCT RUN 1 0.1N H2SO4	11/30/06	16:40
JK7J8	003	HARDIN SDA INLET DUCT RUN 1 0.1N H2SO4	11/30/06	16:40
JK7KA	004	HARDIN SDA INLET DUCT RUN 1 0.1N NAOH	11/30/06	16:46
JK7KE	005	HARDIN SDA INLET DUCT RUN 2 ACE FW	12/01/06	15:58
JK7KG	006	HARDIN SDA INLET DUCT RUN 2 0.1N H2SO4	12/01/06	15:40
JK7KK	007	HARDIN SDA INLET DUCT RUN 2 0.1N H2SO4	12/01/06	15:40
JK7KN	008	HARDIN SDA INLET DUCT RUN 2 0.1N NAOH	12/01/06	15:42
JK7KQ	009	HARDIN SDA INLET DUCT RUN 3 ACE FW	12/02/06	08:07
JK7KT	010	HARDIN SDA INLET DUCT RUN 3 0.1N H2SO4	12/02/06	08:32
JK7KV	011	HARDIN SDA INLET DUCT RUN 3 0.1N H2SO4	12/02/06	08:32
JK7KW	012	HARDIN SDA INLET DUCT RUN 3 0.1N NAOH	12/02/06	08:36
JK7K0	013	HARDIN STACK & SDA INLET RB 0.1N H2SO4 BLANK	12/01/06	15:53
JK7K1	014	HARDIN STACK & SDA INLET RB 0.1N H2SO4 BLANK	12/01/06	15:53
JK7K2	015	HARDIN STACK & SDA INLET RB 0.1N NAOH BLANK	12/01/06	15:51
JK7K4	016	HARDIN STACK & SDA INLET RB D.I.WATER BLANK	12/01/06	15:49

NOTE(S) :

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filter test, pH, porosity pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight.

PROJECT NARRATIVE

H6L110106

Revised

01/19/07

NOTE: This data package has been revised to include ammonia results that were inadvertently omitted from the original package.

The results reported herein are applicable to the samples submitted for analysis only.

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The original chain of custody documentation is included with this report.

Sample Receipt

The chain of custody documentation shows that container number 2 was retained by ASAI. However, container number 2 was received.

Custody seals were not present upon sample receipt at STL Knoxville.

Subcontract

The following analyses were performed by the STL North Canton Laboratory (NELAP Accrediting Authority: FLDOH; Lab ID E87225), 4101 Shuffel Drive, NW, North Canton, OH 44720, (330) 497-9396, Opal Johnson, Laboratory Director: Ammonia Nitrogen (MCAWW 350.3)

Quality Control and Data Interpretation

Unless otherwise noted, all holding times and QC criteria were met and the test results shown in this report meet all applicable NELAC requirements.

Samples were analyzed for chloride (Cl⁻), fluoride (F⁻) and bromide (Br⁻) by ion chromatography using SOP number KNOX-WC-005 (based on EPA methods 9056, 9057 and 26A). Results for the H₂SO₄ impinger samples were reported as total µg hydrogen chloride (HCl), total µg hydrogen fluoride (HF) and total µg hydrogen bromide (HBr).

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PROJECT NARRATIVE

H6L110106

Revised

01/19/07

Results for the NaOH impinger samples were reported as total μg chlorine (Cl_2), total μg hydrogen fluoride (HF) and total μg hydrogen bromine (Br_2).

Please note that the halogen fluorine (F) is not expected to be present in stack gas as diatomic fluorine (F_2). Fluorine reacts with water vapor in a favored reaction that forms HF: $2\text{F}_2 + 2\text{H}_2\text{O} \rightarrow 4\text{HF} + \text{O}_2$. Therefore, the results from the H_2SO_4 impingers and the NaOH impingers are reported as HF, and no F_2 is expected in the samples.

Results were calculated using the following equations:

$$\text{HX, } \mu\text{g} = (\text{X}^-, \mu\text{g} / \text{mL}) * (\text{Sample Volume, mL}) * \left(\frac{\text{Molecular Weight HX}}{\text{Molecular Weight X}^-} \right) * (\text{Bench Dilution})$$

$$\text{Cl}_2, \text{Br}_2 \mu\text{g} = (\text{X}^-, \mu\text{g} / \text{mL}) * (\text{Sample Volume, mL}) * (\text{Bench Dilution})$$

NaOH impinger samples were treated with sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$) prior to the final analysis in order to convert residual hypochlorite (OCl^-) to chloride ion. The presence of hypobromite is also assumed to be converted to bromide under these conditions.

Note: A sample volume of 100 mL was used to convert the results to total μg for the method blanks, laboratory control samples, and client reagent blanks.

For demonstration of analytical method performance on these samples, STL Knoxville analyzed matrix spikes (MS) and matrix spike duplicates (MSD). Acceptable recoveries of these spikes demonstrate that quantitation from this particular stack gas matrix is accurate and acceptable. Impinger samples containing 0.1N H_2SO_4 and 0.1N NaOH display matrix interference effects causing poor method performance and possibly giving unreliable data unless the interference is removed. Therefore, the samples were diluted in the lab to remove the interference for a more accurate chloride response. The samples may be analyzed at increasing dilutions along with matrix spikes until matrix spikes recover from the sample within laboratory control limits. The ion chromatograph

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PROJECT NARRATIVE

H6L110106

Revised

01/19/07

calibration range used to quantitate the sample results permits a standard ten-fold sample dilution while supporting the reporting limit with the low calibration standard.

The dilution factor reported on the sample result form does not represent the bench dilution factor. It is actually the combination of factors required by the method to convert the anion reporting limit and method detection limit from $\mu\text{g/mL}$ to total μg . It may appear to be elevated because it includes the total sample volume in mL.

All holding times and QC criteria were met.

The pH for several samples was adjusted prior to analysis. Refer to the STL Knoxville Source Air Analysis Sample Information form in the Raw Data section of the deliverable.

The measurement of the mass of particulate matter trapped by the probe rinses derived from M-5 sampling trains was performed using SOP number KNOX-WC-0006 (based on EPA Methods 0050 and 5). 150 mL beakers are carefully inspected and tare weighed to constant weight. The acetone probe rinse solution is evaporated to dryness, and then weighed to constant weight to determine the total particulate mass collected in the rinse.

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Sample Data Summary

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 1 0.1N H2SO4

General Chemistry

Lot-Sample #...: H6L110106-002 Work Order #...: JK7J7 Matrix.....: AIR
 Date Sampled...: 11/30/06 Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Hydrogen bromide	ND	430	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 4303.61		MDL.....: 215		
Hydrogen chloride	ND	1750	ug	KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 17483.3		MDL.....: 734		
Hydrogen fluoride	ND	448	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 4475.47		MDL.....: 224		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 1 0.1N NAOH

General Chemistry

Lot-Sample #...: H6L110106-004 Work Order #...: JK7KA Matrix.....: AIR
 Date Sampled...: 11/30/06 Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Bromine	ND	295	ug	KNOX 0050/26A Mod	12/19/06	6356347
		Dilution Factor: 2950		MDL.....: 70.8		
Chlorine	216 B	295	ug	KNOX 0050/26A Mod	12/19/06	6356350
		Dilution Factor: 2950		MDL.....: 124		
Hydrogen fluoride	ND	311	ug	KNOX 0050/26A Mod	12/19/06	6356352
		Dilution Factor: 3106.5		MDL.....: 155		

NOTE(S) :

RL Reporting Limit

B Estimated result. Result is less than RL.

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 2 0.1N H2SO4

General Chemistry

Lot-Sample #...: H6L110106-006 Work Order #...: JK7KG Matrix.....: AIR
Date Sampled...: 12/01/06 Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Hydrogen bromide	ND	405	ug	KNOX 0050/26A Mod	12/18/06	6361375
				Dilution Factor: 4050.46	MDL.....: 203	
Hydrogen chloride	ND	1650	ug	KNOX 0050/26A Mod	12/28/06	6363147
				Dilution Factor: 16454.87	MDL.....: 691	
Hydrogen fluoride	ND	421	ug	KNOX 0050/26A Mod	12/18/06	6361376
				Dilution Factor: 4212.21	MDL.....: 211	

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 2 0.1N NAOH

General Chemistry

Lot-Sample #...: H6L110106-008

Work Order #...: JK7KN

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	280	ug	KNOX 0050/26A Mod	12/19/06	6356347
		Dilution Factor: 2800		MDL.....: 67.2		
Chlorine	151 B	280	ug	KNOX 0050/26A Mod	12/19/06	6356350
		Dilution Factor: 2800		MDL.....: 118		
Hydrogen fluoride	ND	295	ug	KNOX 0050/26A Mod	12/19/06	6356352
		Dilution Factor: 2948.55		MDL.....: 147		

NOTE(S) :

RI. Reporting Limit

B Estimated result. Result is less than RI..

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 3 0.1N H2SO4

General Chemistry

Lot-Sample #...: H6L110106-010

Work Order #...: JK7KT

Matrix.....: AIR

Date Sampled...: 12/02/06

Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Hydrogen bromide	ND	368	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 3675.79		MDL.....: 184		
Hydrogen chloride	ND	1490	ug	KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 14932.79		MDL.....: 627		
Hydrogen fluoride	ND	382	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 3822.58		MDL.....: 191		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 3 0.1N NAOH

General Chemistry

Lot-Sample #...: H6L110106-012 Work Order #...: JK7KW Matrix.....: AIR
 Date Sampled...: 12/02/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	270	ug	KNOX 0050/26A Mod	12/19/06	6356347
		Dilution Factor: 2700		MDL.....: 64.8		
Chlorine	159 B	270	ug	KNOX 0050/26A Mod	12/19/06	6356350
		Dilution Factor: 2700		MDL.....: 113		
Hydrogen fluoride	ND	284	ug	KNOX 0050/26A Mod	12/19/06	6356352
		Dilution Factor: 2843.24		MDL.....: 142		

NOTE(S) :

RL Reporting Limit

B Estimated result. Result is less than RL.

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK & SDA INLET RB 0.1N H2SO4 BLANK

General Chemistry

Lot-Sample #...: H6L110106-013

Work Order #...: JK7K0

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Hydrogen bromide	ND	101	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 1012.61		MDL.....: 50.6		
Hydrogen chloride	ND	206	ug	KNOX 0050/26A Mod	12/18/06	6363098
		Dilution Factor: 2056.86		MDL.....: 86.4		
Hydrogen fluoride	ND	105	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 1053.05		MDL.....: 52.7		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK & SDA INLET RB 0.1N NAOH BLANK

General Chemistry

Lot-Sample #...: H6L110106-015

Work Order #...: JK7K2

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	100	ug	KNOX 0050/26A Mod	12/19/06	6356347
			Dilution Factor: 1000	MDL.....: 24.0		
Chlorine	47.4 B	100	ug	KNOX 0050/26A Mod	12/19/06	6356350
			Dilution Factor: 1000	MDL.....: 42.0		
Hydrogen fluoride	ND	105	ug	KNOX 0050/26A Mod	12/19/06	6356352
			Dilution Factor: 1053.05	MDL.....: 52.7		

NOTE(S) :

RL Reporting Limit

B Estimated result. Result is less than RL.

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK & SDA INLET RB D.I.WATER BLANK

General Chemistry

Lot-Sample #...: H6L110106-016

Work Order #...: JK7K4

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Hydrogen bromide	ND	101	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 1012.61		MDL.....: 50.6		
Hydrogen chloride	ND	103	ug	KNOX 0050/26A Mod	12/18/06	6363098
		Dilution Factor: 1028.43		MDL.....: 43.2		
Hydrogen fluoride	ND	105	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 1053.05		MDL.....: 52.7		

METHOD BLANK REPORT

General Chemistry

Client Lot #...: H6L110106

Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	Work Order #: JL21F1AA 10.0	ug	MB Lot-Sample #: H6L220000-347 KNOX 0050/26A Mod	12/19/06	6356347
		Dilution Factor: 100				
Chlorine	ND	Work Order #: JL21W1AA 10.0	ug	MB Lot-Sample #: H6L220000-350 KNOX 0050/26A Mod	12/19/06	6356350
		Dilution Factor: 100				
Hydrogen bromide	ND	Work Order #: JL69F1AA 10.1	ug	MB Lot-Sample #: H6L270000-375 KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 101.2				
Hydrogen chloride	ND	Work Order #: JL8TM1AA 10.3	ug	MB Lot-Sample #: H6L290000-098 KNOX 0050/26A Mod	12/18/06	6363098
		Dilution Factor: 102.8				
Hydrogen chloride	ND	Work Order #: JL9AA1AA 10.3	ug	MB Lot-Sample #: H6L290000-147 KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 102.8				
Hydrogen fluoride	ND	Work Order #: JL69G1AA 10.5	ug	MB Lot-Sample #: H6L270000-376 KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 105.3				
Hydrogen fluoride	ND	Work Order #: JL22H1AA 10.5	ug	MB Lot-Sample #: H6L220000-352 KNOX 0050/26A Mod	12/19/06	6356352
		Dilution Factor: 105.3				

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

General Chemistry

Lot-Sample #...: H6L110106

Matrix.....: AIR

	PERCENT	RECOVERY	RPD	PREPARATION-	PREP	
PARAMETER	RECOVERY	LIMITS	LIMITS	METHOD	ANALYSIS DATE	BATCH #
Bromine		WO#:JL21F1AC-LCS/JL21F1AD-LCSD LCS Lot-Sample#: H6L220000-347				
	103	(90 - 110)		KNOX 0050/26A Mod	12/19/06	6356347
	101	(90 - 110)	1.9 (0-20)	KNOX 0050/26A Mod	12/19/06	6356347
		Dilution Factor: 100				
Chlorine		WO#:JL21W1AC-LCS/JL21W1AD-LCSD LCS Lot-Sample#: H6L220000-350				
	103	(90 - 110)		KNOX 0050/26A Mod	12/19/06	6356350
	104	(90 - 110)	1.4 (0-20)	KNOX 0050/26A Mod	12/19/06	6356350
		Dilution Factor: 100				
Hydrogen bromide		WO#:JL69F1AC-LCS/JL69F1AD-LCSD LCS Lot-Sample#: H6L270000-375				
	96	(90 - 110)		KNOX 0050/26A Mod	12/18/06	6361375
	99	(90 - 110)	2.6 (0-20)	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 101.2				
Hydrogen chloride		WO#:JL8TM1AC-LCS/JL8TM1AD-LCSD LCS Lot-Sample#: H6L290000-098				
	100	(90 - 110)		KNOX 0050/26A Mod	12/18/06	6363098
	101	(90 - 110)	1.2 (0-20)	KNOX 0050/26A Mod	12/18/06	6363098
		Dilution Factor: 102.8				
Hydrogen chloride		WO#:JL9AA1AC-LCS/JL9AA1AD-LCSD LCS Lot-Sample#: H6L290000-147				
	100	(90 - 110)		KNOX 0050/26A Mod	12/28/06	6363147
	101	(90 - 110)	0.82 (0-20)	KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 102.8				
Hydrogen fluoride		WO#:JL22H1AC-LCS/JL22H1AD-LCSD LCS Lot-Sample#: H6L220000-352				
	102	(90 - 110)		KNOX 0050/26A Mod	12/19/06	6356352
	102	(90 - 110)	0.37 (0-20)	KNOX 0050/26A Mod	12/19/06	6356352
		Dilution Factor: 105.3				
Hydrogen fluoride		WO#:JL69G1AC-LCS/JL69G1AD-LCSD LCS Lot-Sample#: H6L270000-376				
	100	(90 - 110)		KNOX 0050/26A Mod	12/18/06	6361376
	100	(90 - 110)	0.51 (0-20)	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 105.3				

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE DATA REPORT

General Chemistry

Lot-Sample #...: H6L110106

Matrix.....: AIR

PARAMETER	SPIKE AMOUNT	MEASURED AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
WO#:JL21F1AC-LCS/JL21F1AD-LCSD LCS Lot-Sample#: H6L220000-347								
Bromine	75.0	77.2	ug	103		KNOX 0050/26A Mod	12/19/06	6356347
	75.0	75.7	ug	101	1.9	KNOX 0050/26A Mod	12/19/06	6356347
Dilution Factor: 100								
WO#:JL21W1AC-LCS/JL21W1AD-LCSD LCS Lot-Sample#: H6L220000-350								
Chlorine	75.0	77.0	ug	103		KNOX 0050/26A Mod	12/19/06	6356350
	75.0	78.0	ug	104	1.4	KNOX 0050/26A Mod	12/19/06	6356350
Dilution Factor: 100								
WO#:JL69F1AC-LCS/JL69F1AD-LCSD LCS Lot-Sample#: H6L270000-375								
Hydrogen bromide	76.0	73.1	ug	96		KNOX 0050/26A Mod	12/18/06	6361375
	76.0	75.0	ug	99	2.6	KNOX 0050/26A Mod	12/18/06	6361375
Dilution Factor: 101.2								
WO#:JL8TM1AC-LCS/JL8TM1AD-LCSD LCS Lot-Sample#: H6L290000-098								
Hydrogen chloride	77.1	77.2	ug	100		KNOX 0050/26A Mod	12/18/06	6363098
	77.1	78.1	ug	101	1.2	KNOX 0050/26A Mod	12/18/06	6363098
Dilution Factor: 102.8								
WO#:JL9AA1AC-LCS/JL9AA1AD-LCSD LCS Lot-Sample#: H6L290000-147								
Hydrogen chloride	77.1	77.1	ug	100		KNOX 0050/26A Mod	12/28/06	6363147
	77.1	77.8	ug	101	0.82	KNOX 0050/26A Mod	12/28/06	6363147
Dilution Factor: 102.8								
WO#:JL22H1AC-LCS/JL22H1AD-LCSD LCS Lot-Sample#: H6L220000-352								
Hydrogen fluoride	79.0	80.9	ug	102		KNOX 0050/26A Mod	12/19/06	6356352
	79.0	80.6	ug	102	0.37	KNOX 0050/26A Mod	12/19/06	6356352
Dilution Factor: 105.3								
WO#:JL69G1AC-LCS/JL69G1AD-LCSD LCS Lot-Sample#: H6L270000-376								
Hydrogen fluoride	79.0	78.8	ug	100		KNOX 0050/26A Mod	12/18/06	6361376
	79.0	79.2	ug	100	0.51	KNOX 0050/26A Mod	12/18/06	6361376
Dilution Factor: 105.3								

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE EVALUATION REPORT

General Chemistry

Client Lot #...: H6L110106

Matrix.....: AIR

Date Sampled...: 11/30/06

Date Received...: 12/06/06

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD RPD	LIMITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine			WO#:	JK7KA1AE-MS/JK7KA1AF-MSD	MS Lot-Sample #:	H6L110106-004	
	101	(75 - 125)			KNOX 0050/26A Mod	12/19/06	6356347
	93	(75 - 125)	8.4	(0-20)	KNOX 0050/26A Mod	12/19/06	6356347
				Dilution Factor: 2950			
Chlorine			WO#:	JK7KA1AG-MS/JK7KA1AH-MSD	MS Lot-Sample #:	H6L110106-004	
	95	(75 - 125)			KNOX 0050/26A Mod	12/19/06	6356350
	95	(75 - 125)	0.35	(0-20)	KNOX 0050/26A Mod	12/19/06	6356350
				Dilution Factor: 2950			
Hydrogen bromide			WO#:	JK7J71AE-MS/JK7J71AF-MSD	MS Lot-Sample #:	H6L110106-002	
	104	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6361375
	105	(75 - 125)	0.69	(0-20)	KNOX 0050/26A Mod	12/18/06	6361375
				Dilution Factor: 4303.			
Hydrogen chloride			WO#:	JK7J71AJ-MS/JK7J71AK-MSD	MS Lot-Sample #:	H6L110106-002	
	99	(75 - 125)			KNOX 0050/26A Mod	12/28/06	6363147
	99	(75 - 125)	0.59	(0-20)	KNOX 0050/26A Mod	12/28/06	6363147
				Dilution Factor: 17483			
Hydrogen fluoride			WO#:	JK7J71AG-MS/JK7J71AH-MSD	MS Lot-Sample #:	H6L110106-002	
	105	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6361376
	107	(75 - 125)	1.7	(0-20)	KNOX 0050/26A Mod	12/18/06	6361376
				Dilution Factor: 4475.			
Hydrogen fluoride			WO#:	JK7KA1AJ-MS/JK7KA1AK-MSD	MS Lot-Sample #:	H6L110106-004	
	102	(75 - 125)			KNOX 0050/26A Mod	12/19/06	6356352
	105	(75 - 125)	2.5	(0-20)	KNOX 0050/26A Mod	12/19/06	6356352
				Dilution Factor: 3106.			

NOTE (S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE DATA REPORT

General Chemistry

Client Lot #...: H6L110106

Matrix.....: AIR

Date Sampled...: 11/30/06

Date Received...: 12/06/06

PARAMETER	SAMPLE AMOUNT	SPIKE AMT	MEASRD AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine									
WO#: JK7KA1AE-MS/JK7KA1AF-MSD MS Lot-Sample #: H6L110106-004									
	ND	590	596	ug	101		KNOX 0050/26A	12/19/06	6356347
	ND	590	548	ug	93	8.4	KNOX 0050/26A	12/19/06	6356347
Dilution Factor: 2950									
Chlorine									
WO#: JK7KA1AG-MS/JK7KA1AH-MSD MS Lot-Sample #: H6L110106-004									
	216	590	779	ug	95		KNOX 0050/26A	12/19/06	6356350
	216	590	776	ug	95	0.35	KNOX 0050/26A	12/19/06	6356350
Dilution Factor: 2950									
Hydrogen bromide									
WO#: JK7J71AE-MS/JK7J71AF-MSD MS Lot-Sample #: H6L110106-002									
	ND	861	898	ug	104		KNOX 0050/26A	12/18/06	6361375
	ND	861	904	ug	105	0.69	KNOX 0050/26A	12/18/06	6361375
Dilution Factor: 4303.									
Hydrogen chloride									
WO#: JK7J71AJ-MS/JK7J71AK-MSD MS Lot-Sample #: H6L110106-002									
	ND	3500	3470	ug	99		KNOX 0050/26A	12/28/06	6363147
	ND	3500	3450	ug	99	0.59	KNOX 0050/26A	12/28/06	6363147
Dilution Factor: 17483									
Hydrogen fluoride									
WO#: JK7J71AG-MS/JK7J71AH-MSD MS Lot-Sample #: H6L110106-002									
	ND	895	943	ug	105		KNOX 0050/26A	12/18/06	6361376
	ND	895	959	ug	107	1.7	KNOX 0050/26A	12/18/06	6361376
Dilution Factor: 4475.									
Hydrogen fluoride									
WO#: JK7KA1AJ-MS/JK7KA1AK-MSD MS Lot-Sample #: H6L110106-004									
	ND	621	634	ug	102		KNOX 0050/26A	12/19/06	6356352
	ND	621	650	ug	105	2.5	KNOX 0050/26A	12/19/06	6356352
Dilution Factor: 3106.									

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 1 ACE FW

General Chemistry

Lot-Sample #....: H6L110106-001 Work Order #....: JK7J5 Matrix.....: AIR
Date Sampled....: 11/30/06 Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Particulates (total)	1450	0.50	mg	CFR60A 5	12/15-12/18/06	6349313
Dilution Factor: 1				MDL.....: 0.50		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 2 ACE FW

General Chemistry

Lot-Sample #...: H6L110106-005 Work Order #...: JK7KE Matrix.....: AIR
Date Sampled...: 12/01/06 Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Particulates (total)	2170	0.50	mg	CFR60A 5	12/15-12/18/06	6349313
		Dilution Factor: 1		MDL.....: 0.50		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 3 ACE FW

General Chemistry

Lot-Sample #....: H6L110106-009

Work Order #....: JK7KQ

Matrix.....: AIR

Date Sampled....: 12/02/06

Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Particulates (total)	2060	0.50	mg	CFR60A 5	12/15-12/18/06	6349313
		Dilution Factor: 1		MDL.....: 0.50		

Sample Receipt Documentation

**AIR
SAMPLING
ASSOCIATES, INC.**

H6L11D1b6

Chain of Custody Record

Client		Project No.		Page		of		Analysis	
Address		Unit No.		Lab		Lab Contact		Analysis	
City		Project Manager		Lab Contact		Lab Phone No.		Analysis	
State		Test Method		Absorbing Solution		No. of Containers		Comments	
Zip Code		Time		Date		Sample I.D.		Date	
Littleton		CO		80120		1		EPA 17/26A / CTM027	
Run No.		1		11-30-06		1715		1	
Sample No. 1		11-30-06		1715		1		Thimble No. 59	
Sample No. 2		11-30-06		1718		1		ACE F.W.	
Sample No. 3		11-30-06		1640		1		Imps 1:2 + Rinse	
Sample No. 4		11-30-06		1646		1		Imps 3:4 + Rinse	
Reedtemp. Ambient, No custody Seals		696769459203		9199					
MFH 12-Gro, 9 Containers Fedex #		9214		9133					
		9177		9166					
		9188		9225					
Special Instructions: Cont No. 1 & No. 2 retained by ASAI. Split Container No. 3 for IC analysis to determine NH ₃ . HF and HBr are primary analytes for the 26A analysis.									
Turn Around Time Required: ☒ Normal ☐ Rush		Sample Disposal: ☐ Return to ASAI ☒ Disposal By Lab		Archive For		X 3		Months	
1. Recovered By: <i>Bill Mullins</i>		Date: 11-30-06		Time: 1718		Relinquished By: <i>Bill Mullins</i>		Date: 12/3/06 Time: 0910	
2. Received By: <i>Bill Mullins, Jr.</i>		Date: 12/3/06		Time: 0910		Relinquished By: <i>Bill Mullins, Jr.</i>		Date: 12/3/06 Time: 1330	
3. Received By: <i>Alan D. Raylance</i>		Date: 12/3/06		Time: 1330		Relinquished By: <i>Alan D. Raylance</i>		Date: 12/4/06 Time: 0820	
Comments: <i>Bill Mullins</i>		12/4/06		0820		<i>Bill Mullins</i>		12/5/06 1400

**AIR
SAMPLING
ASSOCIATES, INC.**

HL110106

Chain of Custody Record

Client		Project No.		Page		of		Analysis	
Address		Unit No.		Lab		Lab Contact		Analysis	
City		State		Project Manager		Lab Phone No.		Analysis	
Zip Code		Test Method		Absorbing Solution		No. of Containers		Comments	
Run No.		Sample I.D.		Time		Date		Analysis	
AAA-ES		06-057		1		1		Thimble No. 60	
8100 Southpark Way		Harris SDA Inlet Duct		1		1		ACE F.W.	
Littleton		Bill Mullins		1		1		Imps 1:2 + Rinse	
CO 80120		EPA 17/26A/CTMOZ7		1		1		Imps 3:4 + Rinse	
Run No. 2		Date		Time		Date		Analysis	
Cont. No. 1		12-1-06		1556		1		X	
Cont. No. 2		12-1-06		1558		1		X	
Cont. No. 3		12-1-06		1540		1		X	
Cont. No. 4		12-1-06		1542		1		X	
Special Instructions:		Cont. Nos. 1 and 2 retained by ASAI. Split Cont. No. 3 for IC analysis to determine NH ₃ . HF and HBr are primary analytes for the EPA 26A analysis.							
Turn Around Time Required:		Normal		Rush		Sample Disposal:		Return to ASAI	
Recovered By		Date		Time		Date		Time	
Bill W. Mullins		12-1-06		1558		12/3/06		0910	
Received By		Date		Time		Date		Time	
Bill W. Mullins		12/3/06		0910		12/3/06		1330	
Received By		Date		Time		Date		Time	
Alan D. Roylance		12/3/06		1330		12/4/06		0820	
Comments:		12/4/06 0830 12/5/06 1400							

P.O. Box 1175 • Lewisville, TX 75067 • Office: (972) 492-1400 • Fax: (972) 492-1402 • Toll-Free: (866) 311-9940

Rec'd By: Matthew F. Howard, 12-6-06, 09:15

**AIR
SAMPLING
ASSOCIATES, INC.**

H62110106

Chain of Custody Record

Client		Project No.		Page	of	Analysis	
Address		Unit No.	Lab	3	4		
City	State	Zip Code	Project Manager	Lab Contact	Lab Phone No.		
Run No.	Sample I.D.	Date	Absorbing Solution	No. of Containers	Comments		
3							
Cont. 1		12-2-06	0801	1	Thimble No. 61	X	NH ₃
Cont. 2		12-2-06	0807	1	ACE FW.	X	Hydrogen Halide
Cont. 3		12-2-06	0832	1	Imps 1:2 + Rinse	X	X
Cont. 4		12-2-06	0836	1	Imps 3:4 + Rinse	X	X
Special Instructions: Containers No. 1 and 2 retained by ASAI. Split Cont. No. 3 for IC analysis to determine NH ₃ . HF and HBr are primary analytes for the def analysis.							
Turn Around Time Required:	☒ Normal ☐ Rush	Sample Disposal:		☐ Return to ASAI ☒ Disposal By Lab	Archive For	3	Months
1. Recovered By	Bill Wynn	Date	Time	1. Relinquished By	Date	Time	
		12-2-06	0836	Bill Wynn	12/3/06	0910	
2. Received By	Bill Wynn	Date	Time	2. Relinquished By	Date	Time	
		12/3/06	0910	Bill Wynn	12/3/06	1330	
3. Received By	Alan D. Payne	Date	Time	3. Relinquished By	Date	Time	
		12/3/06	1330	Alan D. Payne	12/14/06	0820	
Comments:	12/4/06 0820 12/5/06 1400

701017941

Chain of Custody Record

[illegible]

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Read by: Matthew F Konec, 12-6-06, 09:15

STL KNOXVILLE SAMPLE RECEIPT/CONDITION UPON RECEIPT ANOMALY CHECKLIST

Client: AirSampling Associate Project: _____

Lot Number: 176L110106

Review Items	Yes	No	NA	If No, what was the problem?	Comments/Actions Taken
1. Do sample container labels match COC? (IDs, Dates, Times)				☐ 1a Do not match COC ☐ 1b Incomplete information ☐ 1c Marking smeared ☐ 1d Label torn ☐ 1e No label ☐ 1f COC not received ☒ 1g Other:	<u>4a</u> <u>1g Cont. No. 2 was peiced, The CoC says that Cont. 1 and 2 were retained by ASAI.</u>
2. Is the cooler temperature within limits? (> freezing temp. of water to 6°C; NC, 1668, 1613B: 0-4°C; VOST: 10°C; MA: 2-6°C)			☒	☐ 2a Temp Blank = _____ ☐ 2b Cooler Temp = _____	
3. Were samples received with correct chemical preservative (excluding Encore)?	☒			☐ 3a Sample preservative = _____	
4. Were custody seals present/intact on cooler and/or containers?		☒		☒ 4a Not present ☐ 4b Not intact ☐ 4c Other:	
5. Were all of the samples listed on the COC received?	☒			☐ 5a Samples received-not on COC ☐ 5b Samples not received-on COC	
6. Were all of the sample containers received intact?	☒			☐ 6a Leaking ☐ 6b Broken	
7. Were VOA samples received without headspace?			☒	☐ 7a Headspace (VOA only)	
8. Were samples received in appropriate containers?	☒			☐ 8a Improper container	
9. Did you check for residual chlorine, if necessary?			☒	☐ 9a Could not be determined due to matrix interference ☐ 10a Holding time expired	
10. Were samples received within holding time?	☒			☐ Incomplete information	
11. For rad samples, was sample activity info. provided?			☒	If yes & appears to be > 1%, was SOG notified?	
12. For SOG water samples (1613B, 1668A, 8290, LR PAHs), do samples have visible solids present?			☒	☐ 13a Leaking ☐ 13b Other:	
13. Are the shipping containers intact?	☒			☐ 14a Not relinquished ☐ 15a Incomplete information	
14. Was COC relinquished? (Signed/Dated/Timed)	☒			☐ 15a Incomplete information ☐ 15a Incomplete information	
15. Are tests/parameters listed for each sample?	☒			☐ 15a Incomplete information ☐ 15a Incomplete information	
16. Is the matrix of the samples noted?	☒			☐ 15a Incomplete information ☐ 15a Incomplete information	
17. Is the date/time of sample collection noted?	☒			☐ 15a Incomplete information ☐ 15a Incomplete information	
18. Is the client and project name/# identified?	☒			☐ 15a Incomplete information ☐ 15a Incomplete information	
19. Was the sampler identified on the COC?	☒				
Quote #: _____ PM Instructions: _____					

Sample Receiving Associate: Matthew Howard Date: 12-6-06

Wet Chemistry

Sample Summary

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 1 ACE FW

General Chemistry

Lot-Sample #....: H6L110106-001 Work Order #....: JK7J5 Matrix.....: AIR
Date Sampled....: 11/30/06 Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Particulates (total)	1450	0.50	mg	CFR60A 5	12/15-12/18/06	6349313
Dilution Factor: 1				MDL.....: 0.50		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 1 0.1N H2SO4

General Chemistry

Lot-Sample #...: H6L110106-002
 Date Sampled...: 11/30/06

Work Order #...: JK7J7
 Date Received...: 12/06/06

Matrix.....: AIR

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Hydrogen bromide	ND	430	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 4303.61		MDL.....: 215		
Hydrogen chloride	ND	1750	ug	KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 17483.3		MDL.....: 734		
Hydrogen fluoride	ND	448	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 4475.47		MDL.....: 224		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 1 0.1N NAOH

General Chemistry

Lot-Sample #...: H6L110106-004 Work Order #...: JK7KA Matrix.....: AIR
Date Sampled...: 11/30/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	295	ug	KNOX 0050/26A Mod	12/19/06	6356347
		Dilution Factor: 2950		MDL.....: 70.8		
Chlorine	216 B	295	ug	KNOX 0050/26A Mod	12/19/06	6356350
		Dilution Factor: 2950		MDL.....: 124		
Hydrogen fluoride	ND	311	ug	KNOX 0050/26A Mod	12/19/06	6356352
		Dilution Factor: 3106.5		MDL.....: 155		

NOTE(S) :

RL Reporting Limit

B Estimated result. Result is less than RL.

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 2 ACE FW

General Chemistry

Lot-Sample #....: H6L110106-005 Work Order #....: JK7KE Matrix.....: AIR
Date Sampled....: 12/01/06 Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Particulates (total)	2170	0.50	mg	CFR60A 5	12/15-12/18/06	6349313
		Dilution Factor: 1		MDL.....: 0.50		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 2 0.1N H2SO4

General Chemistry

Lot-Sample #...: H6L110106-006 Work Order #...: JK7KG Matrix.....: AIR
 Date Sampled...: 12/01/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Hydrogen bromide	ND	405	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 4050.46		MDL.....: 203		
Hydrogen chloride	ND	1650	ug	KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 16454.87		MDL.....: 691		
Hydrogen fluoride	ND	421	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 4212.21		MDL.....: 211		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 2 0.1N NAOH

General Chemistry

Lot-Sample #...: H6L110106-008 Work Order #...: JK7KN Matrix.....: AIR
Date Sampled...: 12/01/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	280	ug	KNOX 0050/26A Mod	12/19/06	6356347
		Dilution Factor: 2800		MDL.....: 67.2		
Chlorine	151 B	280	ug	KNOX 0050/26A Mod	12/19/06	6356350
		Dilution Factor: 2800		MDL.....: 118		
Hydrogen fluoride	ND	295	ug	KNOX 0050/26A Mod	12/19/06	6356352
		Dilution Factor: 2948.55		MDL.....: 147		

NOTE(S) :

RL Reporting Limit

B Estimated result. Result is less than RL.

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 3 ACE FW

General Chemistry

Lot-Sample #....: H6L110106-009 Work Order #....: JK7KQ Matrix.....: AIR
Date Sampled....: 12/02/06 Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Particulates (total)	2060	0.50	mg	CFR60A 5	12/15-12/18/06	6349313
		Dilution Factor: 1		MDL.....: 0.50		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 3 0.1N H2SO4

General Chemistry

Lot-Sample #...: H6L110106-010 Work Order #...: JK7KT Matrix.....: AIR
 Date Sampled...: 12/02/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Hydrogen bromide	ND	368	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 3675.79		MDL.....: 184		
Hydrogen chloride	ND	1490	ug	KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 14932.79		MDL.....: 627		
Hydrogen fluoride	ND	382	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 3822.58		MDL.....: 191		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 3 0.1N NAOH

General Chemistry

Lot-Sample #...: H6L110106-012 Work Order #...: JK7KW Matrix.....: AIR
 Date Sampled...: 12/02/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	270	ug	KNOX 0050/26A Mod	12/19/06	6356347
		Dilution Factor: 2700		MDL.....: 64.8		
Chlorine	159 B	270	ug	KNOX 0050/26A Mod	12/19/06	6356350
		Dilution Factor: 2700		MDL.....: 113		
Hydrogen fluoride	ND	284	ug	KNOX 0050/26A Mod	12/19/06	6356352
		Dilution Factor: 2843.24		MDL.....: 142		

NOTE(S) :

RL Reporting Limit

B Estimated result. Result is less than RL.

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK & SDA INLET RB 0.1N H2SO4 BLANK

General Chemistry

Lot-Sample #...: H6L110106-013 Work Order #...: JK7K0 Matrix.....: AIR
 Date Sampled...: 12/01/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Hydrogen bromide	ND	101	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 1012.61		MDL.....: 50.6		
Hydrogen chloride	ND	206	ug	KNOX 0050/26A Mod	12/18/06	6363098
		Dilution Factor: 2056.86		MDL.....: 86.4		
Hydrogen fluoride	ND	105	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 1053.05		MDL.....: 52.7		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK & SDA INLET RB 0.1N NAOH BLANK

General Chemistry

Lot-Sample #...: H6L110106-015 Work Order #...: JK7K2 Matrix.....: AIR
 Date Sampled...: 12/01/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	100	ug	KNOX 0050/26A Mod	12/19/06	6356347
		Dilution Factor: 1000		MDL.....: 24.0		
Chlorine	47.4 B	100	ug	KNOX 0050/26A Mod	12/19/06	6356350
		Dilution Factor: 1000		MDL.....: 42.0		
Hydrogen fluoride	ND	105	ug	KNOX 0050/26A Mod	12/19/06	6356352
		Dilution Factor: 1053.05		MDL.....: 52.7		

NOTE(S) :

RL: Reporting Limit

B Estimated result. Result is less than RL.

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK & SDA INLET RB D.I.WATER BLANK

General Chemistry

Lot-Sample #...: H6L110106-016

Work Order #...: JK7K4

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Hydrogen bromide	ND	101	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 1012.61		MDL.....: 50.6		
Hydrogen chloride	ND	103	ug	KNOX 0050/26A Mod	12/18/06	6363098
		Dilution Factor: 1028.43		MDL.....: 43.2		
Hydrogen fluoride	ND	105	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 1053.05		MDL.....: 52.7		

QC Summary

METHOD BLANK REPORT

General Chemistry

Client Lot #...: H6L110106

Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	Work Order #: JL21F1AA 10.0	ug	MB Lot-Sample #: H6L220000-347 KNOX 0050/26A Mod	12/19/06	6356347
		Dilution Factor: 100				
Chlorine	ND	Work Order #: JL21W1AA 10.0	ug	MB Lot-Sample #: H6L220000-350 KNOX 0050/26A Mod	12/19/06	6356350
		Dilution Factor: 100				
Hydrogen bromide	ND	Work Order #: JL69F1AA 10.1	ug	MB Lot-Sample #: H6L270000-375 KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 101.2				
Hydrogen chloride	ND	Work Order #: JL8TM1AA 10.3	ug	MB Lot-Sample #: H6L290000-098 KNOX 0050/26A Mod	12/18/06	6363098
		Dilution Factor: 102.8				
Hydrogen chloride	ND	Work Order #: JL9AA1AA 10.3	ug	MB Lot-Sample #: H6L290000-147 KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 102.8				
Hydrogen fluoride	ND	Work Order #: JL69G1AA 10.5	ug	MB Lot-Sample #: H6L270000-376 KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 105.3				
Hydrogen fluoride	ND	Work Order #: JL22H1AA 10.5	ug	MB Lot-Sample #: H6L220000-352 KNOX 0050/26A Mod	12/19/06	6356352
		Dilution Factor: 105.3				

NOTE (S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

General Chemistry

Lot-Sample #...: H6L110106

Matrix.....: AIR

	PERCENT	RECOVERY	RPD	LIMITS	METHOD	PREPARATION-	PREP
PARAMETER	RECOVERY	LIMITS	RPD	LIMITS	METHOD	ANALYSIS DATE	BATCH #
Bromine		WO#:JL21F1AC-LCS/JL21F1AD-LCSD LCS Lot-Sample#: H6L220000-347					
	103	(90 - 110)			KNOX 0050/26A Mod	12/19/06	6356347
	101	(90 - 110)	1.9	(0-20)	KNOX 0050/26A Mod	12/19/06	6356347
		Dilution Factor: 100					
Chlorine		WO#:JL21W1AC-LCS/JL21W1AD-LCSD LCS Lot-Sample#: H6L220000-350					
	103	(90 - 110)			KNOX 0050/26A Mod	12/19/06	6356350
	104	(90 - 110)	1.4	(0-20)	KNOX 0050/26A Mod	12/19/06	6356350
		Dilution Factor: 100					
Hydrogen bromide		WO#:JL69F1AC-LCS/JL69F1AD-LCSD LCS Lot-Sample#: H6L270000-375					
	96	(90 - 110)			KNOX 0050/26A Mod	12/18/06	6361375
	99	(90 - 110)	2.6	(0-20)	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 101.2					
Hydrogen chloride		WO#:JL8TM1AC-LCS/JL8TM1AD-LCSD LCS Lot-Sample#: H6L290000-098					
	100	(90 - 110)			KNOX 0050/26A Mod	12/18/06	6363098
	101	(90 - 110)	1.2	(0-20)	KNOX 0050/26A Mod	12/18/06	6363098
		Dilution Factor: 102.8					
Hydrogen chloride		WO#:JL9AA1AC-LCS/JL9AA1AD-LCSD LCS Lot-Sample#: H6L290000-147					
	100	(90 - 110)			KNOX 0050/26A Mod	12/28/06	6363147
	101	(90 - 110)	0.82	(0-20)	KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 102.8					
Hydrogen fluoride		WO#:JL22H1AC-LCS/JL22H1AD-LCSD LCS Lot-Sample#: H6L220000-352					
	102	(90 - 110)			KNOX 0050/26A Mod	12/19/06	6356352
	102	(90 - 110)	0.37	(0-20)	KNOX 0050/26A Mod	12/19/06	6356352
		Dilution Factor: 105.3					
Hydrogen fluoride		WO#:JL69G1AC-LCS/JL69G1AD-LCSD LCS Lot-Sample#: H6L270000-376					
	100	(90 - 110)			KNOX 0050/26A Mod	12/18/06	6361376
	100	(90 - 110)	0.51	(0-20)	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 105.3					

NOTE (S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE DATA REPORT

General Chemistry

Lot-Sample #...: H6L110106

Matrix.....: AIR

PARAMETER	SPIKE AMOUNT	MEASURED AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine								
						WO#:JL21F1AC-LCS/JL21F1AD-LCSD LCS Lot-Sample#:	H6L220000	-347
	75.0	77.2	ug	103		KNOX 0050/26A Mod	12/19/06	6356347
	75.0	75.7	ug	101	1.9	KNOX 0050/26A Mod	12/19/06	6356347
						Dilution Factor: 100		
Chlorine								
						WO#:JL21W1AC-LCS/JL21W1AD-LCSD LCS Lot-Sample#:	H6L220000	-350
	75.0	77.0	ug	103		KNOX 0050/26A Mod	12/19/06	6356350
	75.0	78.0	ug	104	1.4	KNOX 0050/26A Mod	12/19/06	6356350
						Dilution Factor: 100		
Hydrogen bromide								
						WO#:JL69F1AC-LCS/JL69F1AD-LCSD LCS Lot-Sample#:	H6L270000	-375
	76.0	73.1	ug	96		KNOX 0050/26A Mod	12/18/06	6361375
	76.0	75.0	ug	99	2.6	KNOX 0050/26A Mod	12/18/06	6361375
						Dilution Factor: 101.2		
Hydrogen chloride								
						WO#:JL8TM1AC-LCS/JL8TM1AD-LCSD LCS Lot-Sample#:	H6L290000	-098
	77.1	77.2	ug	100		KNOX 0050/26A Mod	12/18/06	6363098
	77.1	78.1	ug	101	1.2	KNOX 0050/26A Mod	12/18/06	6363098
						Dilution Factor: 102.8		
Hydrogen chloride								
						WO#:JL9AA1AC-LCS/JL9AA1AD-LCSD LCS Lot-Sample#:	H6L290000	-147
	77.1	77.1	ug	100		KNOX 0050/26A Mod	12/28/06	6363147
	77.1	77.8	ug	101	0.82	KNOX 0050/26A Mod	12/28/06	6363147
						Dilution Factor: 102.8		
Hydrogen fluoride								
						WO#:JL22H1AC-LCS/JL22H1AD-LCSD LCS Lot-Sample#:	H6L220000	-352
	79.0	80.9	ug	102		KNOX 0050/26A Mod	12/19/06	6356352
	79.0	80.6	ug	102	0.37	KNOX 0050/26A Mod	12/19/06	6356352
						Dilution Factor: 105.3		
Hydrogen fluoride								
						WO#:JL69G1AC-LCS/JL69G1AD-LCSD LCS Lot-Sample#:	H6L270000	-376
	79.0	78.8	ug	100		KNOX 0050/26A Mod	12/18/06	6361376
	79.0	79.2	ug	100	0.51	KNOX 0050/26A Mod	12/18/06	6361376
						Dilution Factor: 105.3		

NOTE (S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE EVALUATION REPORT

General Chemistry

Client Lot #...: H6L110106

Matrix.....: AIR

Date Sampled...: 11/30/06

Date Received...: 12/06/06

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine			WO#:		JK7KA1AE-MS/JK7KA1AF-MSD	MS Lot-Sample #:	H6L110106-004
	101	(75 - 125)			KNOX 0050/26A Mod	12/19/06	6356347
	93	(75 - 125)	8.4	(0-20)	KNOX 0050/26A Mod	12/19/06	6356347
					Dilution Factor: 2950		
Chlorine			WO#:		JK7KA1AG-MS/JK7KA1AH-MSD	MS Lot-Sample #:	H6L110106-004
	95	(75 - 125)			KNOX 0050/26A Mod	12/19/06	6356350
	95	(75 - 125)	0.35	(0-20)	KNOX 0050/26A Mod	12/19/06	6356350
					Dilution Factor: 2950		
Hydrogen bromide			WO#:		JK7J71AE-MS/JK7J71AF-MSD	MS Lot-Sample #:	H6L110106-002
	104	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6361375
	105	(75 - 125)	0.69	(0-20)	KNOX 0050/26A Mod	12/18/06	6361375
					Dilution Factor: 4303.		
Hydrogen chloride			WO#:		JK7J71AJ-MS/JK7J71AK-MSD	MS Lot-Sample #:	H6L110106-002
	99	(75 - 125)			KNOX 0050/26A Mod	12/28/06	6363147
	99	(75 - 125)	0.59	(0-20)	KNOX 0050/26A Mod	12/28/06	6363147
					Dilution Factor: 17483		
Hydrogen fluoride			WO#:		JK7J71AG-MS/JK7J71AH-MSD	MS Lot-Sample #:	H6L110106-002
	105	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6361376
	107	(75 - 125)	1.7	(0-20)	KNOX 0050/26A Mod	12/18/06	6361376
					Dilution Factor: 4475.		
Hydrogen fluoride			WO#:		JK7KA1AJ-MS/JK7KA1AK-MSD	MS Lot-Sample #:	H6L110106-004
	102	(75 - 125)			KNOX 0050/26A Mod	12/19/06	6356352
	105	(75 - 125)	2.5	(0-20)	KNOX 0050/26A Mod	12/19/06	6356352
					Dilution Factor: 3106.		

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE DATA REPORT

General Chemistry

Client Lot #...: H6L110106

Matrix.....: AIR

Date Sampled...: 11/30/06

Date Received...: 12/06/06

PARAMETER	SAMPLE AMOUNT	SPIKE AMT	MEASRD AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine									
WO#: JK7KA1AE-MS/JK7KA1AF-MSD MS Lot-Sample #: H6L110106-004									
	ND	590	596	ug	101		KNOX 0050/26A	12/19/06	6356347
	ND	590	548	ug	93	8.4	KNOX 0050/26A	12/19/06	6356347
Dilution Factor: 2950									
Chlorine									
WO#: JK7KA1AG-MS/JK7KA1AH-MSD MS Lot-Sample #: H6L110106-004									
	216	590	779	ug	95		KNOX 0050/26A	12/19/06	6356350
	216	590	776	ug	95	0.35	KNOX 0050/26A	12/19/06	6356350
Dilution Factor: 2950									
Hydrogen bromide									
WO#: JK7J71AE-MS/JK7J71AF-MSD MS Lot-Sample #: H6L110106-002									
	ND	861	898	ug	104		KNOX 0050/26A	12/18/06	6361375
	ND	861	904	ug	105	0.69	KNOX 0050/26A	12/18/06	6361375
Dilution Factor: 4303.									
Hydrogen chloride									
WO#: JK7J71AJ-MS/JK7J71AK-MSD MS Lot-Sample #: H6L110106-002									
	ND	3500	3470	ug	99		KNOX 0050/26A	12/28/06	6363147
	ND	3500	3450	ug	99	0.59	KNOX 0050/26A	12/28/06	6363147
Dilution Factor: 17483									
Hydrogen fluoride									
WO#: JK7J71AG-MS/JK7J71AH-MSD MS Lot-Sample #: H6L110106-002									
	ND	895	943	ug	105		KNOX 0050/26A	12/18/06	6361376
	ND	895	959	ug	107	1.7	KNOX 0050/26A	12/18/06	6361376
Dilution Factor: 4475.									
Hydrogen fluoride									
WO#: JK7KA1AJ-MS/JK7KA1AK-MSD MS Lot-Sample #: H6L110106-004									
	ND	621	634	ug	102		KNOX 0050/26A	12/19/06	6356352
	ND	621	650	ug	105	2.5	KNOX 0050/26A	12/19/06	6356352
Dilution Factor: 3106.									

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

Raw Data

Anions

STL Knoxville IC Initial Calibration Data Review / Narrative Checklist
Methods: 300.0, 9056, 9057 and 26A, SOP: KNOX-WC-0005, Rev. 8

Page 1 of 1

(ICS-1500)

Analysis Date:	10/18/06	File ID:	J18-LOWLEVEL-FLN02BRND3-101806
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Initial Calibration Review Items	N/A	Yes	No	If No, why is data reportable?	2nd ✓
1. Were at least 5 levels of each analyte analyzed?		✓			✓
2. Is low level standard concentration $\leq$ RL?		✓			✓
3. Are the correlation coefficients (r) ≥ 0.995 ; $r^2 \geq 0.990$?		✓			✓
4. For method 300.0, was the calibration curve processed using linear regression?	✓				NA
5. For manual integrated standards, are before/after chromatograms provided with initials/date/reason?	✓			Reasons: S=Split peak, U=Undetected peak, I=Incorrect peak integration, B=Baseline correction, W=Wrong peak chosen by data system	NA

Analyst:	CWK	Date:	10/19/06
Comments:			
Range: 0.075 - 2.0 mg/L			
- 2 nd order calibration using peak hgt. vs amount.			
LOW LEVEL			
2 nd Level Reviewer:	Dowhul	Date:	10/19/06
Comments:	Cal std (5) = ICWS-8919 (CL)		
$\text{peak height} = 0 + 2.19733(.9966) + 0.033578(.9966)^2$ $= 0 + 2.1899 + 0.0334$ $= 2.223$			

Scanned
10/19/06
DKW

1 CAL STD #1 ICWS-8915

Sample Name: CAL STD #1 ICWS-8915
Vial Number: 1292
Sample Type: standard
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 10/18/2006 9:14
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.26	Fluoride	0.20347	0.035	16.69	0.0752	BMB
2	4.61	Chloride	0.21212	0.036	16.87	0.0964	BMB
3	5.37	Nitrite-N	0.30167	0.057	26.98	0.0791	BMB
4	6.67	Bromide	0.05610	0.011	5.39	0.0791	BMB
5	7.47	Nitrate-N	0.28758	0.072	34.07	0.0828	BMB

2 CAL STD #2 ICWS-8916

Sample Name: CAL STD #2 ICWS-8916
Vial Number: 1293
Sample Type: standard
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 10/18/2006 9:32
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.25	n.a.	0.09910	0.019	6.45	n.a.	BMB
2	3.26	Fluoride	0.26277	0.046	15.73	0.0970	BMB
3	4.61	Chloride	0.23228	0.052	17.83	0.1055	BMB
4	5.37	Nitrite-N	0.38584	0.072	24.74	0.1012	BMB
5	6.68	Bromide	0.06928	0.015	5.09	0.0977	BMB
6	7.47	Nitrate-N	0.35086	0.088	30.16	0.1009	BMB

3 CAL STD #3 ICWS-8917

Sample Name: CAL STD #3 ICWS-8917
Vial Number: 1293
Sample Type: standard
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 10/18/2006 9:49
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.25	n.a.	0.09667	0.019	2.79	n.a.	BMB
2	3.26	Fluoride	0.66838	0.127	18.21	0.2438	BMB
3	4.60	Chloride	0.56206	0.103	14.73	0.2548	BMB
4	5.37	Nitrite-N	0.95211	0.184	26.44	0.2484	BMB
5	6.66	Bromide	0.17667	0.040	5.79	0.2488	BMB
6	7.46	Nitrate-N	0.87649	0.223	32.04	0.2502	BMB

4 CAL STD #4 ICWS-8918

Sample Name: CAL STD #4 ICWS-8918
Vial Number: 1295
Sample Type: standard
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 10/18/2006 10:07
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.25	n.a.	0.10012	0.018	1.29	n.a.	BMB
2	3.26	Fluoride	1.39754	0.256	18.63	0.4996	BMB
3	4.61	Chloride	1.09898	0.191	13.89	0.4964	BM
4	5.37	Nitrite-N	1.94194	0.385	27.97	0.5022	M
5	6.67	Bromide	0.35570	0.078	5.68	0.4998	MB
6	7.46	Nitrate-N	1.76858	0.448	32.55	0.4985	BMB

5 CAL STD #5 ICWS-8919

Sample Name: CAL STD #5 ICWS-8919
Vial Number: 1295
Sample Type: standard
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 10/18/2006 10:24
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.25	n.a.	0.13527	0.026	0.94	n.a.	BMB
2	3.26	Fluoride	2.91620	0.530	19.16	1.0032	BM
3	4.61	Chloride	2.22320	0.373	13.49	0.9966	M
4	5.37	Nitrite-N	3.92501	0.773	27.95	0.9983	MB
5	6.67	Bromide	0.71491	0.156	5.62	1.0005	Ru
6	7.45	Nitrate-N	3.63765	0.908	32.83	0.9998	BMB

6 CAL STD #6 ICWS-8920

Sample Name: CAL STD #6 ICWS-8920
Vial Number: 1295
Sample Type: standard
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 10/18/2006 10:41
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.25	n.a.	0.15975	0.030	0.53	n.a.	BMB
2	3.25	Fluoride	6.24513	1.086	19.22	1.9994	BM
3	4.60	Chloride	4.53115	0.754	13.35	2.0009	M
4	5.37	Nitrite-N	8.12633	1.598	28.28	2.0003	M
5	6.66	Bromide	1.44051	0.306	5.42	1.9999	Ru
6	7.43	Nitrate-N	7.63891	1.876	33.19	2.0001	MB

~~4 CAL STD #4 ICWS-8918~~Dfn
10/19/06

Sample Name: CAL STD #4 ICWS-8918
 Vial Number: 1295
 Sample Type: standard
 Control Program: AS14A ANIONS METHOD
 Quantif. Method: AS4A-SC ANION METHOD
 Recording Time: #####
 Run Time (min): 15.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret. Time min	Peak Name	Cal. Type	Points	R-Square	Offset	Slope	Curve
1	2.25	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	3.26	Fluoride	Quad	6	✓ 1.0000	0.000000	2.68877	0.217432
3	4.61	Chloride	Quad	6	0.9998	0.000000	2.19733	0.033578
4	5.37	Nitrite-N	Quad	6	1.0000	0.000000	3.80119	0.130678
5	6.67	Bromide	Quad	6	1.0000	0.000000	0.70878	0.005755
6	7.46	Nitrate-N	Quad	6	1.0000	0.000000	3.45770	0.180759
Average:					1.0000	0.0000	2.5708	0.1136

4 CAL STD #4 ICWS-8918Dkw
10/19/06

Sample Name: CAL STD #4 ICWS-8918
 Vial Number: 1295
 Sample Type: standard
 Control Program: AS14A ANIONS METHOD
 Quantif. Method: AS4A-SC ANION METHOD
 Recording Time: #####
 Run Time (min): 15.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	R-Square	Offset	Slope	Curve
1	2.25	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	3.26	Fluoride	Quad	6	1.0000	0.000000	2.68877	0.217432
3	4.61	Chloride	Quad	6	✓ 0.9998	0.000000	2.19733	0.033578
4	5.37	Nitrite-N	Quad	6	1.0000	0.000000	3.80119	0.130678
5	6.67	Bromide	Quad	6	1.0000	0.000000	0.70878	0.005755
6	7.46	Nitrate-N	Quad	6	1.0000	0.000000	3.45770	0.180759
Average:					1.0000	0.0000	2.5708	0.1136

4 CAL STD #4 ICWS-8918DFW
10/19/06

Sample Name: CAL STD #4 ICWS-8918
 Vial Number: 1295
 Sample Type: standard
 Control Program: AS14A ANIONS METHOD
 Quantif. Method: AS4A-SC ANION METHOD
 Recording Time: #####
 Run Time (min): 15.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	R-Square	Offset	Slope	Curve
1	2.25	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	3.26	Fluoride	Quad	6	1.0000	0.000000	2.68877	0.217432
3	4.61	Chloride	Quad	6	0.9998	0.000000	2.19733	0.033578
4	5.37	Nitrite-N	Quad	6	1.0000	0.000000	3.80119	0.130678
5	6.67	Bromide	Quad	6	1.0000	0.000000	0.70878	0.005755
6	7.46	Nitrate-N	Quad	6	1.0000	0.000000	3.45770	0.180759
Average:					1.0000	0.0000	2.5708	0.1136

4 CAL STD #4 ICWS-8918DKW
10/19/06

Sample Name: CAL STD #4 ICWS-8918
 Vial Number: 1295
 Sample Type: standard
 Control Program: AS14A ANIONS METHOD
 Quantif. Method: AS4A-SC ANION METHOD
 Recording Time: #####
 Run Time (min): 15.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	R-Square	Offset	Slope	Curve
1	2.25	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	3.26	Fluoride	Quad	6	1.0000	0.000000	2.68877	0.217432
3	4.61	Chloride	Quad	6	0.9998	0.000000	2.19733	0.033578
4	5.37	Nitrite-N	Quad	6	1.0000	0.000000	3.80119	0.130678
5	6.67	Bromide	Quad	6	✓ 1.0000	0.000000	0.70878	0.005755
6	7.46	Nitrate-N	Quad	6	1.0000	0.000000	3.45770	0.180759
Average:					1.0000	0.0000	2.5708	0.1136

4 CAL STD #4 ICWS-8918		<i>DFW</i> <i>10/19/06</i>	
Sample Name:	CAL STD #4 ICWS-8918	Injection Volume:	50.0
Vial Number:	1295	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	#####	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	R-Square	Offset	Slope	Curve
1	2.25	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	3.26	Fluoride	Quad	6	1.0000	0.000000	2.68877	0.217432
3	4.61	Chloride	Quad	6	0.9998	0.000000	2.19733	0.033578
4	5.37	Nitrite-N	Quad	6	1.0000	0.000000	3.80119	0.130678
5	6.67	Bromide	Quad	6	1.0000	0.000000	0.70878	0.005755
6	7.46	Nitrate-N	Quad	6	✓ 1.0000	0.000000	3.45770	0.180759
Average:					1.0000	0.0000	2.5708	0.1136

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 9/25/06 Chemist: DFW Expiration Date: 12/25/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWTI-8837	F-	17125	ERA	12/31/07	1000 ppm	5.	50	100. mg/L (ppm)
2. (intermed.)	Cl-	36065		6/30/07				
3. (calib.)	NO ₃ N	17075		7/31/07				
4. (source)	BR-	27025		2/28/07				
5.	NO ₃ N-	17026		2/28/08				
6. ICWTI-8838	F-	1-385-2	SPEX	8/15/07	1000 ppm	5.	50	100. ppm (mg/L)
7. (intermed.)	Cl-	1-5CL-2		3/15/07				
8. (2nd source)	NO ₃ N-	1-13NO ₃ N-2		9/15/07				
9.	BR-	1-1BR-2		4/30/07				
10.	NO ₃ N-	1-2NO ₃ N-2		5/15/07				
11.								
12.								
13.								
14.								

Reviewed By: _____

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 10/18/06 Chemist: WY Expiration Date: 10/19/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. 10W3-8915	F-	ICWI-	8838-8837 WY 10/18/06	12/25/06	100 ppm	0.075	100ml	0.075 ppm
2. (Cal std (1))	Cl ⁻							
3.	NO ₂ -N							
4.	Br ⁻							
5.	NO ₃ -N							
6. 10W3-8916	F-					0.100		0.100 ppm
7. (Cal std (2))	Cl ⁻							
8.	NO ₂ -N							
9.	Br ⁻							
10.	NO ₃ -N							
11. 10W3-8917	F-					0.250		0.250 ppm
12. (Cal std (3))	Cl ⁻							
13.	NO ₂ -N							
14.	Br ⁻							
NO ₃ -N								
Reviewed By _____								

WC031R3.DOC, 8/28/03

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 10/18/06 Chemist: WVK Expiration Date: 10/19/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. 1WVS-8918	F-	ICWI-	8837	12/25/06	100 ppm	0.500	100 ml	0.50 ppm
2. (CAL STD (4))	Cl-							
3.	NO ₃ -N							
4.	Br-							
5.	NO ₃ -N							
6. 1WVS-8919	F-					1.00		1.0 ppm
7. (CAL STD (5))	Cl-							
8.	NO ₃ -N							
9.	Br-							
10.	NO ₃ -N							
11. 1WVS-8920	F-					2.00		2.0 ppm
12. (CAL STD (6))	Cl-							
13.	NO ₃ -N							
14.	Br-							
NO ₃ -N								

Reviewed By: _____

STL Knoxville IC Initial Calibration Data Review / Narrative Checklist
Methods: 300.0, 9056, 9057 and 26A, SOP: KNOX-WC-0005, Rev. 8

Page 1 of 1

DX600 (ARAGORN)

Analysis Date:	12/14/06	File ID:	L14A-COW_AIR-ANLONS-121406
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Initial Calibration Review Items	N/A	Yes	No	If No, why is data reportable?	2nd ✓
1. Were at least 5 levels of each analyte analyzed?		✓			✓
2. Is low level standard concentration $\leq$ RL?		✓			✓
3. Are the correlation coefficients (r) ≥ 0.995 ; $r^2 \geq 0.990$?		✓			✓
4. For method 300.0, was the calibration curve processed using linear regression?	✓				N/A
5. For manual integrated standards, are before/after chromatograms provided with initials/date/reason?		✓		Reasons: S=Split peak, U=Undetected peak, I=Incorrect peak integration, B=Baseline correction, W=Wrong peak chosen by data system	✓

Analyst: D. Whitham | Date: 12/15/06
 Comments: low level anion calibration for air analysts -
Range = 0.075 - 2 ppm F⁻; Cl⁻; NO₂N⁻; NO₃N⁻; BR⁻
- Quad fit using peak height vs. amount -

2nd Level Reviewer: R. M. Zuercher | Date: 12/15/06
 Comments:

1 CAL STD 1 = ICWS-9045 @ (0.075ppm)

Sample Name:	CAL STD 1 = ICWS-9045 @ (0.075ppm)	Injection Volume:	50.0
Vial Number:	98	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/14/2006 16:54	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.23417	0.030	19.30	0.0748	BMB
2	4.70	Chloride	0.16248	0.024	15.76	0.0868	BMB
3	5.54	Nitrite-N	0.25345	0.043	27.70	0.0748	BMB
4	7.00	Bromide	0.04768	0.010	6.42	0.0837	BMB*
5	7.88	Nitrate-N	0.20803	0.048	30.83	0.0756	BMB

1 CAL STD 1 = ICWS-9045 @ (0.075ppm)

Sample Name:	CAL STD 1 = ICWS-9045 @ (0.075ppm)	Injection Volume:	50.0
Vial Number:	98	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/14/2006 16:54	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.23417	0.030	20.62	n.a.	BMB
2	4.70	Chloride	0.16248	0.024	16.84	n.a.	BMB
3	5.54	Nitrite-N	0.25345	0.043	29.60	n.a.	BMB
4	7.88	Nitrate-N	0.20803	0.048	32.94	n.a.	BMB

2 CAL STD 2 = ICWS-9046 @ (0.10ppm)

Sample Name:	CAL STD 2 = ICWS-9046 @ (0.10ppm)	Injection Volume:	50.0
Vial Number:	99	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/14/2006 17:11	Sample Weight:	1.0000
Run Time (min):	10.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.31346	0.037	18.04	0.0999	BMB
2	4.69	Chloride	0.21253	0.030	14.47	0.1134	BMB
3	5.53	Nitrite-N	0.34978	0.059	28.59	0.1031	BMB
4	6.98	Bromide	0.05646	0.011	5.19	0.0991	BMB
5	7.87	Nitrate-N	0.28533	0.070	33.71	0.1036	BMB

3 CAL STD 3 = ICWS-9047 @ (0.25ppm)

Sample Name:	CAL STD 3 = ICWS-9047 @ (0.25ppm)	Injection Volume:	50.0
Vial Number:	100	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/14/2006 17:24	Sample Weight:	1.0000
Run Time (min):	10.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.78262	0.100	19.79	0.2477	BMB
2	4.70	Chloride	0.47425	0.066	13.11	0.2518	BMB
3	5.54	Nitrite-N	0.84353	0.144	28.39	0.2473	BMB
4	7.01	Bromide	0.14435	0.029	5.64	0.2526	BMB
5	7.87	Nitrate-N	0.68927	0.167	33.06	0.2483	BMB

4 CAL STD 4 = ICWS-9048 @ (0.50ppm)

Sample Name:	CAL STD 4 = ICWS-9048 @ (0.50ppm)	Injection Volume:	50.0
Vial Number:	101	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/14/2006 17:36	Sample Weight:	1.0000
Run Time (min):	10.00	Sample Amount:	1.0000

No.	Ret. Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel. Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	1.60279	0.210	20.40	0.5010	BMB
2	4.69	Chloride	0.94632	0.132	12.83	0.4981	BMB
3	5.53	Nitrite-N	1.71930	0.302	29.30	0.4988	BMB
4	6.99	Bromide	0.28167	0.054	5.25	0.4908	BMB
5	7.84	Nitrate-N	1.39855	0.332	32.22	0.4972	BMB

5 CAL STD 5 = ICWS-9049 @ (1.ppm)

Sample Name:	CAL STD 5 = ICWS-9049 @ (1.ppm)	Injection Volume:	50.0
Vial Number:	102	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/14/2006 17:48	Sample Weight:	1.0000
Run Time (min):	10.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (μS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	3.27751	0.412	19.61	1.0002	BMB
2	4.69	Chloride	1.92630	0.278	13.23	0.9967	BMB
3	5.53	Nitrite-N	3.52256	0.606	28.87	1.0015	BMB
4	6.99	Bromide	0.58187	0.122	5.80	1.0046	BM
5	7.83	Nitrate-N	2.89372	0.682	32.48	1.0020	MB

6 CAL STD 6 = ICWS-9050 @ (2.ppm)

Sample Name:	CAL STD 6 = ICWS-9050 @ (2.ppm)	Injection Volume:	50.0
Vial Number:	103	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/14/2006 18:01	Sample Weight:	1.0000
Run Time (min):	10.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	6.86489	0.858	19.88	1.9999	BMB
2	4.69	Chloride	3.99899	0.564	13.08	2.0008	BMB
3	5.53	Nitrite-N	7.31424	1.247	28.92	1.9998	BMB
4	6.99	Bromide	1.17848	0.240	5.56	1.9994	BM
5	7.82	Nitrate-N	6.07244	1.404	32.55	1.9997	MB

~~6 CAL STD 6 = ICWS-9050 @ (2.ppm)~~Drw
12/15/06

Sample Name: CAL STD 6 = ICWS-9050 @ (2.ppm)
 Vial Number: 103
 Sample Type: standard
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: #####
 Run Time (min): 10.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	Corr.Coeff. (R)	Offset	Slope	Curve
1	3.23	Fluoride	Quad	6	0.9997	0.0000	3.120830	0.155880
2	4.69	Chloride	Quad	6	0.9997	0.0000	1.867234	0.065694
3	5.53	Nitrite-N	Quad	6	0.9998	0.0000	3.376824	0.140386
4	6.99	Bromide	Quad	6	0.9999	0.0000	0.568855	0.010287
5	7.82	Nitrate-N	Quad	6	0.9997	0.0000	2.738783	0.148955
Average:					0.9998	0.0000	2.3345	0.1042

~~6 CAL STD 6 = ICWS-9050 @ (2.ppm) →~~DKW
12/15/06

Sample Name: CAL STD 6 = ICWS-9050 @ (2.ppm)
 Vial Number: 103
 Sample Type: standard
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: #####
 Run Time (min): 10.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	Corr.Coeff. (R)	Offset	Slope	Curve
1	3.23	Fluoride	Quad	6	0.9997	0.0000	3.120830	0.155880
2	4.69	Chloride	Quad	6	0.9997	0.0000	1.867234	0.065694
3	5.53	Nitrite-N	Quad	6	0.9998	0.0000	3.376824	0.140386
4	6.99	Bromide	Quad	6	0.9999	0.0000	0.568855	0.010287
5	7.82	Nitrate-N	Quad	6	0.9997	0.0000	2.738783	0.148955
Average:					0.9998	0.0000	2.3345	0.1042

~~6~~ CAL STD 6 = ICWS-9050 @ (2.ppm) →OK
12/15/06

Sample Name: CAL STD 6 = ICWS-9050 @ (2.ppm)
 Vial Number: 103
 Sample Type: standard
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: #####
 Run Time (min): 10.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	Corr.Coeff. (R)	Offset	Slope	Curve
1	3.23	Fluoride	Quad	6	0.9997	0.0000	3.120830	0.155880
2	4.69	Chloride	Quad	6	0.9997	0.0000	1.867234	0.065694
3	5.53	Nitrite-N	Quad	6	0.9998	0.0000	3.376824	0.140386
4	6.99	Bromide	Quad	6	0.9999	0.0000	0.568855	0.010287
5	7.82	Nitrate-N	Quad	6	0.9997	0.0000	2.738783	0.148955
Average:					0.9998	0.0000	2.3345	0.1042

~~6~~ CAL STD 6 = ICWS-9050 @ (2.ppm) →D/W
12/15/06

Sample Name: CAL STD 6 = ICWS-9050 @ (2.ppm)
 Vial Number: 103
 Sample Type: standard
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: #####
 Run Time (min): 10.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	Corr.Coeff. (R)	Offset	Slope	Curve
1	3.23	Fluoride	Quad	6	0.9997	0.0000	3.120830	0.155880
2	4.69	Chloride	Quad	6	0.9997	0.0000	1.867234	0.065694
3	5.53	Nitrite-N	Quad	6	0.9998	0.0000	3.376824	0.140386
4	6.99	Bromide	Quad	6	0.9999	0.0000	0.568855	0.010287
5	7.82	Nitrate-N	Quad	6	0.9997	0.0000	2.738783	0.148955
Average:					0.9998	0.0000	2.3345	0.1042

~~6 CAL STD 6 = ICWS-9050 @ (2.ppm)~~DFW
12/15/06

Sample Name: CAL STD 6 = ICWS-9050 @ (2.ppm)
 Vial Number: 103
 Sample Type: standard
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: #####
 Run Time (min): 10.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	Corr.Coeff. (R)	Offset	Slope	Curve
1	3.23	Fluoride	Quad	6	0.9997	0.0000	3.120830	0.155880
2	4.69	Chloride	Quad	6	0.9997	0.0000	1.867234	0.065694
3	5.53	Nitrite-N	Quad	6	0.9998	0.0000	3.376824	0.140386
4	6.99	Bromide	Quad	6	0.9999	0.0000	0.568855	0.010287
5	7.82	Nitrate-N	Quad	6	0.9997	0.0000	2.738783	0.148955
Average:					0.9998	0.0000	2.3345	0.1042

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 9/25/06 Chemist: DKW Expiration Date: 12/25/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWT-8837	F-	17125	ERA	12/31/07	1000 ppm	5.	50	100. mg/L (ppm) ✓
2. (intermed. colib. source)	Cl-	36065		6/30/07				
3.	NO ₃ N	17075		7/31/07				
4.	BR-	27025		2/28/07				
5.	NO ₃ N-	17026		2/28/08				
6. ICWT-8838	F-	1-38F-2	SPEX	8/15/07	1000 ppm	5.	50	100. ppm (mg/L) ✓
7. (intermed. 2nd source)	Cl-	1-5CL-2		3/15/07				
8.	NO ₃ N-	1-13NO ₃ N-2		9/15/07				
9.	BR-	1-1BR-2		4/30/07				
10.	NO ₃ N-	1-27NO ₃ N-2		5/15/07				
11.								
12.								
13.								
14.								

Reviewed By: DKW

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 12/14/06 Chemist: DW Expiration Date: 12/15/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWS-9045	F-	ICW I-	8837	12/25/06	100.8 ppm	0.075	100,	0.075 ppm ✓
2. (CAL ①)	Cl-							
3.	NO ₃ N-							
4.	BR-							
5.	NO ₃ N-							
6. ICWS-9046	F-					0.100		0.100 ppm ✓
7. (CAL ③)	Cl-							
8.	NO ₃ N-							
9.	BR-							
10.	NO ₃ N-							
11. ICWS-9047	F-					0.250		0.250 ppm ✓
12. (CAL ③)	Cl-							
13.	NO ₃ N-							
14. (D ⁵ W 12/14/06)	NO ₃ -BR							
15.	NO ₃ N-							

Reviewed By: DW 12/15/06

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 12/14/06 Chemist: DFW Expiration Date: 12/15/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWS-9048	F-	ICWI -	8837	12/25/06	100 PPM	0.500	100,	0.500 ppm
2. (CAL (4))	Cl-							
3.	NO ₃ N-							
4.	Br-							
5.	NO ₃ N-							
6. ICWS-9049	F-					1.		1. ppm
7. (CAL (5))	Cl-							
8. (+ CCW)	NO ₃ N-							
9.	Br-							
10.	NO ₃ N-							
11. ICWS-9050	F-					2.		2. pp-
12. (CAL (6))	Cl-							
13.	NO ₃ N-							
14.	Br-							
15.	NO ₃ N-							

Reviewed By: DFW 12/15/06

WC031R3.DOC, 8/28/03

STL Knoxville

Prep Date: 12/18/2006 0800

Comp Date: 12/18/2006 0800

CAS #: 7664-39-3

QuantUMS #: 5646

Analyst LIMS Code: 072000

Instr. ID: 600

Date:

Date:

MW Factor: 1.053051836

[illegible]

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (ug/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (ug/mL)	LIMS DF	True Spike Amount (ug)
LCS	ICWI-8838	100.00	0.750	100.0	JL69G1AC	0.75	105.31	78.98
LCSD	ICWI-8838	100.00	0.750	100.0	JL69G1AD	0.75	105.31	78.98
MS (1)	ICWI-8838	100.00	0.020	10.0	JK7JR1AG	0.20	5,054.65	1,010.93
MSD (1)	ICWI-8838	100.00	0.020	10.0	JK7JR1AH	0.20	5,054.65	1,010.93
MS (2)	ICWI-8838	100.00	0.020	10.0	JK7J71AG	0.20	4,475.47	895.09
MSD (2)	ICWI-8838	100.00	0.020	10.0	JK7J71AH	0.20	4,475.47	895.09
MS (3)	ICWI-8838	100.00	0.020	10.0	JK7K01AF	0.20	1,053.05	210.61
MSD (3)								
MS (4)	ICWI-8838	100.00	0.020	10.0	JK7K41AF	0.20	1,053.05	210.61
MSD (4)								
MS (5)								
MSD (5)								

Comments:

True Spike Amount (ug) = Standard Concentration (ug/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

STL Knoxville

SOP KNOX-WC-0005

Anions in Air Data Worksheet

Batch #: 6363098

Prep Date: 12/18/2006 0800

Comp Date: 12/18/2006 0800

Analyte: Hydrogen Chloride

CAS #: 7647-01-0

QuantIMS #: 2702

Analyst Initials: DFW

Analyst LIMS Code: 072000

Instr. ID: 600

Reviewed by:

Date:

MW Factor: 1.028429188

[illegible]

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (µg/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (µg/mL)	LIMS DF	True Spike Amount (µg)
LCS	ICWI-8838	100.00	0.750	100.0	JL8TM1AC	0.75	102.84	77.13
LCSD	ICWI-8838	100.00	0.750	100.0	JL8TM1AD	0.75	102.84	77.13
MS (1)	ICWI-8838	100.00	0.020	10.0	JK7JR1AJ	0.20	9,872.92	1,974.58
MSD (1)								
MS (2)	ICWI-8838	100.00	0.020	10.0	JK7K41AG	0.20	1,028.43	205.69
MSD (2)								
MS (3)								
MSD (3)								
MS (4)								
MSD (4)								
MS (5)								
MSD (5)								

True Spike Amount (µg) = Standard Concentration (µg/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

Comments:

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (ug/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (ug/mL)	LIMS DF	True Spike Amount (ug)
LCS	ICWI-8838	100.00	0.750	100.0	JL69F1AC	0.75	101.26	75.95
LCSD	ICWI-8838	100.00	0.750	100.0	JL69F1AD	0.75	101.26	75.95
MS (1)	ICWI-8838	100.00	0.020	10.0	JK7JR1AE	0.20	4,860.55	972.11
MSD (1)	ICWI-8838	100.00	0.020	10.0	JK7JR1AF	0.20	4,860.55	972.11
MS (2)	ICWI-8838	100.00	0.020	10.0	JK7J71AE	0.20	4,303.61	860.72
MSD (2)	ICWI-8838	100.00	0.020	10.0	JK7J71AF	0.20	4,303.61	860.72
MS (3)	ICWI-8838	100.00	0.020	10.0	JK7K01AE	0.20	1,012.61	202.52
MSD (3)								
MS (4)	ICWI-8838	100.00	0.020	10.0	JK7K41AE	0.20	1,012.61	202.52
MSD (4)								
MS (5)								
MSD (5)								

Comments:

True Spike Amount (ug) = Standard Concentration (ug/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

STL Knoxville
Dionex IC Runlog Cover Page

93

Analyst: <u>DFW</u>	Date: <u>12/18/06</u>	Sequence ID: <u>L18A-LOW AIR ANIONS-121806</u>
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Instrument: <u>Asagorn</u> ☒ DX-600 ☐ ICS-1500 ☐ DX-320	Method: ☐ KNOX-WC-0003, SW-846 0061/7199 ☐ KNOX-WC-0005, ☐ SW-846 9056 ☐ EPA 300.0 ☐ SW-846 9057-Mod ☒ EPA 26A-Mod ☐ KNOX-WC-0014, EPA 314.0
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Preventive Maintenance	Instrument Conditions
Daily: ☐ Check pump and gas pressure ☐ Check all lines for crimping, leaks and discoloration As Needed: ☐ Change column and guard column ☐ Change column and/or guard column bed support ☐ Clean conductivity cell ☐ De-gas pump head when flow is erratic ☐ Check/replace eluant end line filter	Flow Rate = <u>1.00</u> mL/min Pressure = <u>2200.</u> psi Conductance = <u>22.8</u> μ S Suppressor Current = <u>43.</u> mA Eluent Generator = <u>N/A</u> mM KOH

MS/MSD Spike Information						
WO #	Compound	Spike ID	Parent Conc.	Spike Added (mL)	Final Volume (mL)	Final Conc.
JK7JR	F ⁻	ICWT-8838	100. ppm	8.02	10 mL	0.20 ppm
	Cl ⁻					
	Br ⁻					
JK7J7	F ⁻					
	Cl ⁻					
	Br ⁻					
JK7K0	F ⁻					
	Cl ⁻					
	Br ⁻					
JK7K4	F ⁻					
	Cl ⁻					
	Br ⁻					
				<u>DFW 12/28/06</u>		

Comments:

HF Batch - 6361376

HBr Batch - 6361375

☐ Sodium Thiosulfate added to NaOH impinger samples.

Sequence: L18A_LOW_AIR_ANIONS_121806
 Operator: wheelerd

Page 1 of 2
 Printed: 12/19/2006 7:35:58 AM

Title:

Datasource: Aragorn_net
 Location: IC_ARAGORN
 Timebase: IC_Aragorn
 #Samples: 36

Created: 12/18/2006 10:16:29 AM by wheelerd
 Last Update: 12/19/2006 7:35:45 AM by wheelerd

DW
 12/19/06

No.	Name	Sample ID	Inj. Vol.	Inj. Date/Time	Dil. Factor	*Multiplier [Liters]	Weight
1	🔍 CAL STD 1 = ICWS-9045 @ (0.075ppm)		50.0	12/14/2006 4:54:12 PM	1.0000		1.0000
2	🔍 CAL STD 2 = ICWS-9046 @ (0.10ppm)		50.0	12/14/2006 5:11:38 PM	1.0000		1.0000
3	🔍 CAL STD 3 = ICWS-9047 @ (0.25ppm)		50.0	12/14/2006 5:24:03 PM	1.0000		1.0000
4	🔍 CAL STD 4 = ICWS-9048 @ (0.50ppm)		50.0	12/14/2006 5:36:29 PM	1.0000		1.0000
5	🔍 CAL STD 5 = ICWS-9049 @ (1.ppm)		50.0	12/14/2006 5:48:54 PM	1.0000		1.0000
6	🔍 CAL STD 6 = ICWS-9050 @ (2.ppm)		50.0	12/14/2006 6:01:20 PM	1.0000		1.0000
7	🔍 ICV/LCS= ICWS-9056		50.0	12/18/2006 10:17:27 AM	1.0000		1.0000
8	🔍 ICV/LCSD= ICWS-9057		50.0	12/18/2006 10:34:53 AM	1.0000		1.0000
9	🔍 ICB/ METHOD BLANK		50.0	12/18/2006 10:52:18 AM	1.0000		1.0000
10	🔍 H6L110105-JK7JR-1/10		50.0	12/18/2006 11:26:40 AM	10.0000		1.0000
11	🔍 H6L110106-JK7J7-1/10		50.0	12/18/2006 11:44:06 AM	10.0000		1.0000
12	🔍 H6L110105-JK7JR-1/20		50.0	12/18/2006 12:08:40 PM	20.0000		1.0000
13	🔍 H6L110105-JK7JR-1/10-MS		50.0	12/18/2006 12:43:28 PM	10.0000		1.0000
14	🔍 H6L110105-JK7JR-1/10-MSD		50.0	12/18/2006 1:00:54 PM	10.0000		1.0000
15	🔍 H6L110105-JK7JR-1/20-MS		50.0	12/18/2006 1:18:20 PM	20.0000		1.0000
16	🔍 CCV = ICWS-9058		50.0	12/18/2006 1:35:45 PM	1.0000		1.0000
17	🔍 CCB		50.0	12/18/2006 1:53:11 PM	1.0000		1.0000
18	🔍 H6L110106-JK7J7-1/10-MS		50.0	12/18/2006 2:10:37 PM	10.0000		1.0000
19	🔍 H6L110106-JK7J7-1/10-MSD		50.0	12/18/2006 2:28:03 PM	10.0000		1.0000
20	🔍 H6L110105-JK7JX-1/10		50.0	12/18/2006 2:47:03 PM	10.0000		1.0000
21	🔍 H6L110105-JK7J1-1/10		50.0	12/18/2006 3:04:28 PM	10.0000		1.0000
22	🔍 H6L110106-JK7KG-1/10		50.0	12/18/2006 3:21:54 PM	10.0000		1.0000
23	🔍 H6L110105-JK7KT-1/10		50.0	12/18/2006 3:39:19 PM	10.0000		1.0000
24	🔍 H6L110106-JK7K0-1/10		50.0	12/18/2006 3:56:45 PM	10.0000		1.0000
25	🔍 H6L110106-JK7K0-1/10-MS		50.0	12/18/2006 4:14:11 PM	10.0000		1.0000
26	🔍 H6L110106-JK7K4-1/10		50.0	12/18/2006 4:31:36 PM	10.0000		1.0000
27	🔍 H6L110106-JK7K4-1/10-MS		50.0	12/18/2006 4:49:02 PM	10.0000		1.0000
28	🔍 CCV= ICWS-9058		50.0	12/18/2006 5:06:27 PM	1.0000		1.0000
29	🔍 CCB		50.0	12/18/2006 5:23:52 PM	1.0000		1.0000
30	🔍 H6L110106-JK7K0-1/20		50.0	12/18/2006 5:41:18 PM	20.0000		1.0000
31	🔍 H6L110106-JK7K0-1/20-MS		50.0	12/18/2006 5:58:43 PM	20.0000		1.0000
32	🔍 H6L110106-JK7K0-1/40		50.0	12/18/2006 6:16:09 PM	40.0000		1.0000
33	🔍 H6L110106-JK7K0-1/40-MS		50.0	12/18/2006 6:33:34 PM	40.0000		1.0000
34	🔍 CCV= ICWS-9058		50.0	12/18/2006 6:50:59 PM	1.0000		1.0000
35	🔍 CCB		50.0	12/18/2006 7:08:24 PM	1.0000		1.0000
36	🔍 SHUTDOWN		50.0	12/18/2006 7:25:50 PM	1.0000		1.0000

7 ICV/LCS= ICWS-9056

Sample Name:	ICV/LCS= ICWS-9056	Injection Volume:	50.0
Vial Number:	104	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/18/2006 10:17	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	2.42157	0.305	19.82	0.7480	BMB ✓
2	4.71	Chloride	1.43770	0.207	13.45	0.7502	BMB ✓
3	5.55	Nitrite-N	2.59076	0.450	29.23	0.7442	BMB
4	7.01	Bromide	0.41601	0.083	5.39	0.7219	BMB ✓
5	7.87	Nitrate-N	2.11264	0.495	32.11	0.7415	BMB

HF - JL68G-1AC
HBr - JL69F-1AC
HCl - JL8TM-1AC

8 ICV/LCSD= ICWS-9057

Sample Name: ICV/LCSD= ICWS-9057
Vial Number: 105
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 10:34
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	2.43474	0.307	20.23	0.7519	BMB ✓
2	4.71	Chloride	1.45569	0.205	13.51	0.7593	BMB ✓
3	5.55	Nitrite-N	2.56761	0.424	27.92	0.7377	BMB
4	7.01	Bromide	0.42719	0.086	5.70	0.7410	BMB ✓
5	7.86	Nitrate-N	2.12412	0.495	32.64	0.7454	BMB

HF - JLG9G-1AD
HBr - JLG9F-1AD
HCl - JLS8TM-1AD

9 ICB/ METHOD BLANK

Sample Name: ICB/ METHOD BLANK
Vial Number: 139
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 10:52
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area µS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
-----	--------------------	-----------	----------------	----------------	-----------------	------------------	--------------

ND

HF- JLG9G-1AA
HB- JLG9F-1AA
HCL- JLG8TM-1AA

11 H6L110106-JK7J7-1/10

Sample Name: H6L110106-JK7J7-1/10
Vial Number: 141
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 11:44
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 10.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.52	n.a.	0.10057	0.018	0.03	n.a.	BMB
2	4.84	Chloride	0.28417	0.098	0.13	1.5138	bMB
3	7.91	Nitrate-N	0.13805	0.030	0.04	0.5027	BMB
4	10.79	n.a.	0.19479	0.056	0.08	n.a.	BMB
5	11.87	n.a.	#####	72.927	99.72	n.a.	BMB

HF-ND ✓
HBr-ND ✓

11 H6L110106-JK7J7-1/10

Sample Name:	H6L110106-JK7J7-1/10	Injection Volume:	50.0
Vial Number:	141	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/18/2006 11:44	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.52	n.a.	0.10057	0.018	0.03	n.a.	BMB
2	4.84	Chloride	0.28417	0.098	0.13	1.5138	bMB
3	7.91	Nitrate-N	0.13805	0.030	0.04	0.5027	BMB
4	10.79	n.a.	0.19479	0.056	0.08	n.a.	BMB
5	11.87	n.a.	#####	72.927	99.72	n.a.	BMB

16 CCV = ICWS-9058

Sample Name: **CCV = ICWS-9058**
Vial Number: **147**
Sample Type: **unknown**
Control Program: **ANIONS_AS14A**
Quantif. Method: **ANIONS**
Recording Time: **12/18/2006 13:35**
Run Time (min): **15.00**

Injection Volume: **50.0**
Channel: **ECD_1**
Wavelength: **n.a.**
Bandwidth: **n.a.**
Dilution Factor: **1.0000**
Sample Weight: **1.0000**
Sample Amount: **1.0000**

No.	Ret.Time (min.)	Peak Name	Height (μS)	Area $\mu\text{S} \cdot \text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.85	n.a.	0.18302	0.106	4.79	n.a.	BMB*
2	3.25	Fluoride	3.26791	0.404	18.23	0.9974	Rd*
3	4.73	Chloride	1.95319	0.274	12.36	1.0101	BMB
4	5.57	Nitrite-N	3.51969	0.608	27.45	1.0007	BMB
5	7.03	Bromide	0.58477	0.123	5.55	1.0095	BMB
6	7.88	Nitrate-N	2.90661	0.677	30.56	1.0062	BMB
7	12.05	n.a.	0.07024	0.023	1.05	n.a.	BMB

16 CCV = ICWS-9058

Sample Name: CCV = ICWS-9058
Vial Number: 147
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 13:35
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.85	n.a.	0.18302	0.052	2.35	n.a.	BM
2	3.25	Fluoride	3.36406	0.458	20.68	1.0254	MB
3	4.73	Chloride	1.95319	0.274	12.36	1.0101	BMB
4	5.57	Nitrite-N	3.51969	0.608	27.45	1.0007	BMB
5	7.03	Bromide	0.58477	0.123	5.55	1.0095	BMB
6	7.88	Nitrate-N	2.90661	0.677	30.56	1.0062	BMB
7	12.05	n.a.	0.07024	0.023	1.05	n.a.	BMB

17 CCB

Sample Name:	CCB	Injection Volume:	50.0
Vial Number:	148	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/18/2006 13:53	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret. Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel. Area (%)	Amount (mg/L)	Peak Type
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ND

18 H6L110106-JK7J7-1/10-MS

Sample Name: H6L110106-JK7J7-1/10-MS
Vial Number: 149
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 14:10
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 10.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.26	Fluoride	0.66476	0.081	0.11	2.1079	BMB ✓
2	4.53	n.a.	0.07663	0.013	0.02	n.a.	BMB
3	4.82	Chloride	0.70076	0.158	0.21	3.7046	bM
4	5.58	Nitrite-N	0.79567	0.143	0.19	2.3336	MB
5	7.03	Bromide	0.11918	0.023	0.03	2.0871	BMB ✓
6	7.90	Nitrate-N	0.72528	0.168	0.23	2.6111	BMB
7	10.77	n.a.	0.15082	0.045	0.06	n.a.	BMB
8	11.86	n.a.	#####	73.413	99.15	n.a.	BMB

19 H6L110106-JK7J7-1/10-MSD

Sample Name: H6L110106-JK7J7-1/10-MSD
 Vial Number: 150
 Sample Type: unknown
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: 12/18/2006 14:28
 Run Time (min): 15.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 10.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.25	Fluoride	0.67613	0.083	0.11	2.1436	BMB ✓
2	4.52	n.a.	0.08511	0.014	0.02	n.a.	BMB
3	4.81	Chloride	0.69145	0.160	0.22	3.6560	BM
4	5.58	Nitrite-N	0.79716	0.139	0.19	2.3380	MB
5	7.04	Bromide	0.12001	0.023	0.03	2.1017	BMB ✓
6	7.90	Nitrate-N	0.73241	0.175	0.24	2.6364	BMB
7	10.79	n.a.	0.13646	0.039	0.05	n.a.	BMB
8	11.86	n.a.	#####	73.451	99.15	n.a.	BMB

22 H6L110106-JK7KG-1/10

Sample Name:	H6L110106-JK7KG-1/10	Injection Volume:	50.0
Vial Number:	153	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/18/2006 15:21	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.53	n.a.	0.13641	0.023	0.03	n.a.	BMB
2	4.84	Chloride	0.32998	0.111	0.14	1.7564	BMB
3	7.93	Nitrate-N	0.15141	0.033	0.04	0.5512	BMB
4	10.79	n.a.	1.62974	0.480	0.62	n.a.	BMB
5	11.86	n.a.	#####	76.555	99.16	n.a.	bMB

HF - (ND) ✓
HBr - (ND) ✓

6 em 12/18/06
23 H6L110105-JK7KT-1/10

Sample Name: H6L110105-JK7KT-1/10
Vial Number: 161
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 15:39
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 10.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.26	Fluoride	0.12412	0.015	0.02	0.3969	BMB
2	4.83	Chloride	0.34716	0.144	0.17	1.8472	BMB
3	7.93	Nitrate-N	0.19611	0.042	0.05	0.7133	BMB
4	10.19	n.a.	0.06112	0.018	0.02	n.a.	BMB
5	11.83	n.a.	#####	86.331	99.75	n.a.	BMB

HBr-(ND) ✓

24 H6L110106-JK7K0-1/10

Sample Name: H6L110106-JK7K0-1/10
Vial Number: 162
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 15:56
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 10.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area µS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.84	Chloride	0.36692	0.177	0.16	1.9517	BMB
2	11.78	n.a.	#####	112.940	99.84	n.a.	BMB

HF - (ND) ✓
HBr - (ND) ✓

25 H6L110106-JK7K0-1/10-MS

Sample Name:	H6L110106-JK7K0-1/10-MS	Injection Volume:	50.0
Vial Number:	163	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/18/2006 16:14	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.25	Fluoride	0.61755	0.080	0.07	1.9596	BMB
2	4.82	Chloride	0.81881	0.204	0.18	4.3195	BM
3	5.60	Nitrite-N	0.79855	0.145	0.13	2.3420	MB
4	7.07	Bromide	0.11681	0.023	0.02	2.0459	BMB
5	7.93	Nitrate-N	0.59481	0.145	0.13	2.1467	BMB
6	11.78	n.a.	#####	113.040	99.47	n.a.	BMB

26 H6L110106-JK7K4-1/10

Sample Name: H6L110106-JK7K4-1/10
Vial Number: 164
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 16:31
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 10.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	12.08	n.a.	0.16774	0.068	100.00	n.a.	BMB

ALL (ND) ✓

27 H6L110106-JK7K4-1/10-MS

Sample Name:	H6L110106-JK7K4-1/10-MS	Injection Volume:	50.0
Vial Number:	165	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/18/2006 16:49	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.24	Fluoride	0.65758	0.084	18.29	2.0853	BMB*
2	4.73	Chloride	0.42054	0.058	12.74	2.2346	BMB*
3	5.58	Nitrite-N	0.70290	0.121	26.39	2.0638	BMB
4	7.06	Bromide	0.11409	0.021	4.66	1.9983	BMB
5	7.93	Nitrate-N	0.57178	0.135	29.45	2.0645	BMB
6	12.08	n.a.	0.08212	0.039	8.47	n.a.	BMB

27 H6L110106-JK7K4-1/10-MS

Sample Name: H6L110106-JK7K4-1/10-MS
Vial Number: 165
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 16:49
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 10.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.24	Fluoride	0.80083	0.347	47.67	2.5340	BMB
2	3.78	n.a.	0.05067	0.007	0.92	n.a.	Rd
3	4.73	Chloride	0.42054	0.058	8.02	2.2346	bMB
4	5.58	Nitrite-N	0.70290	0.121	16.60	2.0638	BMB
5	7.06	Bromide	0.11409	0.021	2.93	1.9983	BMB
6	7.93	Nitrate-N	0.57178	0.135	18.53	2.0645	BMB
7	12.08	n.a.	0.08212	0.039	5.33	n.a.	BMB

28 CCV= ICWS-9058

Sample Name:	CCV= ICWS-9058	Injection Volume:	50.0
Vial Number:	166	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/18/2006 17:06	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.25	Fluoride	3.29330	0.422	19.95	1.0048	BMB ✓
2	4.73	Chloride	1.92845	0.274	12.94	0.9978	BMB ✓
3	5.58	Nitrite-N	3.53011	0.610	28.81	1.0035	BMB ✓
4	7.06	Bromide	0.58345	0.124	5.88	1.0073	BM ✓
5	7.92	Nitrate-N	2.89375	0.686	32.42	1.0020	MB

29 CCB

Sample Name:	CCB	Injection Volume:	50.0
Vial Number:	167	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/18/2006 17:23	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
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ND

Lot #:	Analysis Date:	File ID:	L19A - LOW - AIR - ANIONS - 121906	ICAL File ID:	L14A - LOW - AIR - ANIONS - 121406
46110118-Rmd HCL 110106	12/19/06				
Review Items					
1. Were PM checklists (L40), Lot Summary and any applicable QAS reviewed?	NA	Yes	No	If No, why is data reportable?	2 nd ✓
2. ICV within 90-110%R?		✓			✓
3. ICB/CCB < 1/2 RL?		✓		□ [ccb1] No analyte > MDL in associated samples.	✓
4. CCVs/CCBs run after every 10 samples, and at end of sequence?		✓			✓
5. Is %D ≤ 10% for each CCV?		✓			✓
6. If CCV failed, was it rerun only once?	✓				N/A
7. LCS/LCSD analytes within 90-110%R? If no, list LCS ID:		✓		□ [lcs3] LCS recovery > upper control limit & sample results < RL.	✓
8. Method blank < 1/2 RL? If no, list blank ID:		✓		□ [mb3] No analyte > RL in associated samples.	✓
9. Matrix spikes run at required frequency?		✓		□ [mb7] Sample results > 10x higher than blank.	✓
10. Matrix spikes within 75-125% recovery? If no, list MS ID:		✓		□ [air ms1] MS %R slightly outside limits for 1 sample.	✓
		✓		□ [air ms2] MS %R slightly outside limits for > 1 sample.	✓
		✓		□ Air train reagent blank - spike result not reported.	✓
11. Were MS run #'s assigned to all matrix spikes except reagent blanks?		✓			✓
12. Sample analyses done within holding time (HT)? If no, list samples:		✓		□ [ht1] HT expired upon receipt.	✓
13. Were results processed using correct ICAL?		✓		□ [ht2] Analysis requested after HT expired.	✓
14. Are positive results within the calibration range?		✓			✓
15. Is integration acceptable for all samples, QC samples and standards?		✓			✓
16. For manual integrated standards and QC samples, are before/after chromatograms provided with initials/date/reason?		✓		Reasons: S=Split peak, U=Undetected peak, I=Incorrect peak integration, B=Baseline correction, W=Wrong peak chosen by data system.	✓
17. Calculations checked for error? (Document manual calculation checks.)		✓			✓
18. Were spreadsheets checked for transcription errors?		✓			✓
19. Final report/F6 correct? (Verify results, RLs, units, qualifiers, DFs, dates, spikes.)	✓				✓
20. Are all nonconformances documented and discussed in narrative?				List NCM #:	N/A
21. Appropriate air train autotext selected for narrative?				□ [air1] Cl ⁻ reported as HCl and Cl ₂ . □ [air2] Cl ⁻ reported as HCl only. <i>and run 12/28/06</i> □ [air3] Cl ⁻ , F ⁻ reported as HCl, Cl ₂ , HF. □ [air4] Cl ⁻ , F ⁻ , Br ⁻ reported as HCl, Cl ₂ , HF, HBr, Br ₂ . □ [air5] Cl ⁻ , F ⁻ , NO ₂ , NO ₃ reported as HCl, Cl ₂ , HF, HNO ₂ , HNO ₃ . □ [air6] Cl ⁻ , F ⁻ , Br ⁻ , I ⁻ reported as HCl, Cl ₂ , HF, HBr, Br ₂ , I ₂ . □ [air7] Cl ⁻ , F ⁻ , NO ₂ , NO ₃ reported as Cl ⁻ , F ⁻ , NO ₂ , NO ₃ . □ [air pH] Sample pH adjusted prior to analysis. □ [audit2] Audit results in mg/L.	air 4
22. Sample pH adjustment included in narrative?	✓				air pH
23. Audit sample results included in narrative?	✓				N/A
1 st Level Reviewer: CWK	Date: 12/22/06	2 nd Level Reviewer: <i>AWK</i>	Date: 12/28/06		
JLMGE 1/20					
y = 0 + 1.867234(0.0599) + 0.065644(0.0599) ²					
y = 0.111847317 + 0.000235711					
y = 0.1120 ✓					

Nonconformance memos are required for bold and italicized [autotext] statements: **Bold** = deficiency, *italicized* = anomaly.

Batch #: 6356352
Prep Date: 12/19/2006 0800
Comp Date: 12/19/2006 1900

Batch #: 6356352

Rep Date: 12/19/2006 0800

Comp Date: 12/19/2006 1900

Analyte: Hydrogen Fluoride

CAS #: 7664-39-3

Analyst Initials: CWK

Analyst LIMS Code: 035620

Reviewed by:

Date:

MW Factor: 1.053051836

H6L110106 Balch 6356352.xls

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (ug/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (ug/mL)	LIMS DF	True Spike Amount (ug)
LCS	ICWI-8838	100.00	0.750	100.0	JL22H1AC	0.75	105.31	78.98
LCSD	ICWI-8838	100.00	0.750	100.0	JL22H1AD	0.75	105.31	78.98
MS (1)	ICWI-8838	100.00	0.020	10.0	JK7KA1AJ	0.20	3,106.50	621.30
MSD (1)	ICWI-8838	100.00	0.020	10.0	JK7KA1AK	0.20	3,106.50	621.30
MS (2)	ICWI-8838	100.00	0.020	10.0	JK7K21AG	0.20	1,053.05	210.61
MSD (2)								
MS (3)								
MSD (3)								
MS (4)								
MSD (4)								
MS (5)								
MSD (5)								

True Spike Amount (ug) = Standard Concentration (ug/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

Comments:

STL Knoxville

SOP KNOX-WC-0005

Anions in Air Data Worksheet

Prep Date: 12/19/2006 0800

Comp Date: 12/19/2006 1900

CAS #: 7782-50-5

QuantIMS #: 515

Analyst LIMS Code: 035620

Instr. ID: 600

Date:

MW Factor: 1.0

[illegible]

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (µg/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (µg/mL)	LIMS DF	True Spike Amount (µg)
LCS	ICWI-8838	100.00	0.750	100.0	JL21W1AC	0.75	100.00	75.00
LCSD	ICWI-8838	100.00	0.750	100.0	JL21W1AD	0.75	100.00	75.00
MS (1)	ICWI-8838	100.00	0.020	10.0	JK7KA1AG	0.20	2,950.00	590.00
MSD (1)	ICWI-8838	100.00	0.020	10.0	JK7KA1AH	0.20	2,950.00	590.00
MS (2)	ICWI-8838	100.00	0.020	10.0	JK7K21AF	0.20	1,000.00	200.00
MSD (2)								
MS (3)								
MSD (3)								
MS (4)								
MSD (4)								
MS (5)								
MSD (5)								

Comments:

True Spike Amount (µg) = Standard Concentration (µg/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

STL Knoxville

SOP KNOX-WC-0005

Anions in Air Data Worksheet

Rep Date: 12/19/2006 0800

mp Date: 12/19/2006 1900

CAS #: 7726-95-6

QuantIMS #: 3450

Analyst LIMS Code: 035520

Instr. ID: 600

Date:

MW Factor: 1.0

[illegible]

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (ug/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (ug/mL)	LIMS DF	True Spike Amount (ug)
LCS	ICWI-8838	100.00	0.750	100.0	JL21F1AC	0.75	100.00	75.00
LCSD	ICWI-8838	100.00	0.750	100.0	JL21F1AD	0.75	100.00	75.00
MS (1)	ICWI-8838	100.00	0.020	10.0	JK7KA1AE	0.20	2,950.00	590.00
MSD (1)	ICWI-8838	100.00	0.020	10.0	JK7KA1AF	0.20	2,950.00	590.00
MS (2)	ICWI-8838	100.00	0.020	10.0	JK7K21AE	0.20	1,000.00	200.00
MSD (2)								
MS (3)								
MSD (3)								
MS (4)								
MSD (4)								
MS (5)								
MSD (5)								

True Spike Amount (ug) = Standard Concentration (ug/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

Comments:

STL Knoxville
Dionex IC Runlog Cover Page

121

Analyst:	CWK	Date:	12/19/06	Sequence ID:	L19A - LDW - AIR - ANIONS - 121906
Instrument:	☒ DX-600	Method:	☐ KNOX-WC-0003, SW-846 0061/7199		
	☐ ICS-1500		☐ KNOX-WC-0005, ☐ SW-846 9056 ☐ EPA 300.0 ☐ SW-846 9057-Mod ☒ EPA 26A-Mod		
	☐ DX-320		☐ KNOX-WC-0014, EPA 314.0		

Preventive Maintenance	Instrument Conditions
<u>Daily:</u>	Flow Rate = 1.00 mL/min
☒ Check pump and gas pressure	Pressure = 222.6 psi
☐ Check all lines for crimping, leaks and discoloration	Conductance = 23.1 µS
<u>As Needed:</u>	Suppressor Current = 43 mA
☐ Change column and guard column	Eluent Generator = — mM KOH
☐ Change column and/or guard column bed support	
☐ Clean conductivity cell	
☐ De-gas pump head when flow is erratic	
☐ Check/replace eluant end line filter	

MS/MSD Spike Information						
WO #	Compound	Spike ID	Parent Conc.	Spike Added (mL)	Final Volume (mL)	Final Conc.
JK7KA	F ⁻	ICWI-8838	100 ppm	0.020 mL	10 mL	0.20 ppm
	Cl ⁻					
	Br ⁻					
JK7K2	F ⁻					
	Cl ⁻					
	Br ⁻					
JLMGE	Cl ⁻					

Comments:

Batch HCl for H6L160118: 6356131
 Batch Br₂ - 6356347
 Batch Cl₂ - 6356350
 Batch HF - 6356352

☒ Sodium Thiosulfate added to NaOH impinger samples.

Sequence: L19A_LOW_AIR_ANIONS_121906
Operator: kauker

Page 1 of 1
Printed: 12/20/2006 8:10:35 AM

Title:
Datasource: Aragorn_net
Location: IC_ARAGORN
Timebase: IC_Aragorn
#Samples: 38

Created: 12/19/2006 8:06:15 AM by kauker
Last Update: 12/19/2006 1:44:16 PM by kauker

CWK
12/20/06

No.	Name	Sample ID	Inj. Vol.	Inj. Date/Time	Dil. Factor	*Multiplier [Liters]
1	CAL STD 1 = ICWS-9045 @ (0.075ppm)		50.0	12/14/2006 4:54:12 PM	1.0000	
2	CAL STD 2 = ICWS-9046 @ (0.10ppm)		50.0	12/14/2006 5:11:38 PM	1.0000	
3	CAL STD 3 = ICWS-9047 @ (0.25ppm)		50.0	12/14/2006 5:24:03 PM	1.0000	
4	CAL STD 4 = ICWS-9048 @ (0.50ppm)		50.0	12/14/2006 5:36:29 PM	1.0000	
5	CAL STD 5 = ICWS-9049 @ (1.ppm)		50.0	12/14/2006 5:48:54 PM	1.0000	
6	CAL STD 6 = ICWS-9050 @ (2.ppm)		50.0	12/14/2006 6:01:20 PM	1.0000	
7	ICV/LCS= ICWS-9059		50.0	12/19/2006 8:24:36 AM	1.0000	
8	ICV/LCSD= ICWS-9060		50.0	12/19/2006 8:42:02 AM	1.0000	
9	ICB/ METHOD BLANK		50.0	12/19/2006 8:59:27 AM	1.0000	
10	H6L110106 JK7KA 1/10		50.0	12/19/2006 9:16:53 AM	10.0000	
11	H6L110106 JK7KA MS 1/10 0.2 PPM F, CL, BR		50.0	12/19/2006 9:49:19 AM	10.0000	
12	H6L110106 JK7K2 1/10		50.0	12/19/2006 10:21:44 AM	10.0000	
13	H6L110106 JK7K2 MS 1/10 0.2 PPM F, CL, BR		50.0	12/19/2006 10:54:09 AM	10.0000	
14	H6L110106 JK7KA MSD 1/10 0.2 PPM F, CL, BR		50.0	12/19/2006 11:26:35 AM	10.0000	
15	H6L110106 JK7KN 1/10		50.0	12/19/2006 11:59:00 AM	10.0000	
16	CCV = ICWS-9061		50.0	12/19/2006 12:31:25 PM	1.0000	
17	CCB		50.0	12/19/2006 12:48:51 PM	1.0000	
18	H6L110106 JK7KW 1/10		50.0	12/19/2006 1:06:16 PM	10.0000	
19	H6L160118 JLMGE 1/10		50.0	12/19/2006 1:38:41 PM	10.0000	
20	H6L160118 JLMGE 1/20		50.0	12/19/2006 1:56:07 PM	20.0000	
21	H6L160118 JLMGE 1/40		50.0	12/19/2006 2:13:32 PM	40.0000	
22	H6L160118 JLMGE MS 1/10 0.2 PPM CL		50.0	12/19/2006 2:30:57 PM	10.0000	
23	H6L160118 JLMGE MSD 1/10 0.2 PPM CL		50.0	12/19/2006 2:48:23 PM	10.0000	
24	H6L160118 JLMGE MS 1/20 0.2 PPM CL		50.0	12/19/2006 3:05:48 PM	20.0000	
25	H6L160118 JLMGE MSD 1/20 0.2 PPM CL		50.0	12/19/2006 3:23:13 PM	20.0000	
26	H6L160118 JLMGE MS 1/40 0.2 PPM CL		50.0	12/19/2006 3:40:39 PM	40.0000	
27	H6L160118 JLMGE MSD 1/40 0.2 PPM CL		50.0	12/19/2006 3:58:04 PM	40.0000	
28	CCV= ICWS-9061		50.0	12/19/2006 4:15:30 PM	1.0000	
29	CCB		50.0	12/19/2006 4:32:54 PM	1.0000	
30	H6L160118 JLMGG 1/10		50.0	12/19/2006 4:50:20 PM	10.0000	
31	H6L160118 JLMGG 1/20		50.0	12/19/2006 5:07:45 PM	20.0000	
32	H6L160118 JLMGG 1/40		50.0	12/19/2006 5:25:11 PM	40.0000	
33	H6L160118 JLMGJ 1/10		50.0	12/19/2006 5:42:36 PM	10.0000	
34	H6L160118 JLMGJ 1/20		50.0	12/19/2006 6:00:02 PM	20.0000	
35	H6L160118 JLMGJ 1/40		50.0	12/19/2006 6:17:27 PM	40.0000	
36	CCV= ICWS-9061		50.0	12/19/2006 6:34:53 PM	1.0000	
37	CCB		50.0	12/19/2006 6:52:18 PM	1.0000	
38	SHUTDOWN		50.0	12/19/2006 7:09:43 PM	1.0000	

7 ICV/LCS= ICWS-9059

Sample Name:	ICV/LCS= ICWS-9059	Injection Volume:	50.0
Vial Number:	104	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/19/2006 8:24	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.22	n.a.	0.06381	0.011	0.66	n.a.	BMB
2	3.24	Fluoride	2.48867	0.321	19.80	0.7680	✓ BMB
3	4.72	Chloride	1.47644	0.210	12.99	0.7699	✓ BMB
4	5.55	Nitrite-N	2.67428	0.469	28.97	0.7675	BMB
5	7.02	Bromide	0.44520	0.091	5.65	0.7718	✓ BMB
6	7.87	Nitrate-N	2.19530	0.517	31.92	0.7694	BMB

Br₂-JL21F1A/C En 12/28/06Cl₂-JL21W1A/C

HF-JL22H1A/C

JL1R51A/C HCl

8 ICV/LCSD= ICWS-9060

Sample Name:	ICV/LCSD= ICWS-9060	Injection Volume:	50.0
Vial Number:	105	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/19/2006 8:42	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	2.47891	0.322	20.25	0.7651	✓ BMB
2	4.71	Chloride	1.49722	0.215	13.50	0.7804	✓ BMB
3	5.54	Nitrite-N	2.66310	0.454	28.58	0.7644	BMB
4	6.99	Bromide	0.43676	0.088	5.55	0.7574	✓ BMB
5	7.85	Nitrate-N	2.19377	0.511	32.13	0.7689	BMB

Br₂ - JL21FIAD
 Cl₂ - JL21WIAD
 HF - JL22HIAD

JL18SIAD HCl

9 ICB/ METHOD BLANK

Sample Name:	ICB/ METHOD BLANK	Injection Volume:	50.0
Vial Number:	139	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/19/2006 8:59	Sample Weight:	1.0000
Run Time (min):	15.01	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
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Br₂ - JL21F1AA

JL1R51AA HCl

Cl₂ - JL21W1AA

HF - JL22H1AA

ND

10 H6L110106 JK7KA 1/10

Sample Name: H6L110106 JK7KA 1/10
 Vial Number: 140
 Sample Type: unknown
 Control Program: ANIONS_AS14A_CI2
 Quantif. Method: ANIONS
 Recording Time: 12/19/2006 9:16
 Run Time (min): 30.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 10.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.22	n.a.	1.67848	0.308	0.19	n.a.	BMB*
2	3.22	Fluoride	0.05666	0.007	0.00	0.1814	Rd*
3	3.83	n.a.	0.20009	0.026	0.02	n.a.	BMB
4	4.46	n.a.	0.34155	0.050	0.03	n.a.	BM
5	4.68	Chloride	0.13695	0.020	0.01	0.7315	MB^
6	5.52	Nitrite-N	0.04065	0.012	0.01	0.1203	BMB
7	7.83	Nitrate-N	0.36919	0.089	0.05	1.3383	BMB
8	10.66	n.a.	19.82899	5.673	3.51	n.a.	BM
9	11.69	n.a.	#####	103.018	63.80	n.a.	MB
10	21.93	n.a.	56.70455	52.270	32.37	n.a.	BMB

manual integration F -
 CWK 12/19/06
 default_letter/Integration

Chloride peak misidentified
 based on spike recovery.
 Peak manually identified

Chromeleon (c) Dionex 1996-2001
 Version 6.50 SP4 Build 1000

CWK 12/19/06

10 H6L110106 JK7KA 1/10

Sample Name: H6L110106 JK7KA 1/10
 Vial Number: 140
 Sample Type: unknown
 Control Program: ANIONS_AS14A_CI2
 Quantif. Method: ANIONS
 Recording Time: 12/19/2006 9:16
 Run Time (min): 30.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 10.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.22	n.a.	1.67848	0.304	0.19	n.a.	BM
2	3.22	Fluoride	0.07242	0.011	0.01	0.2318	MB
3	3.83	n.a.	0.20009	0.026	0.02	n.a.	BMB
4	4.46	Chloride	0.34155	0.050	0.03	1.8175	BM
5	4.68	n.a.	0.13695	0.020	0.01	n.a.	MB
6	5.52	Nitrite-N	0.04065	0.012	0.01	0.1203	BMB
7	7.83	Nitrate-N	0.36919	0.089	0.05	1.3383	BMB
8	10.66	n.a.	19.82899	5.673	3.51	n.a.	BM
9	11.69	n.a.	#####	103.018	63.80	n.a.	MB
10	21.93	n.a.	56.70455	52.270	32.37	n.a.	BMB

11 H6L110106 JK7KA MS 1/10 0.2 PPM F, CL, BR

Sample Name:	H6L110106 JK7KA MS 1/10 0.2 PPM F, CL,	Injection Volume:	50.0
Vial Number:	141	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A_C12	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/19/2006 9:49	Sample Weight:	1.0000
Run Time (min):	13.88	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.23	n.a.	1.72838	0.298	0.27	n.a.	BMB
2	3.23	Fluoride	0.64330	0.083	0.08	2.0405	bMB
3	3.83	n.a.	0.20493	0.027	0.02	n.a.	BMB
4	4.47	n.a.	0.37660	0.055	0.05	n.a.	BM
5	4.70	Chloride	0.49779	0.082	0.07	2.6414	MB
6	5.53	Nitrite-N	0.71269	0.133	0.12	2.0923	BMB
7	6.98	Bromide	0.11543	0.023	0.02	2.0218	BMB
8	7.83	Nitrate-N	0.95547	0.223	0.20	3.4249	BMB
9	10.68	n.a.	19.53185	5.569	5.07	n.a.	BM
10	11.71	n.a.	#####	103.405	94.09	n.a.	MB

$$F^- \quad 2.0405 - 0.1814 = 1.8591 / 2.0 = 92.96\% R$$

$$\text{default_letter/Integration} \quad Br^- \quad 2.0218 / 2 = 101.1\% R$$

$$Cl^- \quad 2.6414 - 0.7315 = 1.9099 / 2 = 95.5\% R$$

12 H6L110106 JK7K2 1/10

Sample Name: H6L110106 JK7K2 1/10
Vial Number: 142
Sample Type: unknown
Control Program: ANIONS_AS14A_CI2
Quantif. Method: ANIONS
Recording Time: 12/19/2006 10:21
Run Time (min): 30.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 10.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.23	n.a.	1.44714	0.254	0.48	n.a.	BMB
2	4.70	Chloride	0.08865	0.011	0.02	0.4740	BMB*
3	6.48	n.a.	0.17716	0.247	0.47	n.a.	BMB
4	11.98	n.a.	0.50966	0.176	0.33	n.a.	BMB
5	21.97	n.a.	56.57459	52.193	98.70	n.a.	BMB

manual integration CI-

Ⓟ CLK 12/19/06

12 H6L110106 JK7K2 1/10

Sample Name:	H6L110106 JK7K2 1/10	Injection Volume:	50.0
Vial Number:	142	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A_CI2	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/19/2006 10:21	Sample Weight:	1.0000
Run Time (min):	30.00	Sample Amount:	1.0000

No.	Ret. Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel. Area (%)	Amount (mg/L)	Peak Type
1	2.23	n.a.	1.44714	0.254	0.48	n.a.	BMB
2	4.70	Chloride	0.22151	0.156	0.29	1.1814	BMB
3	5.00	n.a.	0.03334	0.024	0.04	n.a.	Rd
4	6.48	n.a.	0.17716	0.247	0.47	n.a.	BMB
5	11.98	n.a.	0.50966	0.176	0.33	n.a.	BMB
6	21.97	n.a.	56.57459	52.193	98.39	n.a.	BMB

original

13 H6L110106 JK7K2 MS 1/10 0.2 PPM F, CL, BR

Sample Name:	H6L110106 JK7K2 MS 1/10 0.2 PPM F, CL,	Injection Volume:	50.0
Vial Number:	143	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A_CI2	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/19/2006 10:54	Sample Weight:	1.0000
Run Time (min):	30.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.22	n.a.	1.45986	0.249	0.47	n.a.	BMB
2	3.23	Fluoride	0.65024	0.083	0.16	2.0623	BMB
3	4.69	Chloride	0.47198	0.066	0.13	2.5056	BMB*
4	5.48	Nitrite-N	0.71363	0.092	0.17	2.0951	BMB
5	6.96	Bromide	0.11106	0.024	0.05	1.9455	BMB
6	7.83	Nitrate-N	0.55673	0.133	0.25	2.0108	BMB
7	11.96	n.a.	0.42070	0.151	0.28	n.a.	BMB
8	21.96	n.a.	56.64823	52.175	98.49	n.a.	BMB

$$\text{Cl}^- \quad 2.5056 - 0.4740 = 2.0316 \bigg|_{2.0} = 101.6\% R$$

13 H6L110106 JK7K2 MS 1/10 0.2 PPM F, CL, BR

Sample Name:	H6L110106 JK7K2 MS 1/10 0.2 PPM F, CL,	Injection Volume:	50.0
Vial Number:	143	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A_CI2	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/19/2006 10:54	Sample Weight:	1.0000
Run Time (min):	30.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (μS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.22	n.a.	1.45986	0.249	0.47	n.a.	BMB
2	3.23	Fluoride	0.65024	0.083	0.16	2.0623	BMB
3	4.69	Chloride	0.51228	0.107	0.20	2.7176	BMB
4	5.48	Nitrite-N	0.71363	0.092	0.17	2.0951	BMB
5	6.96	Bromide	0.11106	0.024	0.05	1.9455	BMB
6	7.83	Nitrate-N	0.55673	0.133	0.25	2.0108	BMB
7	11.96	n.a.	0.42070	0.151	0.28	n.a.	BMB
8	21.96	n.a.	56.64823	52.175	98.42	n.a.	BMB

original

14 H6L110106 JK7KA MSD 1/10 0.2 PPM F, CL, BR

Sample Name:	H6L110106 JK7KA MSD 1/10 0.2 PPM F, CL	Injection Volume:	50.0
Vial Number:	143	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A_CI2	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/19/2006 11:26	Sample Weight:	1.0000
Run Time (min):	30.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area µS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.23	n.a.	1.77246	0.299	0.18	n.a.	BMB
2	3.23	Fluoride	0.65994	0.089	0.05	2.0928	bMB
3	3.83	n.a.	0.21125	0.028	0.02	n.a.	BMB
4	4.47	n.a.	0.37079	0.055	0.03	n.a.	BM
5	4.70	Chloride	0.49601	0.081	0.05	2.6320	MB
6	5.53	Nitrite-N	0.72648	0.135	0.08	2.1325	BMB
7	6.98	Bromide	0.10608	0.020	0.01	1.8585	BMB
8	7.84	Nitrate-N	0.93800	0.216	0.13	3.3633	BMB
9	10.68	n.a.	18.87528	5.394	3.31	n.a.	BM
10	11.71	n.a.	#####	103.793	63.74	n.a.	MB
11	21.96	n.a.	56.91333	52.722	32.38	n.a.	BMB

15 H6L110106 JK7KN 1/10

Sample Name:	H6L110106 JK7KN 1/10	Injection Volume:	50.0
Vial Number:	144	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A_CI2	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/19/2006 11:59	Sample Weight:	1.0000
Run Time (min):	22.90	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.23	n.a.	1.92701	0.322	0.21	n.a.	BMB
2	3.85	n.a.	0.23754	0.031	0.02	n.a.	BMB
3	4.48	n.a.	0.41921	0.063	0.04	n.a.	BM *
4	4.71	Chloride	0.10109	0.014	0.01	0.5403	MB^A
5	7.88	Nitrate-N	0.44389	0.101	0.07	1.6067	BMB
6	10.68	n.a.	34.84426	9.882	6.53	n.a.	BM
7	11.72	n.a.	#####	105.466	69.67	n.a.	MB
8	21.97	n.a.	52.22795	35.502	23.45	n.a.	BMB

Split Peak / misidentified peak
CW 12/19/06

15 H6L110106 JK7KN 1/10

Sample Name: H6L110106 JK7KN 1/10
Vial Number: 144
Sample Type: unknown
Control Program: ANIONS_AS14A_CI2
Quantif. Method: ANIONS
Recording Time: 12/19/2006 11:59
Run Time (min): 17.88

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 10.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret. Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel. Area (%)	Amount (mg/L)	Peak Type
1	2.23	n.a.	1.92701	0.322	0.28	n.a.	BMB
2	3.85	n.a.	0.23754	0.031	0.03	n.a.	BMB
3	4.48	Chloride	0.38160	0.051	0.04	2.0292	BMB
4	7.88	Nitrate-N	0.44389	0.101	0.09	1.6067	BMB
5	10.68	n.a.	34.84426	9.882	8.53	n.a.	BM
6	11.72	n.a.	#####	105.466	91.03	n.a.	MB

original

16 CCV = ICWS-9061

Sample Name: CCV = ICWS-9061
Vial Number: 147
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/19/2006 12:31
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.23	n.a.	0.09026	0.017	0.76	n.a.	BMB
2	3.24	Fluoride	3.31997	0.424	19.27	1.0126	BMB
3	4.72	Chloride	1.94952	0.272	12.35	1.0083	BMB
4	5.56	Nitrite-N	3.59510	0.619	28.12	1.0213	BMB
5	7.01	Bromide	0.59911	0.122	5.55	1.0339	BMB
6	7.85	Nitrate-N	2.95797	0.696	31.63	1.0231	BMB
7	12.01	n.a.	0.12386	0.051	2.32	n.a.	BMB

17 CCB

Sample Name:	CCB	Injection Volume:	50.0
Vial Number:	148	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/19/2006 12:48	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
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18 H6L110106 JK7KW 1/10

Sample Name: H6L110106 JK7KW 1/10
Vial Number: 149
Sample Type: unknown
Control Program: ANIONS_AS14A_CI2
Quantif. Method: ANIONS
Recording Time: 12/19/2006 13:06
Run Time (min): 30.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 10.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret. Time (min.)	Peak Name	Height (uS)	Area µS*min	Rel. Area (%)	Amount (mg/L)	Peak Type
1	2.23	n.a.	2.11949	0.350	0.19	n.a.	BMB
2	3.84	n.a.	0.30890	0.043	0.02	n.a.	BMB
3	4.48	n.a.	0.40994	0.062	0.03	n.a.	BM *
4	4.71	Chloride	0.10993	0.016	0.01	0.5875	MB**
5	7.87	Nitrate-N	0.49048	0.120	0.07	1.7737	BMB
6	10.65	n.a.	39.88411	11.262	6.15	n.a.	BM
7	11.68	n.a.	#####	118.828	64.93	n.a.	MB
8	21.97	n.a.	56.72228	52.338	28.60	n.a.	BMB

⑤ CWK 12/19/06

Peak misidentified

18 H6L110106 JK7KW 1/10

Sample Name:	H6L110106 JK7KW 1/10	Injection Volume:	50.0
Vial Number:	149	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A_CI2	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/19/2006 13:06	Sample Weight:	1.0000
Run Time (min):	30.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.23	n.a.	2.11949	0.350	0.19	n.a.	BMB
2	3.84	n.a.	0.30890	0.043	0.02	n.a.	BMB
3	4.48	Chloride	0.36885	0.050	0.03	1.9618	BMB
4	7.87	Nitrate-N	0.49048	0.120	0.07	1.7737	BMB
5	10.65	n.a.	39.88411	11.262	6.15	n.a.	BM
6	11.68	n.a.	#####	118.828	64.94	n.a.	MB
7	21.97	n.a.	56.72228	52.338	28.60	n.a.	BMB

original

28 CCV= ICWS-9061

Sample Name: **CCV= ICWS-9061**
Vial Number: **166**
Sample Type: **unknown**
Control Program: **ANIONS_AS14A**
Quantif. Method: **ANIONS**
Recording Time: **12/19/2006 16:15**
Run Time (min): **15.00**

Injection Volume: **50.0**
Channel: **ECD_1**
Wavelength: **n.a.**
Bandwidth: **n.a.**
Dilution Factor: **1.0000**
Sample Weight: **1.0000**
Sample Amount: **1.0000**

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area µS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.23	n.a.	0.09051	0.013	0.63	n.a.	BMB
2	3.25	Fluoride	3.33715	0.425	19.80	1.0176	BMB ✓
3	4.73	Chloride	1.97217	0.277	12.89	1.0196	BMB ✓
4	5.58	Nitrite-N	3.59591	0.614	28.59	1.0215	BMB
5	7.05	Bromide	0.58861	0.122	5.66	1.0161	BMB ✓
6	7.91	Nitrate-N	2.94017	0.697	32.44	1.0173	BMB

29 CCB

Sample Name:	CCB	Injection Volume:	50.0
Vial Number:	167	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/19/2006 16:32	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	5.09	n.a.	0.04319	0.011	100.00	n.a.	BMB

ND

STL Knoxville Anions in Air Data Review / Narrative Checklist for Methods 9056/9057/26A, SOP KNOX-WC-0005, Rev. 8

Page 1 of 1

Lot #: H6L110105 H6L110106 Analysis Date: 12/28/06 File ID: L28-LauLevel-FCHN₂BrNO₃-1228/06 ICAL File ID: 518-LowLevel-FCHN₂BrNO₃-1228/06 101806

Review Items	NA	Yes	No	If No, why is data reportable?	2 nd ✓
1. Were PM checklists (L40), Lot Summary and any applicable QAS reviewed?		✓			✓
2. ICV within 90-110%R?		✓			✓
3. ICB/CCB < 1/2 RL?		✓		□ [ccb1] No analyte > MDL in associated samples.	✓
4. CCVs/CCBs run after every 10 samples, and at end of sequence?		✓			✓
5. Is %D ≤ 10% for each CCV?		✓			✓
6. If CCV failed, was it rerun only once?	✓				N/A
7. LCS/LCSD analytes within 90-110%R? If no, list LCS ID:		✓		□ [lcs3] LCS recovery > upper control limit & sample results < RL.	✓
8. Method blank < 1/2 RL? If no, list blank ID:		✓		□ [mb3] No analyte > RL in associated samples.	✓
9. Matrix spikes run at required frequency?		✓		□ [mb7] Sample results > 10x higher than blank.	✓
10. Matrix spikes within 75-125% recovery? If no, list MS ID:		✓		□ [air ms1] MS %R slightly outside limits for 1 sample.	✓
				□ [air ms2] MS %R slightly outside limits for > 1 sample.	✓
				□ Air train reagent blank – spike result not reported.	✓
11. Were MS run #'s assigned to all matrix spikes except reagent blanks?		✓			✓
12. Sample analyses done within holding time (HT)? If no, list samples:		✓		□ [ht1] HT expired upon receipt.	✓
13. Were results processed using correct ICAL?		✓		□ [ht2] Analysis requested after HT expired.	✓
14. Are positive results within the calibration range?		✓			✓
15. Is integration acceptable for all samples, QC samples and standards?		✓			✓
16. For manual integrated standards and QC samples, are before/after chromatograms provided with initials/date/reason?		✓		Reasons: S=Split peak, U=Undetected peak, I=Incorrect peak integration, B=Baseline correction, W=Wrong peak chosen by data system.	✓
17. Calculations checked for error? (Document manual calculation checks.)		✓			✓
18. Were spreadsheets checked for transcription errors?		✓			✓
19. Final report/F6 correct? (Verify results, RLs, units, qualifiers, DFs, dates, spikes.)		✓			✓
20. Are all nonconformances documented and discussed in narrative?		✓		List NCM #:	N/A
21. Appropriate air train autotext selected for narrative?	✓			□ [air1] Cl ⁻ reported as HCl and Cl ₂ .	
				□ [air2] Cl ⁻ reported as HCl only.	
				□ [air3] Cl ⁻ , F ⁻ reported as HCl, Cl ₂ , HF.	
				□ [air4] Cl ⁻ , F ⁻ , Br ⁻ reported as HCl, Cl ₂ , HF, HBr, Br ₂ .	air 4
				□ [air5] Cl ⁻ , F ⁻ , NO ₂ ⁻ , NO ₃ ⁻ reported as HCl, Cl ₂ , HF, HNO ₂ , HNO ₃ .	
				□ [air6] Cl ⁻ , F ⁻ , Br ⁻ , I ⁻ reported as HCl, Cl ₂ , HF, HBr, Br ₂ , I ₂ .	
				□ [air7] Cl ⁻ , F ⁻ , NO ₂ ⁻ , NO ₃ ⁻ reported as Cl ⁻ , F ⁻ , NO ₂ ⁻ , NO ₃ ⁻ .	
22. Sample pH adjustment included in narrative?	✓			□ [air pH] Sample pH adjusted prior to analysis.	N/A
23. Audit sample results included in narrative?	✓			□ [audit2] Audit results in mg/L.	N/A

1st Level Reviewer: Dawh Date: 12/29/06 2nd Level Reviewer: Shubert Date: 12/29/06

SL9AA (LCS)
Height = $2.19733 (0.7501) + 0.033578 (0.7501)^2 = 1.667$
JK 757 (ms) HCL: $7.932 \mu\text{g/L} \times 425 \text{ mL} \times \frac{(1.0079 + 35.453)}{35.453} = 346.69 \mu\text{g}$

Nonconformance memos are required for bold and italicized [autotext] statements: Bold = deficiency, italicized = anomaly.

WC08IR3.DOC, 6/16/06

Anions in Air Data Worksheet

Comp Date: 12/28/2006 0000

QuantIMS #: 2702

Instr. ID: 1500

MW Factor: 1.028429188

[illegible]

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (µg/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (µg/mL)	LIMS DF	True Spike Amount (µg)
LCS	ICWI-9087	100.00	0.750	100.0	JL9AA1AC	0.75	102.84	77.13
LCSD	ICWI-9087	100.00	0.750	100.0	JL9AA1AD	0.75	102.84	77.13
MS (1)	ICWI-9087	100.00	0.020	10.0	JK7JX1AE	0.20	19,128.78	3,825.76
MSD (1)	ICWI-9087	100.00	0.020	10.0	JK7JX1AF	0.20	19,128.78	3,825.76
MS (2)	ICWI-9087	100.00	0.020	10.0	JK7J71AJ	0.20	17,483.30	3,496.66
MSD (2)	ICWI-9087	100.00	0.020	10.0	JK7J71AK	0.20	17,483.30	3,496.66
MS (3)								
MSD (3)								
MS (4)								
MSD (4)								
MS (5)								
MSD (5)								

Comments:

True Spike Amount (µg) = Standard Concentration (µg/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

Preventive Maintenance	Instrument Conditions
<u>Daily:</u>	Flow Rate = 1.00 mL/min
☒ Check pump and gas pressure	Pressure = 1840. psi
☒ Check all lines for crimping, leaks and discoloration	Conductance = 24.9 μ S
<u>As Needed:</u>	Suppressor Current = 43 mA
☐ Change column and guard column	Eluent Generator = N/A mM KOH
☐ Change column and/or guard column bed support	
☐ Clean conductivity cell	
☐ De-gas pump head when flow is erratic	
☐ Check/replace eluant end line filter	

[illegible]

Comments: HCL Batch 6363147

WC075R1, 6/11/04

Sequence: L28_LOWLEVEL_FCLNO2BRNO3_122806
 Operator: wheelerd

Page 1 of 3
 Printed: 12/29/2006 8:55:10 AM

Title:

Datasource: ICS_1500_net
 Location: ICS1500
 Timebase: ICS1500
 #Samples: 34

Created: 12/28/2006 10:49:27 AM by wheelerd
 Last Update: 12/28/2006 4:28:05 PM by wheelerd

(DEW)
 12/29/06

No.	Name	Sample ID	Inj. Vol.	Inj. Date/Time	Dil. Factor	*Multiplier [Liters]	Weight
1	CAL STD #1 ICWS-8915		50.0	10/18/2006 9:14:56 AM	1.0000		1.0000
2	CAL STD #2 ICWS-8916		50.0	10/18/2006 9:32:20 AM	1.0000		1.0000
3	CAL STD #3 ICWS-8917		50.0	10/18/2006 9:49:45 AM	1.0000		1.0000
4	CAL STD #4 ICWS-8918		50.0	10/18/2006 10:07:09 AM	1.0000		1.0000
5	CAL STD #5 ICWS-8919		50.0	10/18/2006 10:24:33 AM	1.0000		1.0000
6	CAL STD #6 ICWS-8920		50.0	10/18/2006 10:41:57 AM	1.0000		1.0000
7	ICV/LCS= ICWS-9088		50.0	12/28/2006 1:24:09 PM	1.0000		1.0000
8	ICV/LCSD= ICWS-9089		50.0	12/28/2006 1:41:33 PM	1.0000		1.0000
9	ICB/ METHOD BLANK		50.0	12/28/2006 1:58:57 PM	1.0000		1.0000
10	H6L110106-JK7J7-1/20		50.0	12/28/2006 2:16:22 PM	20.0000		1.0000
11	H6L110106-JK7J7-1/20-MS@0.2ppm Cl		50.0	12/28/2006 2:40:20 PM	20.0000		1.0000
12	H6L110106-JK7J7-1/20-MSD@0.2ppm Cl		50.0	12/28/2006 2:57:44 PM	20.0000		1.0000
13	H6L110106-JK7J7-1/40		50.0	12/28/2006 3:15:08 PM	40.0000		1.0000
14	H6L110106-JK7J7-1/40-MS@0.2ppm Cl		50.0	12/28/2006 3:34:42 PM	40.0000		1.0000
15	H6L110106-JK7J7-1/40-MSD@0.2ppm Cl		50.0	12/28/2006 3:52:06 PM	40.0000		1.0000
16	CCV= ICWS-9090		50.0	12/28/2006 4:09:30 PM	1.0000		1.0000
17	CCB		50.0	12/28/2006 4:26:54 PM	1.0000		1.0000
18	H6L110105-JK7JX-1/20		50.0	12/28/2006 4:44:18 PM	20.0000		1.0000
19	H6L110105-JK7JX-1/40		50.0	12/28/2006 5:01:43 PM	40.0000		1.0000
20	H6L110105-JK7J1-1/20		50.0	12/28/2006 5:19:07 PM	20.0000		1.0000
21	H6L110105-JK7J1-1/40		50.0	12/28/2006 5:36:31 PM	40.0000		1.0000
22	H6L110106-JK7KG-1/20		50.0	12/28/2006 5:53:56 PM	20.0000		1.0000
23	H6L110106-JK7KG-1/40		50.0	12/28/2006 6:11:20 PM	40.0000		1.0000
24	H6L110106-JK7KT-1/20		50.0	12/28/2006 6:28:44 PM	20.0000		1.0000
25	H6L110106-JK7KT-1/40		50.0	12/28/2006 6:46:08 PM	40.0000		1.0000
26	CCV= ICWS-9090		50.0	12/28/2006 7:03:32 PM	1.0000		1.0000
27	CCB		50.0	12/28/2006 7:20:56 PM	1.0000		1.0000
28	H6L110105-JK7JX-1/20-MS@0.2ppm Cl		50.0	12/28/2006 7:38:20 PM	20.0000		1.0000
29	H6L110105-JK7JX-1/20-MSD@0.2ppm Cl		50.0	12/28/2006 7:55:44 PM	20.0000		1.0000
30	H6L110105-JK7JX-1/40-MS@0.2ppm Cl		50.0	12/28/2006 8:13:09 PM	40.0000		1.0000
31	H6L110105-JK7JX-1/40-MSD@0.2ppm Cl		50.0	12/28/2006 8:30:33 PM	40.0000		1.0000
32	CCV= ICWS-9090		50.0	12/28/2006 8:47:58 PM	1.0000		1.0000
33	CCB		50.0	12/28/2006 9:05:22 PM	1.0000		1.0000
34	SHUTDOWN		50.0	12/28/2006 9:22:46 PM	1.0000		1.0000

7 ICV/LCS= ICWS-9088

Sample Name:	ICV/LCS= ICWS-9088	Injection Volume:	50.0
Vial Number:	1296	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 13:24	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	2.32322	0.397	19.53	0.8109	BMB
2	4.55	Chloride	1.66709	0.273	13.44	0.7501	BM
3	5.30	Nitrite-N	3.02897	0.586	28.80	0.7761	MB
4	6.56	Bromide	0.54320	0.115	5.64	0.7617	BMB
5	7.32	Nitrate-N	2.77714	0.663	32.59	0.7720	bMB

HCL JL9AA-1AC

8 ICV/LCSD= ICWS-9089

Sample Name:	ICV/LCSD= ICWS-9089	Injection Volume:	50.0
Vial Number:	1297	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 13:41	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret. Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel. Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	0.06095	0.013	0.61	n.a.	BMB
2	3.23	Fluoride	2.32775	0.399	19.45	0.8124	BMB
3	4.55	Chloride	1.68114	0.274	13.35	0.7563	BM
4	5.29	Nitrite-N	3.03772	0.587	28.59	0.7783	M
5	6.55	Bromide	0.53922	0.114	5.54	0.7561	MB
6	7.31	Nitrate-N	2.78963	0.666	32.46	0.7754	BMB

HCL JL9AA-1A7D
Rw 12/29/04

9 ICB/ METHOD BLANK

Sample Name:	ICB/ METHOD BLANK	Injection Volume:	50.0
Vial Number:	1298	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 13:58	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
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ND

HCl JL9AA-1AA

10 H6L110106-JK7J7-1/20

Sample Name:	H6L110106-JK7J7-1/20	Injection Volume:	50.0
Vial Number:	1294	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS_CI2 METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	20.0000
Recording Time:	12/28/2006 14:16	Sample Weight:	1.0000
Run Time (min):	20.95	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.72	n.a.	0.07689	0.016	0.03	n.a.	BMB
2	4.81	Chloride	0.11415	0.043	0.09	1.0382	BMB
3	7.33	Nitrate-N	0.11481	0.027	0.06	0.6629	BMB
4	8.02	n.a.	0.08998	0.016	0.04	n.a.	BMB
5	11.41	n.a.	#####	45.896	99.78	n.a.	BMB

Peak not split - see 1/40.

10 H6L110106-JK7J7-1/20

Sample Name:	H6L110106-JK7J7-1/20	Injection Volume:	50.0
Vial Number:	1294	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS_C12 METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	20.0000
Recording Time:	12/28/2006 14:16	Sample Weight:	1.0000
Run Time (min):	20.95	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.72	n.a.	0.07689	0.016	0.03	n.a.	BMB
2	4.81	Chloride	0.11415	0.043	0.09	1.0382	BMB
3	7.33	Nitrate-N	0.11481	0.027	0.06	0.6629	BMB
4	8.02	n.a.	0.08998	0.016	0.04	n.a.	BMB
5	11.41	n.a.	#####	45.896	99.78	n.a.	BMB

11 H6L110106-JK7J7-1/20-MS@0.2ppm Cl

Sample Name:	H6L110106-JK7J7-1/20-MS@0.2ppm Cl	Injection Volume:	50.0
Vial Number:	1294	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	20.0000
Recording Time:	12/28/2006 14:40	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.60402	0.115	0.25	4.4141	BMB
2	3.70	n.a.	0.04813	0.009	0.02	n.a.	Rd
3	4.59	Chloride	0.43484	0.122	0.26	3.9460	BM
4	5.30	Nitrite-N	0.88289	0.176	0.38	4.6088	MB
5	6.56	Bromide	0.14211	0.028	0.06	4.0035	BMB
6	7.32	Nitrate-N	0.83916	0.196	0.42	4.7938	BMB
7	11.41	n.a.	#####	45.573	98.60	n.a.	BMB

12 H6L110106-JK7J7-1/20-MSD@0.2ppm Cl

Sample Name:	H6L110106-JK7J7-1/20-MSD@0.2ppm Cl	Injection Volume:	50.0
Vial Number:	1316	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	20.0000
Recording Time:	12/28/2006 14:57	Sample Weight:	1.0000
Run Time (min):	13.90	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.59252	0.095	0.20	4.3315	BMB
2	4.60	Chloride	0.45078	0.123	0.27	4.0902	BM
3	5.31	Nitrite-N	0.88058	0.170	0.37	4.5969	MB
4	6.56	Bromide	0.14858	0.031	0.07	4.1856	BMB
5	7.33	Nitrate-N	0.85559	0.208	0.45	4.8865	BMB
6	11.41	n.a.	#####	45.813	98.65	n.a.	BMB

13 H6L110106-JK7J7-1/40

Sample Name:	H6L110106-JK7J7-1/40	Injection Volume:	50.0
Vial Number:	1317	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 15:15	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.55	Chloride	0.01633	0.002	0.01	0.2973	BM *
2	4.86	n.a.	0.07384	0.036	0.17	n.a.	MB*
3	7.33	Nitrate-N	0.05437	0.012	0.06	0.6285	BMB
4	11.46	n.a.	68.39477	21.339	99.76	n.a.	BMB

13 H6L110106-JK7J7-1/40

Sample Name:	H6L110106-JK7J7-1/40	Injection Volume:	50.0
Vial Number:	1317	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 15:15	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.55	Chloride	0.01633	0.002	0.01	0.2973	BM *
2	4.86	n.a.	0.07384	0.036	0.17	n.a.	MB*
3	7.33	Nitrate-N	0.05437	0.012	0.06	0.6285	BMB
4	11.46	n.a.	68.39477	21.339	99.76	n.a.	BMB

13 H6L110106-JK7J7-1/40

Sample Name:	H6L110106-JK7J7-1/40	Injection Volume:	50.0
Vial Number:	1317	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 15:15	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.86	n.a.	0.05739	0.016	0.08	n.a.	BMB
2	7.33	Nitrate-N	0.05437	0.012	0.06	0.6285	BMB
3	11.46	n.a.	68.39477	21.339	99.87	n.a.	BMB

14 H6L110106-JK7J7-1/40-MS@0.2ppm Cl

Sample Name:	H6L110106-JK7J7-1/40-MS@0.2ppm Cl	Injection Volume:	50.0
Vial Number:	1317	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 15:34	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.60020	0.102	0.48	8.7734	BMB
2	4.56	Chloride	0.43705	0.086	0.40	7.9320	BMB
3	5.30	Nitrite-N	0.81527	0.150	0.70	8.5168	bMB
4	6.55	Bromide	0.14598	0.030	0.14	8.2249	BM
5	7.32	Nitrate-N	0.78173	0.187	0.87	8.9389	MB
6	11.47	n.a.	66.89217	20.869	97.41	n.a.	BMB

15 H6L110106-JK7J7-1/40-MSD@0.2ppm Cl

Sample Name:	H6L110106-JK7J7-1/40-MSD@0.2ppm Cl	Injection Volume:	50.0
Vial Number:	1318	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 15:52	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.60384	0.111	0.51	8.8257	BMB
2	4.56	Chloride	0.43447	0.087	0.40	7.8852	BMB
3	5.30	Nitrite-N	0.82309	0.150	0.70	8.5978	bMB
4	6.55	Bromide	0.14688	0.032	0.15	8.2750	BMB
5	7.32	Nitrate-N	0.78556	0.187	0.87	8.9822	BMB
6	11.46	n.a.	67.25044	20.977	97.37	n.a.	BMB

16 CCV= ICWS-9090

Sample Name: CCV= ICWS-9090
Vial Number: 1370
Sample Type: unknown
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 12/28/2006 16:09
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.23	n.a.	0.06059	0.011	0.42	n.a.	BMB
2	3.23	Fluoride	3.09242	0.528	19.53	1.0594	BMB
3	4.55	Chloride	2.21582	0.356	13.19	0.9933	BM ✓
4	5.29	Nitrite-N	4.00209	0.777	28.76	1.0173	MB
5	6.55	Bromide	0.72968	0.151	5.60	1.0210	BMB
6	7.30	Nitrate-N	3.71828	0.878	32.50	1.0209	BMB

17 CCB

Sample Name:	CCB	Injection Volume:	50.0
Vial Number:	1371	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 16:26	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
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ND

22 H6L110106-JK7KG-1/20

Sample Name:	H6L110106-JK7KG-1/20	Injection Volume:	50.0
Vial Number:	1397	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	20.0000
Recording Time:	12/28/2006 17:53	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.79	Chloride	0.13461	0.059	0.12	1.2241	BMB
2	7.33	Nitrate-N	0.09886	0.023	0.05	0.5710	BMB
3	10.32	n.a.	0.76053	0.227	0.47	n.a.	BMB
4	11.40	n.a.	#####	47.768	99.36	n.a.	BMB

Peak not split.
See 1/40

23 H6L110106-JK7KG-1/40

Sample Name:	H6L110106-JK7KG-1/40	Injection Volume:	50.0
Vial Number:	1398	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 18:11	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret. Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel. Area (%)	Amount (mg/L)	Peak Type
1	4.56	Chloride	0.01141	0.001	0.01	0.2077	BM **
2	4.82	n.a.	0.07763	0.031	0.14	n.a.	MB*
3	7.32	Nitrate-N	0.05905	0.015	0.07	0.6826	BMB
4	10.32	n.a.	0.37844	0.114	0.51	n.a.	BMB
5	11.46	n.a.	70.85893	22.110	99.28	n.a.	BMB

23 H6L110106-JK7KG-1/40

Sample Name:	H6L110106-JK7KG-1/40	Injection Volume:	50.0
Vial Number:	1398	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 18:11	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.82	Chloride	0.06637	0.020	0.09	1.2076	BMB
2	7.32	Nitrate-N	0.05905	0.015	0.07	0.6826	BMB
3	10.32	n.a.	0.37844	0.114	0.51	n.a.	BMB
4	11.46	n.a.	70.85893	22.110	99.33	n.a.	BMB

24 H6L110106-JK7KT-1/20

Sample Name:	H6L110106-JK7KT-1/20	Injection Volume:	50.0
Vial Number:	1399	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	20.0000
Recording Time:	12/28/2006 18:28	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.74	Chloride	0.16098	0.071	0.13	1.4636	BMB
2	7.33	Nitrate-N	0.12915	0.030	0.06	0.7456	BMB
3	9.67	n.a.	0.06562	0.020	0.04	n.a.	BMB
4	11.39	n.a.	#####	53.520	99.77	n.a.	BMB

Peak not split
Let 1/40

25 H6L110106-JK7KT-1/40

Sample Name:	H6L110106-JK7KT-1/40	Injection Volume:	50.0
Vial Number:	1400	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 18:46	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.58	Chloride	0.03757	0.005	0.02	0.6837	BM *
2	4.86	n.a.	0.09163	0.038	0.15	n.a.	MB*
3	7.35	Nitrate-N	0.06197	0.014	0.06	0.7162	BMB
4	11.45	n.a.	78.97294	24.839	99.77	n.a.	BMB

25 H6L110106-JK7KT-1/40

Sample Name:	H6L110106-JK7KT-1/40	Injection Volume:	50.0
Vial Number:	1400	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 18:46	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.86	n.a.	0.06340	0.018	0.07	n.a.	BMB
2	7.35	Nitrate-N	0.06197	0.014	0.06	0.7162	BMB
3	11.45	n.a.	78.97294	24.839	99.87	n.a.	BMB

26 CCV= ICWS-9090

Sample Name:	CCV= ICWS-9090	Injection Volume:	50.0
Vial Number:	1401	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 19:03	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	0.07266	0.013	0.48	n.a.	BMB
2	3.23	Fluoride	3.10205	0.520	19.26	1.0624	BMB
3	4.55	Chloride	2.21173	0.358	13.26	0.9915	BM
4	5.30	Nitrite-N	4.02336	0.768	28.45	1.0225	MB
5	6.55	Bromide	0.73552	0.155	5.74	1.0291	BMB
6	7.31	Nitrate-N	3.73776	0.886	32.82	1.0260	BMB

27 CCB

Sample Name:	CCB	Injection Volume:	50.0
Vial Number:	1402	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 19:20	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
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ND

STL Knoxville Source Air Analysis Sample Information

[illegible]

Comments: ~~(*)~~ Adjustments made w/ ICR-NAOH-1010 (IN NAOH)

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 12/18/06 Chemist: DFW Expiration Date: 12/19/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWS-9056	F-	ICWI-	8838	12/25/06	100. PPM	0.750	100.	0.75 PPM
2. (ICV/CS)	CI-							
3.	NON-							
4.	BR-							
5.	NON-							
6. ICWS-9057	F-							
7. (ICV/CS)	CI-							
8.	NON-							
9.	BR-							
10.	NON-							
11. ICWS-9058	F-	ICWI-	8837			1.		1. ppm
12. (CCV)	CI-							
13.	NON-							
14.	BR-							
15.	NON-							

Reviewed By: _____

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 12/19/06 Chemist: CWK Expiration Date: 12/20/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWS-9059	F-	ICWT-	8838	12/25/06	100 ppm	0.750	100ml	0.75 ppm
2. (100/100)	Cl ⁻							
3.	NO ₃ -N							
4.	Br ⁻							
5.	NO ₃ -N							
6. ICWS-9060	F-							
7. (100/100)	Cl ⁻							
8.	NO ₃ -N							
9.	Br ⁻							
10.	NO ₃ -N							
11. ICWS-9061	F-	ICWT-	8837			1.0		1.0 ppm
12. (CCV)	Cl ⁻							
13.	NO ₃ -N							
14.	Br ⁻							
	NO ₃ -N							

Reviewed By: _____

WC031R3.DOC, 8/28/03

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 12/28/06 Chemist: DEW Expiration Date: 3/28/07

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWT-9086	F-	17125	ERA	12/31/07	1000.PPM	5.	50.	100.mg/L (ppm)
2. (Intermediate)	Cl-	36065		6/30/07				
3. (Cell Source)	NO ₃ N-	17075		7/31/07				
4.	Br-	27025		2/28/08				
5.	NO ₃ N-	17026		2/28/08				
6. ICWT-9087	F-	1-386-2	SPEX	8/15/07	5.	5.	50.	100.mg/L (ppm)
7. (Intermediate)	Cl-	1-5CL-2		3/15/07				
8. (2nd Source)	NO ₃ N-	1-13NO ₃ N-2		9/15/07				
9.	Br-	1-1BR-2		4/30/07				
10.	NO ₃ N-	1-27NO ₃ N-2		5/15/07				
11.								
12.			DEW	12/28/07				
13.								
14.								

Reviewed By: _____

WC031R3.DOC, 8/28/03

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 12/28/06 Chemist: DFW Expiration Date: 12/29/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWS-9088	F-	ICWI-	9087	3/28/07	100. PPM	0.750	100.	0.75 ppm
2. (ICV/LCS)	Cl-							
3.	NO ₂ N-							
4.	Br-							
5.	NO ₂ N-							
6. ICWS-9089	F-							
7. (ICV/LCS)	Cl-							
8.	NO ₂ N-							
9.	Br-							
10.	NO ₂ N-							
11. ICWS-9090	F-	ICWI-9086				1.		1. ppm
12. (CCV)	Cl-							
13.	NO ₂ N-							
14.	Br-							
15.	NO ₂ N-							

Reviewed By: _____

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 9/25/06 Chemist: DFW Expiration Date: 12/25/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWI-8837	F-	17125	ERA	12/31/07	1000 ppm	5.	50	100. mg/L (ppm)
2. (Intermed. calib. source)	Cl-	36065		6/30/07				
3.	NO ₃ N	17075		7/31/07				
4.	BR-	27025		2/28/07				
5.	NO ₃ N-	17026		2/28/08				
6. ICWI-8838	F-	1-38F-2	SPEX	8/15/07	1000 ppm	5.	50	100. ppm (mg/L)
7. (Intermed. 2nd Source)	Cl-	1-5CL-2		3/15/07				
8.	NO ₃ N-	1-13NO ₃ N-2		9/15/07				
9.	BR-	1-1BR-2		4/30/07				
10.	NO ₃ N-	1-21NO ₃ N-2		5/15/07				
11.								
12.								
13.								
14.								

Reviewed By: _____

Total Particulates

STL Knoxville Particulate Matter Determination Data Review/Narrative Checklist

Method: SW-846 Method 0050 by SOP KNOX-WC-0006, Rev. 2

Page 1 of 1

Batch Number:	6349313
Lot Number(s):	H6L110106

Review Items					
A. Calibration	N/A	Y	N	If No, why is data reportable?	2nd ✓
1. Was the balance calibration checked with 5, 50 & 100 gram weights prior to use?		✓			✓
2. Was the balance checked with 100 gram weight after every 10 samples?		✓			✓
3. Was the balance tared before each weighing?		✓			✓
4. Was the balance ID documented?		✓			✓
B. Client Sample and QC Sample Results					
1. Were all special project requirements met? (Were PM Checklists, Lot Summary, and any applicable QAS reviewed?)		✓			✓
2. Were sample IDs verified?		✓			✓
3. Were all transcriptions checked?		✓			✓
4. Calculations checked for error?		✓			✓
5. Final report acceptable? (Results correct, units correct, deviations noted in narrative, and analysis dates correct.)		✓			✓
C. Preparation/Matrix QC					
1. Were all sample weighings performed in duplicate (at least)?		✓			✓
2. Was the average of the last two weighings used?		✓			✓
D. Other					
1. Are all nonconformances documented appropriately?	✓			NCM No.:	NA

[illegible]

STL Knoxville

Prep Date: 12/15/2006 0000

Comp Date: 12/18/2006 0000

Analyst: jmh

Reviewed by:

Date:

[Signature]

[illegible]

Comments:

16

STL Knoxville
Sample Data Log
Particulate Matter by KNOX-WC-0006

Batch Number: 6349313												
Sample Number	Work Order Number	Matrix	Filter or Beaker No.	Probe Rinse Volume (mL)	Tare Weight (g)	Replicate No.	Balance ID	Cal Check ²	Individual Weight (g)	Date	Time	Analyst Initials
1	H6L110106-001					1	H-47372	100.0001	66.3618	12/18/06	1153	JMH
				135	64.9126	2	↓	99.9999	66.3622	12/18/06	1412	JMH
						3				JMH		
						4				12/18/06		
2	-005	AC _E	2	121	84.3155	1	H-47372	100.0001	86.4869	12/18/06	1154	JMH
						2	↓	99.9999	86.4869	12/18/06	1413	JMH
						3				JMH		
						4				12/18/06		
3	-009	AC _E	3	104	65.1228	1	H-47372	100.0001	67.1836	12/18/06	1155	JMH
						2	↓	99.9999	67.1839	12/18/06	1414	JMH
						3				JMH		
						4				12/18/06		
4						1						
						2						
						3						
						4						
5						1						
						2						
						3						
						4						

¹ Record the measured weight of the 100 gram weight. Was the measured weight 100 ± 0.0005 grams? (At start, and after every ten containers)

² Was the balance tared before the current weighing?

STL Knoxville

67

Tare Weight Log
Particulate Matter by KNOX-WC-0006

Filter or Beaker No.	Matrix	Replicate No.	Balance ID	Cal Check ¹	Tare? ²	Individual Weight (g)	Date	Time	Analyst Initials	Tare Weight (g)
1 JK735 1	ACE	1	H-47372	100.0000	✓	64.9126	12/15/06	1354	JMH	64.9126
		2								
		3					JMH			
		4					12/15/06			
2 JK7KE 2	ACE	1	H-47372	100.0000	✓	84.3155	12/15/06	1355	JMH	84.3155
		2								
		3					JMH			
		4					12/15/06			
3 JK7KA 3	ACE	1	H-47372	100.0000	✓	65.1228	12/15/06	1356	JMH	65.1228
		2								
		3					JMH			
		4					12/15/06			
4		1								
		2								
		3								
		4								
5		1								
		2								
		3								
		4								
6		1								
		2								
		3								
		4								
7		1								
		2								
		3								
		4								
8		1								
		2								
		3								
		4								
9		1								
		2								
		3								
		4								
10		1								
		2								
		3								
		4								

¹ Record the measured weight of the 100 gram weight. Was the measured weight 100 ± 0.0005 grams?

(At start, and after every ten containers)

² Was the balance tared before the current weighing?

Subcontract

GENERAL CHEMISTRY DATA

SAMPLE DATA

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 1 ACE FW

General Chemistry

Lot-Sample #....: H6L110106-001

Work Order #....: JK7J5

Matrix.....: AIR

Date Sampled...: 11/30/06

Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Particulates (total)	1450	0.50	mg	CFR60A 5	12/15-12/18/06	6349313
		Dilution Factor: 1		MDL.....: 0.50		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 1 0.1N H2SO4

General Chemistry

Lot-Sample #....: H6L110106-003 Work Order #....: JK7J8 Matrix.....: WATER
Date Sampled....: 11/30/06 Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Nitrogen, as Ammonia	4.8	0.20	mg/L	MCAWW 350.3	12/14/06	6348460
		Dilution Factor: 1		MDL.....: 0.057		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 2 ACE FW

General Chemistry

Lot-Sample #....: H6L110106-005 Work Order #....: JK7KE Matrix.....: AIR
Date Sampled....: 12/01/06 Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Particulates (total)	2170	0.50	mg	CFR60A 5	12/15-12/18/06	6349313
		Dilution Factor: 1		MDL.....: 0.50		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 2 0.1N H2SO4

General Chemistry

Lot-Sample #....: H6L110106-007 Work Order #....: JK7KK Matrix.....: WATER
Date Sampled....: 12/01/06 Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Nitrogen, as Ammonia 1.6	0.20		mg/L	MCAWW 350.3	12/14/06	6348460
	Dilution Factor: 1			MDL.....: 0.057		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 3 ACE FW

General Chemistry

Lot-Sample #....: H6L110106-009 Work Order #....: JK7KQ Matrix.....: AIR
Date Sampled....: 12/02/06 Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Particulates (total) 2060	0.50		mg	CFR60A 5	12/15-12/18/06	6349313
	Dilution Factor: 1			MDL.....: 0.50		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN SDA INLET DUCT RUN 3 0.1N H2SO4

General Chemistry

Lot-Sample #....: H6L110106-011 Work Order #....: JK7KV Matrix.....: WATER
Date Sampled....: 12/02/06 Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Nitrogen, as Ammonia 3.3	0.20		mg/L	MCAWW 350.3	12/14/06	6348460
	Dilution Factor: 1			MDL.....: 0.057		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK & SDA INLET RB 0.1N H2SO4 BLANK

General Chemistry

Lot-Sample #....: H6L110106-014 Work Order #....: JK7K1 Matrix.....: WATER
Date Sampled....: 12/01/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Nitrogen, as Ammonia	0.060 B	0.20	mg/L	MCAWW 350.3	12/14/06	6348460
		Dilution Factor: 1		MDL.....: 0.057		

NOTE(S) :

RL Reporting Limit

B Estimated result. Result is less than RL.

METHOD BLANK REPORT

General Chemistry

Client Lot #...: H6L110106

Matrix.....: WATER

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Nitrogen, as Ammonia	ND	Work Order #: JLG661AA		MB Lot-Sample #:	A6L140000-460	
		0.20	mg/L	MCAWW 350.3	12/14/06	6348460
		Dilution Factor: 1				

NOTE (S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

General Chemistry

Client Lot #...: H6L110106

Matrix.....: WATER

<u>PARAMETER</u>	<u>PERCENT RECOVERY</u>	<u>RECOVERY LIMITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Nitrogen, as Ammonia	101	Work Order #: JLG661AC (85 - 114)	LCS Lot-Sample#: A6L140000-460 MCAWW 350.3	12/14/06	6348460
		Dilution Factor: 1			

NOTE (S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE DATA REPORT

General Chemistry

Client Lot #....: H6L110106

Matrix.....: WATER

PARAMETER	SPIKE AMOUNT	MEASURED AMOUNT	UNITS	PERCNT RECVRY	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Nitrogen, as Ammonia	16.3	16.5	mg/L	101	MCAWW 350.3	12/14/06	6348460

Work Order #: JLG661AC LCS Lot-Sample#: A6L140000-460
Dilution Factor: 1

NOTE (S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE EVALUATION REPORT

General Chemistry

Client Lot #...: H6L110106

Matrix.....: WATER

Date Sampled...: 12/13/06

Date Received...: 12/13/06

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Nitrogen, as Ammonia		WO#: JLDNQ1AG-MS/JLDNQ1AH-MSD	MS			Lot-Sample #: A6L130196-001	
	106	(75 - 125)			MCAWW 350.3	12/14/06	6348460
	104	(75 - 125)	1.8	(0-20)	MCAWW 350.3	12/14/06	6348460
		Dilution Factor: 1					

NOTE (S) :

 Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE DATA REPORT

General Chemistry

Client Lot #...: H6L110106

Matrix.....: WATER

Date Sampled...: 12/13/06

Date Received...: 12/13/06

PARAMETER	AMOUNT	AMT	MEASRD AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Nitrogen, as Ammonia	0.21	2.50	2.87	mg/L	106		MCAWW 350.3	12/14/06	6348460
	0.21	2.50	2.82	mg/L	104	1.8	MCAWW 350.3	12/14/06	6348460

WO#: JLDNQ1AG-MS/JLDNQ1AH-MSD MS Lot-Sample #: A6L130196-001

Dilution Factor: 1

NOTE (S) :

 Calculations are performed before rounding to avoid round-off errors in calculated results.

SUPPORTIVE RAW DATA

		50	50	1	579.8875				
		50	50	1	579.8875				
CCV		50	50	1	579.8875	23196%			
CCB		50	50	1	579.8875				
		50	50	1	579.8875				
		50	50	1	579.8875				
		50	50	1	579.8875				
		50	50	1	579.8875				
		50	50	1	579.8875				
		50	50	1	579.8875				
		50	50	1	579.8875				
		50	50	1	579.8875				
		50	50	1	579.8875				
		50	50	1	579.8875				
CCV		50	50	1	579.8875	23196%			
CCB		50	50	1	579.8875				

STL North Canton

Sample Control Chain of Custody for General Chemistry

<u>Lot Number</u>	<u>Sample</u>	<u>Suffix</u>	<u>Lab ID</u>	<u>Test</u>	<u>Prep Date</u>	<u>Prepared by</u>	<u>Analysis Date</u>	<u>Analyzed by</u>
H6L110106	3		JK7J81AA	Nitrogen, Ammonia (ISE - 350.3)	12/14/06	Samantha Scott	12/14/06	Samantha Scott
H6L110106	7		JK7KK1AA	Nitrogen, Ammonia (ISE - 350.3)	12/14/06	Samantha Scott	12/14/06	Samantha Scott
H6L110106	11		JK7KV1AA	Nitrogen, Ammonia (ISE - 350.3)	12/14/06	Samantha Scott	12/14/06	Samantha Scott
H6L110106	14		JK7K11AA	Nitrogen, Ammonia (ISE - 350.3)	12/14/06	Samantha Scott	12/14/06	Samantha Scott

Sample Receipt Documentation

AIR
SAMPLING
ASSOCIATES, INC.

H6L11D106

Chain of Custody Record

Client	ADA-ES	Project No.	06-057	Page	1	of	4	Analysis	
Address	8100 Southpark Way	Unit No.	Hardin SDA Inlet Duct	Lab	STL	Knoxville			
City	Littleton	State	CO	Lab Contact	Terry	Wasmund			
Zip Code	80120	Project Manager	Bill Mullins	Lab Phone No.					
Run No.	1	Test Method	EPA 17/26A / CTM027						
Sample I.D.		Date		Absorbing Solution		No. of Containers		Comments	
Cont. No. 1		11-30-06		---		1		Thimble No. 59	X
Cont. No. 2		11-30-06		---		1		ACE F.W.	X
Cont. No. 3		11-30-06		0.1N H ₂ SO ₄		1		Imps 1:2 + Rinse	X
Cont. No. 4		11-30-06		0.1N NaOH		1		Imps 3:4 + Rinse	X
Rec'd temp. Ambient, No custody Seals									
MFH 12-Gro, 9 Containers Fedex #	696769459203								
	9199								
	9214								
	9133								
	9177								
	9166								
	9188								
	9225								
Special Instructions:	Cont No. 1 & No. 2 retained by ASAI. Split Container No. 3 for IC analysis to determine NH ₃ . HF and HBr are primary analytes for the 26A analysis.								
Turn Around Time Required:	☒ Normal	☐ Rush	Sample Disposal:	☐ Return to ASAI	☒ Disposal By Lab	Archive For	3	Months	
1. Recovered By	Bill Wym	Date	11-30-06	Time	1718	Relinquished By	Bill Wym	Date	12/3/06
2. Received By	Bill Wym	Date	11-30-06	Time	1718	Relinquished By	Bill Wym	Date	12/3/06
3. Received By	Bill Wym	Date	12/3/06	Time	0910	Relinquished By	Bill Wym	Date	12/3/06
Comments:	Man D. Raylance								
	12/3/06 1330								
	12/4/06 0820								
	12/5/06 1400

701011794

Chain of Custody Record

Client	Project No.	Page	of	Analysis			
AQA-ES 800 Southpark Way Littleton CO 80120	06-057	2	4				
Address	Unit No. Hardis SDA Inlet Duct	Lab	STL Knoxville				
City	Project Manager Bill Mullins	Lab Contact	Terry Wassmuel				
Run No. 2	Test Method EPA 17/26A/CTMOZ7	Lab Phone No.					
Sample I.D.	Date	Time	Absorbing Solution	No. of Containers	Comments	Analysis	
Cont. No. 1	12-1-06	1556	-	1	Thimble No. 60	NH ₃	
Cont. No. 2	12-1-06	1558	-	1	ACE F.W.	Halogens	
Cont. No. 3	12-1-06	1540	0.1N H ₂ SO ₄	1	Imps 1:2 + Rinse	X X	
Cont. No. 4	12-1-06	1542	0.1N NaOH	1	Imps 3:4 + Rinse	X X	
Special Instructions: Cont. Nos. 1 and 2 retained by ASAI. Split Cont. No. 3 for IC analysis to determine NH ₃ . HF and HBr are primary analytes for the EPA 26A analysis.							
Turn Around Time Required:		☒ Normal ☐ Rush		Sample Disposal:		☐ Return to ASAI ☒ Disposal By Lab. ☒ Archive For 3 Months	
1. Recovered By Bill Wpy		Date 12-1-06	Time 1558	1. Relinquished By Bill Wpy		Date 12/3/06	Time 0910
2. Received By Billy J. Mullins, Jr.		Date 12/3/06	Time 0910	2. Relinquished By Billy J. Mullins, Jr.		Date 12/3/06	Time 1330
3. Received By Walter D. Raylance		Date 12/3/06	Time 1330	3. Relinquished By Walter D. Raylance		Date 12/4/06	Time 1820
Comments: Found Bred		12/4/06 0830		Found Bred		12/8/06 1400	

P.O. Box 1175 • Lewisville, TX 75067 • Office: (972) 492-1400 • Fax: (972) 492-1402 • Toll-Free: (866) 311-9940

Rec'd By: Matthew Howard. 12-6-06, 09:15

**AIR
SAMPLING
ASSOCIATES, INC.**

H62110106

Chain of Custody Record

Client		Project No.		Page	of	Analysis	
Address		Unit No.	Lab				
City	State	Zip Code	Project Manager	Lab Contact			
Run No.	Sample I.D.	Date	Absorbing Solution	No. of Containers	Comments		
3			EPA 17 / 26A / CTM027				
Cont. 1		12-2-06	0801	1	Thimble No. 61	X	NH ₃
Cont. 2		12-2-06	0807	1	ACE FW.	X	Hydrogen Halide
Cont. 3		12-2-06	0832	1	Imps 1:2 + Rinse	X	X
Cont. 4		12-2-06	0836	1	Imps 3:4 + Rinse	X	X
Special Instructions: Containers No. 1 and 2 retained by ASAI. Split Cont. No. 3 for IC analysis to determine NH ₃ . HF and HBr are primary analytes for the def analysis.							
Turn Around Time Required:	☒ Normal ☐ Rush	Sample Disposal:	☐ Return to ASAI ☒ Disposal By Lab	Archive For	3	Months	
1. Recovered By	Bill Wynn	Date	12-2-06	Time	0836	Relinquished By	Bill Wynn 12/3/06 0910
2. Received By	Bill Wynn	Date	12/3/06	Time	0910	Relinquished By	Bill Wynn 12/3/06 1330
3. Received By	Alan D. Payne	Date	12/3/06	Time	1330	Relinquished By	Alan D. Payne 12/14/06 0820
Comments:	Bill Wynn 12/4/06 0820 Alan D. Payne 12/5/06 1400

AIR
SAMPLING
ASSOCIATES, INC.

1762110106

Chain of Custody Record

Client	Project No.	Unit No.	Project Manager	Test Method	Sample I.D.	Date	Time	Absorbing Solution	No. of Containers	Comments	Page 4 of 4	Analysis
AOA-ES	06-057	Handin Stck & SDA Inlet	Bill Mullins	EPA 17/26A/OTM027								
Address	8100 Southpark Way	State	CO	Zip Code	80120							
City	Littleton											
Run No.	Reagent Blanks											
Sample No.	Cont. No. 6	"	12-1-06	1553	—	1		0.1N H ₂ SO ₄ Blank				Part. N ₂ H ₃
	Cont. No. 7	"	12-1-06	1551	—	1		0.1N NaOH Blank				X
	Cont. No. 8		12-1-06	1549	—	1		D.I. Water Blank				X
	Cont. No. 9		12-1-06	1547	—	1		ACE Blank				X
Special Instructions: Split Cont. No. 6 for IC analysis to determine NH ₃ , HF and HBR and are the primary analytes for EPA 26A. Cont. No. 9 retained by ASAI.												
Turn Around Time Required:	☒ Normal	☐ Rush	Sample Disposal:	Date	Time	1. Relinquished By	2. Relinquished By	3. Relinquished By	Disposal By Lab	Archive For	3	Months
1. Received By	Bill Wpy	12-1-06	1553	12-1-06	1553	Bill Wpy	Bill Wpy	Bill Wpy	12/3/06	0910		
2. Received By	Bill Wpy	12/3/06	0910	12/3/06	0910	Bill Wpy	Bill Wpy	Bill Wpy	12/3/06	1330		
3. Received By	Alan D. Roylance	12/3/06	1330	12/3/06	1330	Alan D. Roylance	Alan D. Roylance	Alan D. Roylance	12/4/06	0820		
Comments	12/4/06 0820 12/5/06 1400											

P.O. Box 1175 • Lewisville, TX 75067 • Office: (972) 492-1400 • Fax: (972) 492-1402 • Toll-Free: (866) 311-9940

Redd BY: Matthew Howard, 12-6-06, 0915

STL KNOXVILLE SAMPLE RECEIPT/CONDITION UPON RECEIPT ANOMALY CHECKLIST

Client: AirSampling Associates Project: _____

Lot Number: 116L11101016

Review Items	Yes	No	NA	If No, what was the problem?	Comments/Actions Taken
1. Do sample container labels match COC? (IDs, Dates, Times)				☐ 1a Do not match COC ☐ 1b Incomplete information ☐ 1c Marking smeared ☐ 1d Label torn ☐ 1e No label ☐ 1f COC not received ☒ 1g Other:	<u>4a</u> <u>1g Cont. No. 2 was peiced, The CoC says that Cont. 1 and 2 were retained by ASAI.</u>
2. Is the cooler temperature within limits? (> freezing temp. of water to 6°C; NC, 1668, 1613B: 0-4°C; VOST: 10°C; MA: 2-6°C)			☒	☐ 2a Temp Blank = _____ ☐ 2b Cooler Temp = _____ ☐ 3a Sample preservative = _____	
3. Were samples received with correct chemical preservative (excluding Encore)?	☒			☒ 4a Not present ☐ 4b Not intact ☐ 4c Other:	
4. Were custody seals present/intact on cooler and/or containers?		☒		☐ 5a Samples received-not on COC ☐ 5b Samples not received-on COC ☐ 6a Leaking ☐ 6b Broken ☐ 7a Headspace (VOA only) ☐ 8a Improper container ☐ 9a Could not be determined due to matrix interference ☐ 10a Holding time expired ☐ Incomplete information If yes & appears to be > 1%, was SOG notified?	
5. Were all of the samples listed on the COC received?	☒			☐ 13a Leaking ☐ 13b Other:	
6. Were all of the sample containers received intact?	☒			☐ 14a Not relinquished ☐ 15a Incomplete information ☐ 15b Incomplete information ☐ 15c Incomplete information ☐ 15d Incomplete information	
7. Were VOA samples received without headspace?		☒			
8. Were samples received in appropriate containers?	☒				
9. Did you check for residual chlorine, if necessary?		☒			
10. Were samples received within holding time?	☒				
11. For rad samples, was sample activity info. provided?			☒		
12. For SOG water samples (1613B, 1668A, 8290, LR PAHs), do samples have visible solids present?			☒		
13. Are the shipping containers intact?	☒				
14. Was COC relinquished? (Signed/Dated/Timed)	☒				
15. Are tests/parameters listed for each sample?	☒				
16. Is the matrix of the samples noted?	☒				
17. Is the date/time of sample collection noted?	☒				
18. Is the client and project name/# identified?	☒				
19. Was the sampler identified on the COC?	☒				
Quote #:	PM Instructions:				

Sample Receiving Associate: Matthew Howard Date: 12-6-06

Severn Trent Laboratories, Inc
SAMPLE ANALYSIS REQUISITION

LABORATORY: STL N Canton
4101 Shuffel Drive NW
North Canton

NEED ANALYTICAL REPORT BY
12/25/06

OH 44720,

ATTN:

C3

12-12-06

LAB PURCHASE ORDER: SR087884

CLIENT CODE: 1353236 PROJECT MANAGER: Terry Wasmund

NUMBER OF SAMPLES IN LOT: 0000

1 Qm
12/19

SAMPLE I.D.	SAMPLING DATE	ANALYSIS REQUIRED
H6L110106-003 JK7J8-1-AA	11/30/06	Nitrogen, Ammonia (ISE - 350.3) (NH3) METHOD: 350.3
H6L110106-007 JK7KK-1-AA	12/01/06	Nitrogen, Ammonia (ISE - 350.3) (NH3) METHOD: 350.3
H6L110106-011 JK7KV-1-AA	12/02/06	Nitrogen, Ammonia (ISE - 350.3) (NH3) METHOD: 350.3
H6L110106-014 JK7K1-1-AA	12/01/06	Nitrogen, Ammonia (ISE - 350.3) (NH3) METHOD: 350.3

NEED DETECTION LIMIT AND ANALYSIS DATE INCLUDED IN REPORT.

SHIPPING METHOD: FEDX

DATE: 12/11/06

SEND REPORT TO: TERRY WASMUND

SAMPLE RECEIVED BY: _____ DATE: _____

PLEASE SEND A SIGNED COPY OF THIS FORM WITH REPORT AT COMPLETION OF ANALYSIS.

THANK YOU.

STL Knoxville

INT: _____

12/11/06 9:22:52

STL N Canton
4101 Shuffel Drive NW
North Canton

OH 44720,

RELINQUISHED BY: Bryan Damm

DATE/TIME: 12-11-06 14:00

RELINQUISHED BY: _____

DATE/TIME: _____

RECEIVED FOR LAB BY: [Signature]

DATE/TIME: 12-12-06 10:15

PLEASE RETURN ORIGINAL SAMPLE ANALYSIS REQUISITION

STL Cooler Receipt Form/Narrative

Lot Number: H6L110006

North Canton Facility

Client: STL Knoxville Project: _____ Quote#: _____
 Cooler Received on: 12-12-06 Opened on: 12-12-06 by: [Signature] (Signature)
 Fedx ☒ Client Drop Off ☐ UPS ☐ DHL ☐ FAS ☐ STL Courier ☐
 Stetson ☐ US Cargo ☐ Other: _____
 STL Cooler No# _____ Foam Box ☐ Client Cooler ☒ Other _____

1. Were custody seals on the outside of the cooler? Yes ☒ No ☐ Intact? Yes ☒ No ☐ NA ☐
 If YES, Quantity 2
 Were the custody seals signed and dated? Yes ☒ No ☐ NA ☐
 2. Shipper's packing slip attached to this form? Yes ☒ No ☐ NA ☐
 3. Did custody papers accompany the samples? Yes ☒ No ☐ Relinquished by client? Yes ☒ No ☐
 4. Did you sign the custody papers in the appropriate place? Yes ☒ No ☐
 5. Packing material used: Bubble Wrap ☒ Foam ☐ None ☐ Other: _____
 6. Cooler temperature upon receipt 18.1 °C (see back of form for multiple coolers/temp)
 METHOD: Temp Vial ☐ Coolant & Sample ☐ Against Bottles ☐ IR ☒ ICE/H₂O Slurry ☐
 COOLANT: Wet Ice ☒ Blue Ice ☐ Dry Ice ☐ Water ☐ None ☒
 7. Did all bottles arrive in good condition (Unbroken)? Yes ☒ No ☐
 8. Could all bottle labels and/or tags be reconciled with the COC? Yes ☒ No ☐ NA ☒
 9. Were samples at the correct pH upon receipt? Yes ☒ No ☐ NA ☒
 10. Were correct bottles used for the tests indicated? Yes ☒ No ☐ NA ☒
 11. Were air bubbles >6 mm in any VOA vials? Yes ☒ No ☐
 12. Sufficient quantity received to perform indicated analyses? Yes ☒ No ☐
 13. Was a Trip Blank present in the cooler? Yes ☐ No ☒ Were VOAs on the COC? Yes ☐ No ☒
 Contacted PM LDE Date: 12-12-06 by: LH via Voice Mail ☐ Verbal ☒ Other ☐
 Concerning: #1

1. CHAIN OF CUSTODY

The following discrepancies occurred:

High temp no Ice in cooler

2. SAMPLE CONDITION

Sample(s) _____ were received after the recommended holding time had expired.
 Sample(s) _____ were received in a broken container.

3. SAMPLE PRESERVATION

Sample(s) _____ were further preserved in sample receiving to meet recommended pH level(s). Nitric Acid Lot # 092006 - Sulfuric Acid Lot # 071805-H₂SO₄; Sodium Hydroxide Lot # -122805 -NaOH; Hydrochloric Acid Lot # 100504-HCl; Sodium Hydroxide and Zinc Acetate Lot # 071604-CH₃COO₂ZN/NaOH

Sample(s) _____ were received with bubble > 6 mm in diameter (cc: PM)

4. Other (see below or back)

Client ID	pH	Date	Initials

Appendix G:

EPA Conditional Test Methods 5 and 26A (Particulate Matter and Hydrogen Halides & Halogens) Analytical Data – Stack

Air Sampling Associates, Inc.

Particulate Analysis Summary

Project Number: 06-057

Date Analysis Completed: 12/12/06

Project Name: ADA-ES

Unit Tested: Stack

Project Location: Hardin, MT

EPA Method 26 A

Run Number:

1 2 3

Particulate Matter on Filter (mg):

10.6 15.4 14.0

Particulate Matter in Front Wash (mg):

13.2 9.7 9.7

Total Particulate Matter in "Front-Half" – MF (mg):

23.8 25.1 23.7

Particulate Matter in "Back-Half" (mg):

— — —

Total Particulate Matter in Sample – MT (mg):

— — —

Billy J. Mallen, Jr.
Analyst

Bill Hym Date: 1-17-07
Data Checked By

Particulate Analysis EPA Method 26A
Stack Filters

Project No. 06-057
Project Name ADA-ES

Location Hardin, MT
Unit Tested Stack

Desiccator Time In	<u>12/05/06 1530</u>	<u>12/07/06 0855</u>			
Desiccator Time Out	<u>12/04/06 0855</u>	<u>12/07/06 1505</u>			

Run No.	<u>1</u>	Filter No.	<u>A092</u>	Sample I.D.	
Filter & Particulate (g)	<u>0.3573</u>	<u>0.3573</u>	✓		

Filter & Particulate Average (g) 0.3573
Initial Filter Weight (g) 0.3467
Total Particulate (mg) 10.6

Run No.	<u>2</u>	Filter No.	<u>A112</u>	Sample I.D.	
Filter & Particulate (g)	<u>0.3989</u>	<u>0.3986</u>	✓		

Filter & Particulate Average (g) 0.3986
Initial Filter Weight (g) 0.3832
Total Particulate (mg) 15.4

Run No.	<u>3</u>	Filter No.	<u>A113</u>	Sample I.D.	
Filter & Particulate (g)	<u>0.3917</u>	<u>0.3918</u>	✓		

Filter & Particulate Average (g) 0.3918
Initial Filter Weight (g) 0.3778
Total Particulate (mg) 14.0

Billy J. Mullins, Jr.
Analyst

**Filter Weight Log
EPA Method 5**

Filter No.	Into Desicator	Weight	Weight	Weight	Weight	Weight	Weight Used
	Date	Date	Date	Date	Date	Date	
	Time	Time	Time	Time	Time	Time	
A091		0.3484	0.3484				0.3484
	8/25/06	9/20/06	9/21/06				
	0900	1400	1410				
A092		0.3462	0.3462				0.3462
	8/25/06	9/20/06	9/21/06				
	0900	1400	1410				
A093	10	0.3457	0.3455				0.3455
	8/22/06	9/21/06	10/3/06				
	0800	0830	1615				
A094		0.3514	0.3514				0.3514
		10/3/06	10/2/06				
		0831	1617				
A095		0.3522	0.3519				0.3519
		10/3/06	10/3/06				
		0832	1619				
A096		0.3653	0.3652				0.3652
		10/3/06	10/3/06				
		0833	1620				
A097		0.3622	0.3619				0.3619
		10/3/06	10/3/06				
		0834	1620				
A098		0.3637	0.3636				0.3636
		10/3/06	10/3/06				
		0835	1621				
A099		0.3695	0.3694				0.3694
		10/3/06	10/3/06				
		0836	1622				
A100		0.3691	0.3691				0.3691
		10/3/06	10/3/06				
		0837	1623				
A101		0.3745	0.3745				0.3745
		10/3/06	10/3/06				
		0838	1624				
A102		0.3789	0.3789				0.3789
		10/3/06	10/3/06				
		0839	1625				
A103		0.3801	0.3802				0.3802
		10/3/06	10/3/06				
		0840	1626				
A104		0.3836	0.3837				0.3837
		10/3/06	10/3/06				
		0841	1626				

**Filter Weight Log
EPA Method 5**

Filter No.	Into Desicator	Weight	Weight	Weight	Weight	Weight	Weight Used
	Date	Date	Date	Date	Date	Date	
	Time	Time	Time	Time	Time	Time	
A105		0.3801	0.3801				0.3801
	10/2/06	10/12/06	10/13/06				
	0800	1000	0826				
A106		0.3827	0.3825				0.3825
	10/2/06	10/12/06	10/13/06				
	0820	1001	0827				
A107		0.3808	0.3810				0.3810
	10/2/06	10/12/06	10/13/06				
	0800	1002	0828				
A108		0.3843	0.3845				0.3845
	10/2/06	10/12/06	10/13/06				
	0800	1003	0829				
A109		0.3872	0.3873				0.3873
	10/2/06	10/12/06	10/13/06				
	0800	1004	0830				
A110		0.3885	0.3886				0.3886
	10/2/06	10/12/06	10/13/06				
	0800	1005	0831				
A112		0.3883	0.3882				0.3882
	10/2/06	10/12/06	10/13/06				
	0800	1006	0832				
A113		0.3781	0.3778				0.3778
	10/2/06	10/12/06	10/13/06				
	0800	1007	0833				
A114		0.3814	0.3812				0.3812
	10/2/06	10/12/06	10/13/06				
	0800	1008	0834				
A115		0.3701	0.3700				0.3700
	10/2/06	10/12/06	10/13/06				
	0800	1009	0835				
A116		0.3678	0.3679				0.3679
	10/2/06	10/12/06	10/13/06				
	0800	1010	0836				
A117		0.3644	0.3644				0.3644
	10/2/06	10/12/06	10/13/06				
	0800	1011	0837				
A118		0.3636	0.3635				0.3635
	10/2/06	11/20/06	11/21/06				
	0800	1245	0807				
A119		0.3655	0.3655				0.3655
	10/2/06	11/20/06	11/21/06				
	0800	1246	0808				
A120		0.3616	0.3615				0.3615
	10/2/06	11/20/06	11/21/06				
	0800	1247	0809				

Particulate Analysis EPA Method 26A
Front Wash

Project No. 06-057 Location Hardin, MT
Project Name ADA-ES Unit Tested Stack

Desiccator Time In	<u>12/08/06 1650</u>	<u>12/11/06 0820</u>	<u>12/12/06 820</u>		
Desiccator Time Out	<u>12/11/06 0817</u>	<u>12/12/06 0815</u>	<u>12/12/06 1530</u>		

Run No.	<u>1</u>	Volume (ml)	<u>140</u>	Sample I.D.	
Final Weight (g)	<u>106.6097</u>	<u>106.6048</u>	<u>106.6046</u> ✓		
Initial Weight (g)	<u>106.5904</u>	<u>106.5904</u>	<u>106.5904</u>		
Particulate Weight (g)					

Particulate Average (mg) 14.2
Less Acetone Blank (mg) 1.0
Total Particulate (mg) 13.2

Run No.	<u>2</u>	Volume (ml)	<u>150</u>	Sample I.D.	
Final Weight (g)	<u>104.0611</u>	<u>104.0568</u>	<u>104.0563</u> ✓		
Initial Weight (g)	<u>104.0455</u>	<u>104.0455</u>	<u>104.0455</u>		
Particulate Weight (g)					

Particulate Average (mg) 10.8
Less Acetone Blank (mg) 1.1
Total Particulate (mg) 9.7

Run No.	<u>3</u>	Volume (ml)	<u>105</u>	Sample I.D.	
Final Weight (g)	<u>91.1131</u>	<u>91.1093</u>	<u>91.1097</u> ✓		
Initial Weight (g)	<u>91.0992</u>	<u>91.0992</u>	<u>91.0992</u>		
Particulate Weight (g)					

Particulate Average (mg) 10.5
Less Acetone Blank (mg) 0.8
Total Particulate (mg) 9.7

Acetone Blank		Volume (ml)	<u>200</u>	Sample I.D.	
Final Weight (g)	<u>104.8397</u>	<u>104.8349</u>	<u>104.8349</u> ✓		
Initial Weight (g)	<u>104.8334</u>	<u>104.8334</u>	<u>104.8334</u>		
Particulate Weight (g)					

Average (mg) 1.5
* mg/l 7.5

* Note: if greater than 7.9 mg/l, use 7.9 mg/l

Billy J. Mullin Jr. Date: 12/12/06
Analyst

**AIR
SAMPLING
ASSOCIATES, INC.**

Particulate Analysis EPA Method 26A

Front Half Tare Weights

Project No. 06-057
Project Name ADA-ES

Location Hardin, MT
Unit Tested Stack

Desiccator Time In	12/05/06 1530	12/06/06 1645	12/07/06 0840	12/07/06 1515	
Desiccator Time Out	12/06/06 1640	12/07/06 0840	12/07/06 1515	12/08/06 0815	

Run No.	1			Sample I.D.
Weight (g)	106.5926	106.5913	106.5900	106.5904 ✓

Run No.	2			Sample I.D.
Weight (g)	104.0453	104.0455 ✓		

Run No.	3			Sample I.D.
Weight (g)	91.0995	91.0992 ✓		

Acetone Blank				Sample I.D.
Weight (g)	104.8332	104.8334 ✓		

Billy J. Mullins, Jr.
Analyst

H6L110105 Analytical Report.....	1
Sample Receipt Documentation	21
Wet Chemistry	26
Sample Summary	27
QC Summary	34
Raw Data	42
Sample Receipt Documentation	152
Total Number of Pages	156

STL

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ANALYTICAL REPORT

PROJECT NO. 06-057

Hardin, Montana Hardin Stack

Lot #: H6L110105

Bill Hefley

Air Sampling Associates, Inc.
407-2B Holford's Prairie Road
Lewisville, TX 75056

SEVERN TRENT LABORATORIES, INC.

A handwritten signature in cursive script, appearing to read "Terry Wasmund".

Terry Wasmund
Project Manager

January 2, 2007

ANALYTICAL METHODS SUMMARY

H6L110105

<u>PARAMETER</u>	<u>ANALYTICAL METHOD</u>
Bromine Emissions	KNOX 0050/26A Mod
Chlorine Emissions	KNOX 0050/26A Mod
Hydrogen Bromide Emissions	KNOX 0050/26A Mod
Hydrogen Chloride Emissions	KNOX 0050/26A Mod
Hydrogen Fluoride Emissions	KNOX 0050/26A Mod

References:

KNOX Severn Trent Laboratories Knoxville, Facility Standard
 Operating Procedure.

QC DATA ASSOCIATION SUMMARY

H6L110105

Sample Preparation and Analysis Control Numbers

<u>SAMPLE#</u>	<u>MATRIX</u>	<u>ANALYTICAL METHOD</u>	<u>LEACH BATCH #</u>	<u>PREP BATCH #</u>	<u>MS RUN#</u>
001	AIR	KNOX 0050/26A Mod		6361375	6362028
	AIR	KNOX 0050/26A Mod		6363098	6363067
	AIR	KNOX 0050/26A Mod		6361376	6362030
002	AIR	KNOX 0050/26A Mod		6354402	6354235
	AIR	KNOX 0050/26A Mod		6354401	6354234
	AIR	KNOX 0050/26A Mod		6354400	6354230
003	AIR	KNOX 0050/26A Mod		6361375	6363101
	AIR	KNOX 0050/26A Mod		6363147	
	AIR	KNOX 0050/26A Mod		6361376	
004	AIR	KNOX 0050/26A Mod		6354402	
	AIR	KNOX 0050/26A Mod		6354401	
	AIR	KNOX 0050/26A Mod		6354400	
005	AIR	KNOX 0050/26A Mod		6361375	
	AIR	KNOX 0050/26A Mod		6363147	
	AIR	KNOX 0050/26A Mod		6361376	
006	AIR	KNOX 0050/26A Mod		6354402	
	AIR	KNOX 0050/26A Mod		6354401	
	AIR	KNOX 0050/26A Mod		6354400	

SAMPLE SUMMARY

H6L110105

WO #	SAMPLE#	CLIENT SAMPLE ID	SAMPLED DATE	SAMP TIME
JK7JR	001	HARDIN STACK RUN 1 0.1N H2SO4	11/30/06	19:28
JK7JW	002	HARDIN STACK RUN 1 0.1N NAOH	11/30/06	19:24
JK7JX	003	HARDIN STACK RUN 2 0.1N H2SO4	12/01/06	18:23
JK7J0	004	HARDIN STACK RUN 2 0.1N NAOH	12/01/06	18:19
JK7J1	005	HARDIN STACK RUN 3 0.1N H2SO4	12/02/06	22:35
JK7J2	006	HARDIN STACK RUN 3 0.1N NAOH	12/02/06	22:26

NOTE(S) :

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filter test, pH, porosity pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight.

PROJECT NARRATIVE

H6L110105

The results reported herein are applicable to the samples submitted for analysis only.

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The original chain of custody documentation is included with this report.

Sample Receipt

Custody seals were not present upon sample receipt at STL Knoxville.

Quality Control and Data Interpretation

Unless otherwise noted, all holding times and QC criteria were met and the test results shown in this report meet all applicable NELAC requirements.

Samples were analyzed for chloride (Cl^-), fluoride (F^-) and bromide (Br^-) by ion chromatography using SOP number KNOX-WC-005 (based on EPA methods 9056, 9057 and 26A). Results for the H_2SO_4 impinger samples were reported as total μg hydrogen chloride (HCl), total μg hydrogen fluoride (HF) and total μg hydrogen bromide (HBr). Results for the NaOH impinger samples were reported as total μg chlorine (Cl_2), total μg hydrogen fluoride (HF) and total μg hydrogen bromine (Br_2).

Please note that the halogen fluorine (F) is not expected to be present in stack gas as diatomic fluorine (F_2). Fluorine reacts with water vapor in a favored reaction that forms HF : $2\text{F}_2 + 2\text{H}_2\text{O} \rightarrow 4\text{HF} + \text{O}_2$. Therefore, the results from the H_2SO_4 impingers and the NaOH impingers are reported as HF , and no F_2 is expected in the samples.

Results were calculated using the following equations:

$$\text{HX, ug} = (\text{X}^-, \text{ug} / \text{mL}) * (\text{Sample Volume, mL}) * \left(\frac{\text{Molecular Weight HX}}{\text{Molecular Weight X}^-} \right) * (\text{Bench Dilution})$$

STL Knoxville maintains the following certifications, approvals and accreditations: Arkansas DEQ Cert. #05-043-0, California DHS ELAP Cert. #2423, Colorado DPHE, Connecticut DPH Cert. #PH-0223, Florida DOH Cert. #E87177, Georgia DNR Cert. #906, Hawaii DOH, Illinois EPA Cert. #000687, Indiana DOH Cert. #C-TN-02, Iowa DNR Cert. #375, Kansas DHE Cert. #E-10349, Kentucky DEP Lab ID #90101, Louisiana DEQ Cert. #03079, Louisiana DOHH Cert. #LA030024, Maryland DHMH Cert. #277, Massachusetts DEP Cert. #M-TN009, Michigan DEQ Lab ID #9933, New Jersey DEP Cert. #TN001, New York DOH Lab #10781, North Carolina DPH Lab ID #21705, North Carolina DEHNR Cert. #64, Ohio EPA VAP Cert. #CL0059, Oklahoma DEQ ID #9415, Pennsylvania DEP Cert. #68-00576, South Carolina DHEC Lab ID #84001001, Tennessee DOH Lab ID #02014, Utah DOH Cert. # QUAN3, Virginia DGS Lab ID #00165, Washington DOE Lab #C120, West Virginia DEP Cert. #345, Wisconsin DNR Lab ID #998044300, Naval Facilities Engineering Service Center and USDA Soil Permit #S-46424. This list of approvals is subject to change and does not imply that laboratory certification is available for all parameters reported in this environmental sample data report.

PROJECT NARRATIVE

H6L110105

$$\text{Cl}_2, \text{Br}_2 \text{ ug} = (\text{X}^-, \text{ ug / mL}) * (\text{Sample Volume, mL}) * (\text{Bench Dilution})$$

NaOH impinger samples were treated with sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$) prior to the final analysis in order to convert residual hypochlorite (OCl^-) to chloride ion. The presence of hypobromite is also assumed to be converted to bromide under these conditions.

Note: A sample volume of 100 mL was used to convert the results to total μg for the method blanks, laboratory control samples, and client reagent blanks.

For demonstration of analytical method performance on these samples, STL Knoxville analyzed matrix spikes (MS) and matrix spike duplicates (MSD). Acceptable recoveries of these spikes demonstrate that quantitation from this particular stack gas matrix is accurate and acceptable. Impinger samples containing 0.1N H_2SO_4 and 0.1N NaOH display matrix interference effects causing poor method performance and possibly giving unreliable data unless the interference is removed. Therefore, the samples were diluted in the lab to remove the interference for a more accurate chloride response. The samples may be analyzed at increasing dilutions along with matrix spikes until matrix spikes recover from the sample within laboratory control limits. The ion chromatograph calibration range used to quantitate the sample results permits a standard ten-fold sample dilution while supporting the reporting limit with the low calibration standard.

The dilution factor reported on the sample result form does not represent the bench dilution factor. It is actually the combination of factors required by the method to convert the anion reporting limit and method detection limit from $\mu\text{g/mL}$ to total μg . It may appear to be elevated because it includes the total sample volume in mL.

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Sample Data Summary

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 1 0.1N H2SO4

General Chemistry

Lot-Sample #...: H6L110105-001 Work Order #...: JK7JR Matrix.....: AIR
 Date Sampled...: 11/30/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Hydrogen bromide	ND	486	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 4860.55		MDL.....: 243		
Hydrogen chloride	ND	987	ug	KNOX 0050/26A Mod	12/18/06	6363098
		Dilution Factor: 9872.92		MDL.....: 415		
Hydrogen fluoride	ND	505	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 5054.65		MDL.....: 253		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 1 0.1N NAOH

General Chemistry

Lot-Sample #...: H6L110105-002

Work Order #...: JK7JW

Matrix.....: AIR

Date Sampled...: 11/30/06

Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	240	ug	KNOX 0050/26A Mod	12/18/06	6354402
		Dilution Factor: 2400		MDL.....: 57.6		
Chlorine	440	240	ug	KNOX 0050/26A Mod	12/18/06	6354401
		Dilution Factor: 2400		MDL.....: 101		
Hydrogen fluoride	ND	253	ug	KNOX 0050/26A Mod	12/18/06	6354400
		Dilution Factor: 2527.32		MDL.....: 126		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 2 0.1N H2SO4

General Chemistry

Lot-Sample #...: H6L110105-003

Work Order #...: JK7JX

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>RL</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Hydrogen bromide	ND	471	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 4708.65		MDL.....: 235		
Hydrogen chloride	ND	1910	ug	KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 19128.78		MDL.....: 803		
Hydrogen fluoride	ND	490	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 4896.69		MDL.....: 245		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 2 0.1N NAOH

General Chemistry

Lot-Sample #...: H6L110105-004 Work Order #...: JK7J0 Matrix.....: AIR
 Date Sampled...: 12/01/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	250	ug	KNOX 0050/26A Mod	12/18/06	6354402
		Dilution Factor: 2500		MDL.....: 60.0		
Chlorine	480	250	ug	KNOX 0050/26A Mod	12/18/06	6354401
		Dilution Factor: 2500		MDL.....: 105		
Hydrogen fluoride	ND	263	ug	KNOX 0050/26A Mod	12/18/06	6354400
		Dilution Factor: 2632.63		MDL.....: 132		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 3 0.1N H2SO4

General Chemistry

Lot-Sample #...: H6L110105-005

Work Order #...: JK7J1

Matrix.....: AIR

Date Sampled...: 12/02/06

Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Hydrogen bromide	ND	608	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 6075.68		MDL.....: 304		
Hydrogen chloride	ND	2470	ug	KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 24682.3		MDL.....: 1040		
Hydrogen fluoride	ND	632	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 6318.31		MDL.....: 316		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 3 0.1N NAOH

General Chemistry

Lot-Sample #...: H6L110105-006 Work Order #...: JK7J2 Matrix.....: AIR
 Date Sampled...: 12/02/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	270	ug	KNOX 0050/26A Mod	12/18/06	6354402
		Dilution Factor: 2700		MDL.....: 64.8		
Chlorine	483	270	ug	KNOX 0050/26A Mod	12/18/06	6354401
		Dilution Factor: 2700		MDL.....: 113		
Hydrogen fluoride	ND	284	ug	KNOX 0050/26A Mod	12/18/06	6354400
		Dilution Factor: 2843.24		MDL.....: 142		

METHOD BLANK REPORT

General Chemistry

Client Lot #...: H6L110105

Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	Work Order #: JLWCC1AA 10.0	ug	MB Lot-Sample #: H6L200000-402 KNOX 0050/26A Mod 12/18/06		6354402
		Dilution Factor: 100				
Chlorine	ND	Work Order #: JLWAA1AA 10.0	ug	MB Lot-Sample #: H6L200000-401 KNOX 0050/26A Mod 12/18/06		6354401
		Dilution Factor: 100				
Hydrogen bromide	ND	Work Order #: JL69F1AA 10.1	ug	MB Lot-Sample #: H6L270000-375 KNOX 0050/26A Mod 12/18/06		6361375
		Dilution Factor: 101.2				
Hydrogen chloride	ND	Work Order #: JL8TM1AA 10.3	ug	MB Lot-Sample #: H6L290000-098 KNOX 0050/26A Mod 12/18/06		6363098
		Dilution Factor: 102.8				
Hydrogen chloride	ND	Work Order #: JL9AA1AA 10.3	ug	MB Lot-Sample #: H6L290000-147 KNOX 0050/26A Mod 12/28/06		6363147
		Dilution Factor: 102.8				
Hydrogen fluoride	ND	Work Order #: JLV9M1AA 10.5	ug	MB Lot-Sample #: H6L200000-400 KNOX 0050/26A Mod 12/18/06		6354400
		Dilution Factor: 105.3				
Hydrogen fluoride	ND	Work Order #: JL69G1AA 10.5	ug	MB Lot-Sample #: H6L270000-376 KNOX 0050/26A Mod 12/18/06		6361376
		Dilution Factor: 105.3				

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

General Chemistry

Lot-Sample #...: H6L110105

Matrix.....: AIR

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD LIMITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine		WO#:JLWCC1AC-LCS/JLWCC1AD-LCSD LCS Lot-Sample#: H6L200000-402				
	101	(90 - 110)		KNOX 0050/26A Mod	12/18/06	6354402
	101	(90 - 110)	0.63 (0-20)	KNOX 0050/26A Mod	12/18/06	6354402
		Dilution Factor: 100				
Chlorine		WO#:JLWAA1AC-LCS/JLWAA1AD-LCSD LCS Lot-Sample#: H6L200000-401				
	101	(90 - 110)		KNOX 0050/26A Mod	12/18/06	6354401
	101	(90 - 110)	0.22 (0-20)	KNOX 0050/26A Mod	12/18/06	6354401
		Dilution Factor: 100				
Hydrogen bromide		WO#:JL69F1AC-LCS/JL69F1AD-LCSD LCS Lot-Sample#: H6L270000-375				
	96	(90 - 110)		KNOX 0050/26A Mod	12/18/06	6361375
	99	(90 - 110)	2.6 (0-20)	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 101.2				
Hydrogen chloride		WO#:JL8TM1AC-LCS/JL8TM1AD-LCSD LCS Lot-Sample#: H6L290000-098				
	100	(90 - 110)		KNOX 0050/26A Mod	12/18/06	6363098
	101	(90 - 110)	1.2 (0-20)	KNOX 0050/26A Mod	12/18/06	6363098
		Dilution Factor: 102.8				
Hydrogen chloride		WO#:JL9AA1AC-LCS/JL9AA1AD-LCSD LCS Lot-Sample#: H6L290000-147				
	100	(90 - 110)		KNOX 0050/26A Mod	12/28/06	6363147
	101	(90 - 110)	0.82 (0-20)	KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 102.8				
Hydrogen fluoride		WO#:JLV9M1AC-LCS/JLV9M1AD-LCSD LCS Lot-Sample#: H6L200000-400				
	101	(90 - 110)		KNOX 0050/26A Mod	12/18/06	6354400
	101	(90 - 110)	0.06 (0-20)	KNOX 0050/26A Mod	12/18/06	6354400
		Dilution Factor: 105.3				
Hydrogen fluoride		WO#:JL69G1AC-LCS/JL69G1AD-LCSD LCS Lot-Sample#: H6L270000-376				
	100	(90 - 110)		KNOX 0050/26A Mod	12/18/06	6361376
	100	(90 - 110)	0.51 (0-20)	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 105.3				

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE DATA REPORT

General Chemistry

Lot-Sample #...: H6L110105

Matrix.....: AIR

PARAMETER	SPIKE AMOUNT	MEASURED AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine								
						WO#:JLWCC1AC-LCS/JLWCC1AD-LCSD LCS Lot-Sample#:	H6L200000-402	
	75.0	75.6	ug	101		KNOX 0050/26A Mod	12/18/06	6354402
	75.0	76.0	ug	101	0.63	KNOX 0050/26A Mod	12/18/06	6354402
						Dilution Factor: 100		
Chlorine								
						WO#:JLWAA1AC-LCS/JLWAA1AD-LCSD LCS Lot-Sample#:	H6L200000-401	
	75.0	75.8	ug	101		KNOX 0050/26A Mod	12/18/06	6354401
	75.0	76.0	ug	101	0.22	KNOX 0050/26A Mod	12/18/06	6354401
						Dilution Factor: 100		
Hydrogen bromide								
						WO#:JL69F1AC-LCS/JL69F1AD-LCSD LCS Lot-Sample#:	H6L270000-375	
	76.0	73.1	ug	96		KNOX 0050/26A Mod	12/18/06	6361375
	76.0	75.0	ug	99	2.6	KNOX 0050/26A Mod	12/18/06	6361375
						Dilution Factor: 101.2		
Hydrogen chloride								
						WO#:JL8TM1AC-LCS/JL8TM1AD-LCSD LCS Lot-Sample#:	H6L290000-098	
	77.1	77.2	ug	100		KNOX 0050/26A Mod	12/18/06	6363098
	77.1	78.1	ug	101	1.2	KNOX 0050/26A Mod	12/18/06	6363098
						Dilution Factor: 102.8		
Hydrogen chloride								
						WO#:JL9AA1AC-LCS/JL9AA1AD-LCSD LCS Lot-Sample#:	H6L290000-147	
	77.1	77.1	ug	100		KNOX 0050/26A Mod	12/28/06	6363147
	77.1	77.8	ug	101	0.82	KNOX 0050/26A Mod	12/28/06	6363147
						Dilution Factor: 102.8		
Hydrogen fluoride								
						WO#:JLV9M1AC-LCS/JLV9M1AD-LCSD LCS Lot-Sample#:	H6L200000-400	
	79.0	79.4	ug	101		KNOX 0050/26A Mod	12/18/06	6354400
	79.0	79.5	ug	101	0.06	KNOX 0050/26A Mod	12/18/06	6354400
						Dilution Factor: 105.3		
Hydrogen fluoride								
						WO#:JL69G1AC-LCS/JL69G1AD-LCSD LCS Lot-Sample#:	H6L270000-376	
	79.0	78.8	ug	100		KNOX 0050/26A Mod	12/18/06	6361376
	79.0	79.2	ug	100	0.51	KNOX 0050/26A Mod	12/18/06	6361376
						Dilution Factor: 105.3		

NOTE (S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE EVALUATION REPORT

General Chemistry

Client Lot #...: H6L110105

Matrix.....: AIR

Date Sampled...: 11/30/06

Date Received...: 12/06/06

<u>PARAMETER</u>	<u>PERCENT RECOVERY</u>	<u>RECOVERY LIMITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Hydrogen chloride	105	Work Order #...: JK7JR1AJ (75 - 125)	KNOX 0050/26A Mod	MS Lot-Sample #: H6L110105-001 12/18/06	6363098
		Dilution Factor: 9872.			

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE DATA REPORT

General Chemistry

Client Lot #...: H6L110105

Matrix.....: AIR

Date Sampled...: 11/30/06

Date Received...: 12/06/06

PARAMETER	SAMPLE AMOUNT	SPIKE AMT	MEASURED AMOUNT	UNITS	PERCENT RECOVERY	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Hydrogen chloride	ND	1970	2070	ug	105	KNOX 0050/26A	12/18/06	6363098

Work Order #...: JK7JR1AJ MS Lot-Sample #: H6L110105-001
Dilution Factor: 9872.

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE EVALUATION REPORT

General Chemistry

Client Lot #...: H6L110105

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD RPD	RPD LIMITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine			WO#: JK7JW1AJ-MS/JK7JW1AK-MSD MS Lot-Sample #: H6L110105-002				
	106	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6354402
	103	(75 - 125)	3.2	(0-20)	KNOX 0050/26A Mod	12/18/06	6354402
			Dilution Factor: 2400				
Chlorine			WO#: JK7JW1AG-MS/JK7JW1AH-MSD MS Lot-Sample #: H6L110105-002				
	114	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6354401
	118	(75 - 125)	1.8	(0-20)	KNOX 0050/26A Mod	12/18/06	6354401
			Dilution Factor: 2400				
Hydrogen bromide			WO#: JK7JR1AE-MS/JK7JR1AF-MSD MS Lot-Sample #: H6L110105-001				
	94	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6361375
	94	(75 - 125)	0.25	(0-20)	KNOX 0050/26A Mod	12/18/06	6361375
			Dilution Factor: 4860.				
Hydrogen chloride			WO#: JK7JX1AE-MS/JK7JX1AF-MSD MS Lot-Sample #: H6L110105-003				
	109	(75 - 125)			KNOX 0050/26A Mod	12/28/06	6363147
	99	(75 - 125)	9.9	(0-20)	KNOX 0050/26A Mod	12/28/06	6363147
			Dilution Factor: 19128				
Hydrogen fluoride			WO#: JK7JR1AG-MS/JK7JR1AH-MSD MS Lot-Sample #: H6L110105-001				
	103	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6361376
	104	(75 - 125)	0.94	(0-20)	KNOX 0050/26A Mod	12/18/06	6361376
			Dilution Factor: 5054.				
Hydrogen fluoride			WO#: JK7JW1AE-MS/JK7JW1AF-MSD MS Lot-Sample #: H6L110105-002				
	99	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6354400
	98	(75 - 125)	0.59	(0-20)	KNOX 0050/26A Mod	12/18/06	6354400
			Dilution Factor: 2527.				

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE DATA REPORT

General Chemistry

Client Lot #...: H6L110105

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

	SAMPLE	SPIKE	MEASRD		PERCNT			PREPARATION-	PREP
PARAMETER	AMOUNT	AMT	AMOUNT	UNITS	RECVRY	RPD	METHOD	ANALYSIS DATE	BATCH #
Bromine			WO#:	JK7JW1AJ-MS/JK7JW1AK-MSD	MS	Lot-Sample #:	H6L110105-002		
	ND	480	510	ug	106		KNOX 0050/26A	12/18/06	6354402
	ND	480	494	ug	103	3.2	KNOX 0050/26A	12/18/06	6354402
			Dilution Factor: 2400						
Chlorine			WO#:	JK7JW1AG-MS/JK7JW1AH-MSD	MS	Lot-Sample #:	H6L110105-002		
	440	480	987	ug	114		KNOX 0050/26A	12/18/06	6354401
	440	480	1000	ug	118	1.8	KNOX 0050/26A	12/18/06	6354401
			Dilution Factor: 2400						
Hydrogen bromide			WO#:	JK7JR1AE-MS/JK7JR1AF-MSD	MS	Lot-Sample #:	H6L110105-001		
	ND	972	913	ug	94		KNOX 0050/26A	12/18/06	6361375
	ND	972	910	ug	94	0.25	KNOX 0050/26A	12/18/06	6361375
			Dilution Factor: 4860.						
Hydrogen chloride			WO#:	JK7JX1AE-MS/JK7JX1AF-MSD	MS	Lot-Sample #:	H6L110105-003		
	ND	3830	4170	ug	109		KNOX 0050/26A	12/28/06	6363147
	ND	3830	3780	ug	99	9.9	KNOX 0050/26A	12/28/06	6363147
			Dilution Factor: 19128						
Hydrogen fluoride			WO#:	JK7JR1AG-MS/JK7JR1AH-MSD	MS	Lot-Sample #:	H6L110105-001		
	ND	1010	1040	ug	103		KNOX 0050/26A	12/18/06	6361376
	ND	1010	1050	ug	104	0.94	KNOX 0050/26A	12/18/06	6361376
			Dilution Factor: 5054.						
Hydrogen fluoride			WO#:	JK7JW1AE-MS/JK7JW1AF-MSD	MS	Lot-Sample #:	H6L110105-002		
	ND	505	499	ug	99		KNOX 0050/26A	12/18/06	6354400
	ND	505	496	ug	98	0.59	KNOX 0050/26A	12/18/06	6354400
			Dilution Factor: 2527.						

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

Sample Receipt Documentation

AIR
SAMPLING
ASSOCIATES, INC.

11/10/05

Chain of Custody Record

Client	ADA-ES		Project No.	06-057		Page	1	of	3	Analysis	
Address	8100 Southpark Way		Unit No.	Hardin Stack		Lab	STL		Hydrogen Helide		
City	CO	80120	Project Manager	Bill Mullins		Lab Contact	Tony Waomund		Particulate		
Run No.	1		Test Method	26A		Lab Phone No.			Helogno		
Sample I.D.	Date	Time	Absorbing Solution	No. of Containers	Comments						
Cont. 1	11-30-06	1924	—	1	Filter No. A092						
Cont. 2	11-30-06	1926	—	1	ACE F.W.						
Cont. 3	11-30-06	1928	0.1N H2SO4	1	Imp. 1, 2 + Hot Line						
Cont. 4	11-30-06	1924	0.1N NaOH	1	Imp. 3, 4						
Read temp. Ambient			MPH 12/6/06								
Q coolers Read Fedex #	696769459202	1919	69459188								
No Custody Seals.		9214	696745								
MPH 12-6-06		9133									
		9157									
		9166									
Special Instructions:											
Cont. Nos. 1 & 2 retained by ASAI. HF: HBr are primary analytes for the ZGA analysis.											
Turn Around Time Required:	☒ Normal	☐ Rush	Sample Disposal:	☐ Return to ASAI	☒ Disposal By Lab	☒ Archive For	3	Months			
1. Recovered By	Bill Wym	Date	11-30-06	Time	1928	Relinquished By	Bill Wym	Date	12/3/06	Time	0900
2. Received By	Bill J. Mullins	Date	12/3/06	Time	0900	Relinquished By	Bill J. Mullins	Date	12/3/06	Time	1330
3. Received By	Alan P. Polance	Date	12/3/06	Time	1330	Relinquished By	Alan P. Polance	Date	12/4/06	Time	0820
Comments:	Grand Bill 12/4/06 0820 Bill Wym 12/5/06 1400

Chain of Custody Record

P.O. Box 1175 · Lewisville, TX 75067 · Office: (972) 492-1400 · Fax: (972) 492-1402 · Toll-Free: (866) 311-9940

23

**AIR
SAMPLING
ASSOCIATES, INC.**

HVL110105

Chain of Custody Record

Client		Project No.		Page 3 of 3		Analysis	
Address		Unit No.		Lab		Analysis	
City		Project Manager		Lab Contact		Analysis	
State		Test Method		Lab Phone No.		Analysis	
Zip Code		Absorbing Solution		No. of Containers		Analysis	
Run No.		Time		Comments		Analysis	
ADA-ES	06-057	Handin Stack	STZ Knoxville	Filter No. A113	Hydrogen Halide	Hydrogen Halide	Hydrogen Halide
8100 Southpark Way	Bill Mullins	—	—	ACE FW	Particulate	Particulate	Particulate
Littleton	CO 80120	0.1N H2SO4	0.1N NaOH	Imps 1, 2 + Hot Line			
3	26A	2219	2232	Imps 3, 4			
Sample I.D.	Date	Time					
Cont. 1	12-2-06	2219					
Cont. 2	12-2-06	2232					
Cont. 3	12-2-06	2235					
Cont. 4	12-2-06	2226					
Special Instructions: Cont. Nos. 1 & 2 retained by ASAI. HF & HBr are primary analytes for the 26A analysis.							
Turn Around Time Required:		Sample Disposal:		Return to ASAI		Disposal By Lab	
1. Received By		Date		1. Relinquished By		Date	
Bill Mullins		12-2-06 2235		Bill Mullins		12/3/06 0900	
2. Received By		Date		2. Relinquished By		Date	
Bill J. Mullins		12/3/06 0900		Bill J. Mullins		12/3/06 1330	
3. Received By		Date		3. Relinquished By		Date	
Alan D. Roylance		12/3/06 1330		Alan D. Roylance		12/4/06 0820	
Comments		Date		Date		Date	
Bill Mullins		12/4/06 0820		Bill Mullins		12/5/06 1400	

STL KNOXVILLE SAMPLE RECEIPT/CONDITION UPON RECEIPT ANOMALY CHECKLIST

Client: Air Sampling Associates Project: Lot Number: HALLWOODS

Review Items	Yes	No	NA	If No, what was the problem?	Comments/Actions Taken
1. Do sample container labels match COC? (IDs, Dates, Times)				☐ 1a Do not match COC ☐ 1b Incomplete information ☐ 1c Marking smeared ☐ 1d Label torn ☐ 1e No label ☐ 1f COC not received ☐ 1g Other:	HA
2. Is the cooler temperature within limits? (> freezing temp. of water to 6 °C; NC, 1668, 1613B: 0-4 °C; VOST: 10 °C; MA: 2-6 °C)	✓			☐ 2a Temp Blank = ☐ 2b Cooler Temp =	
3. Were samples received with correct chemical preservative (excluding Encore)?	✓			☐ 3a Sample preservative =	
4. Were custody seals present/intact on cooler and/or containers?		✓		☒ 4a Not present ☐ 4b Not intact ☐ 4c Other:	
5. Were all of the samples listed on the COC received?	✓			☐ 5a Samples received-not on COC ☐ 5b Samples not received-on COC	
6. Were all of the sample containers received intact?	✓			☐ 6a Leaking ☐ 6b Broken	
7. Were VOA samples received without headspace?			✓	☐ 7a Headspace (VOA only)	
8. Were samples received in appropriate containers?	✓			☐ 8a Improper container	
9. Did you check for residual chlorine, if necessary?			✓	☐ 9a Could not be determined due to matrix interference	
10. Were samples received within holding time?	✓			☐ 10a Holding time expired	
11. For rad samples, was sample activity info. provided?			✓	☐ Incomplete information	
12. For SOG water samples (1613B, 1668A, 8290, LR PAHs), do samples have visible solids present?			✓	If yes & appears to be >1%, was SOG notified?	
13. Are the shipping containers intact?	✓			☐ 13a Leaking ☐ 13b Other:	
14. Was COC relinquished? (Signed/Dated/Timed)	✓			☐ 14a Not relinquished	
15. Are tests/parameters listed for each sample?	✓			☐ 15a Incomplete information	
16. Is the matrix of the samples noted?	✓			☐ 15a Incomplete information	
17. Is the date/time of sample collection noted?	✓			☐ 15a Incomplete information	
18. Is the client and project name/# identified?	✓			☐ 15a Incomplete information	
19. Was the sampler identified on the COC?	✓		✓	☐ 15a Incomplete information	

Quote #: _____ PM Instructions: _____

Sample Receiving Associate: Matthew Howard Date: 12-6-06

Wet Chemistry

Sample Summary

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 1 0.1N H2SO4

General Chemistry

Lot-Sample #...: H6L110105-001 Work Order #...: JK7JR Matrix.....: AIR
 Date Sampled...: 11/30/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Hydrogen bromide	ND	486	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 4860.55		MDL.....: 243		
Hydrogen chloride	ND	987	ug	KNOX 0050/26A Mod	12/18/06	6363098
		Dilution Factor: 9872.92		MDL.....: 415		
Hydrogen fluoride	ND	505	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 5054.65		MDL.....: 253		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 1 0.1N NAOH

General Chemistry

Lot-Sample #...: H6L110105-002

Work Order #...: JK7JW

Matrix.....: AIR

Date Sampled...: 11/30/06

Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	240	ug	KNOX 0050/26A Mod	12/18/06	6354402
		Dilution Factor: 2400		MDL.....: 57.6		
Chlorine	440	240	ug	KNOX 0050/26A Mod	12/18/06	6354401
		Dilution Factor: 2400		MDL.....: 101		
Hydrogen fluoride	ND	253	ug	KNOX 0050/26A Mod	12/18/06	6354400
		Dilution Factor: 2527.32		MDL.....: 126		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 2 0.1N H2SO4

General Chemistry

Lot-Sample #...: H6L110105-003

Work Order #...: JK7JX

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Hydrogen bromide	ND	471	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 4708.65		MDL.....: 235		
Hydrogen chloride	ND	1910	ug	KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 19128.78		MDL.....: 803		
Hydrogen fluoride	ND	490	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 4896.69		MDL.....: 245		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 2 0.1N NAOH

General Chemistry

Lot-Sample #...: H6L110105-004 Work Order #...: JK7J0 Matrix.....: AIR
 Date Sampled...: 12/01/06 Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	250	ug	KNOX 0050/26A Mod	12/18/06	6354402
		Dilution Factor: 2500		MDL.....: 60.0		
Chlorine	480	250	ug	KNOX 0050/26A Mod	12/18/06	6354401
		Dilution Factor: 2500		MDL.....: 105		
Hydrogen fluoride	ND	263	ug	KNOX 0050/26A Mod	12/18/06	6354400
		Dilution Factor: 2632.63		MDL.....: 132		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 3 0.1N H2SO4

General Chemistry

Lot-Sample #...: H6L110105-005

Work Order #...: JK7J1

Matrix.....: AIR

Date Sampled...: 12/02/06

Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Hydrogen bromide	ND	608	ug	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 6075.68		MDL.....: 304		
Hydrogen chloride	ND	2470	ug	KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 24682.3		MDL.....: 1040		
Hydrogen fluoride	ND	632	ug	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 6318.31		MDL.....: 316		

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 3 0.1N NAOH

General Chemistry

Lot-Sample #...: H6L110105-006

Work Order #...: JK7J2

Matrix.....: AIR

Date Sampled...: 12/02/06

Date Received...: 12/06/06

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	270	ug	KNOX 0050/26A Mod	12/18/06	6354402
		Dilution Factor: 2700		MDL.....: 64.8		
Chlorine	483	270	ug	KNOX 0050/26A Mod	12/18/06	6354401
		Dilution Factor: 2700		MDL.....: 113		
Hydrogen fluoride	ND	284	ug	KNOX 0050/26A Mod	12/18/06	6354400
		Dilution Factor: 2843.24		MDL.....: 142		

QC Summary

METHOD BLANK REPORT

General Chemistry

Client Lot #...: H6L110105

Matrix.....: AIR

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine	ND	Work Order #: JLWCC1AA 10.0	ug	MB Lot-Sample #: H6L200000-402 KNOX 0050/26A Mod	12/18/06	6354402
		Dilution Factor: 100				
Chlorine	ND	Work Order #: JLWAA1AA 10.0	ug	MB Lot-Sample #: H6L200000-401 KNOX 0050/26A Mod	12/18/06	6354401
		Dilution Factor: 100				
Hydrogen bromide	ND	Work Order #: JL69F1AA 10.1	ug	MB Lot-Sample #: H6L270000-375 KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 101.2				
Hydrogen chloride	ND	Work Order #: JL8TM1AA 10.3	ug	MB Lot-Sample #: H6L290000-098 KNOX 0050/26A Mod	12/18/06	6363098
		Dilution Factor: 102.8				
Hydrogen chloride	ND	Work Order #: JL9AA1AA 10.3	ug	MB Lot-Sample #: H6L290000-147 KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 102.8				
Hydrogen fluoride	ND	Work Order #: JLV9M1AA 10.5	ug	MB Lot-Sample #: H6L200000-400 KNOX 0050/26A Mod	12/18/06	6354400
		Dilution Factor: 105.3				
Hydrogen fluoride	ND	Work Order #: JL69G1AA 10.5	ug	MB Lot-Sample #: H6L270000-376 KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 105.3				

NOTE (S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

General Chemistry

Lot-Sample #...: H6L110105

Matrix.....: AIR

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine		WO#:JLWCC1AC-LCS/JLWCC1AD-LCSD LCS Lot-Sample#: H6L200000-402					
	101	(90 - 110)			KNOX 0050/26A Mod	12/18/06	6354402
	101	(90 - 110)	0.63	(0-20)	KNOX 0050/26A Mod	12/18/06	6354402
		Dilution Factor: 100					
Chlorine		WO#:JLWAA1AC-LCS/JLWAA1AD-LCSD LCS Lot-Sample#: H6L200000-401					
	101	(90 - 110)			KNOX 0050/26A Mod	12/18/06	6354401
	101	(90 - 110)	0.22	(0-20)	KNOX 0050/26A Mod	12/18/06	6354401
		Dilution Factor: 100					
Hydrogen bromide		WO#:JL69F1AC-LCS/JL69F1AD-LCSD LCS Lot-Sample#: H6L270000-375					
	96	(90 - 110)			KNOX 0050/26A Mod	12/18/06	6361375
	99	(90 - 110)	2.6	(0-20)	KNOX 0050/26A Mod	12/18/06	6361375
		Dilution Factor: 101.2					
Hydrogen chloride		WO#:JL8TM1AC-LCS/JL8TM1AD-LCSD LCS Lot-Sample#: H6L290000-098					
	100	(90 - 110)			KNOX 0050/26A Mod	12/18/06	6363098
	101	(90 - 110)	1.2	(0-20)	KNOX 0050/26A Mod	12/18/06	6363098
		Dilution Factor: 102.8					
Hydrogen chloride		WO#:JL9AA1AC-LCS/JL9AA1AD-LCSD LCS Lot-Sample#: H6L290000-147					
	100	(90 - 110)			KNOX 0050/26A Mod	12/28/06	6363147
	101	(90 - 110)	0.82	(0-20)	KNOX 0050/26A Mod	12/28/06	6363147
		Dilution Factor: 102.8					
Hydrogen fluoride		WO#:JLV9M1AC-LCS/JLV9M1AD-LCSD LCS Lot-Sample#: H6L200000-400					
	101	(90 - 110)			KNOX 0050/26A Mod	12/18/06	6354400
	101	(90 - 110)	0.06	(0-20)	KNOX 0050/26A Mod	12/18/06	6354400
		Dilution Factor: 105.3					
Hydrogen fluoride		WO#:JL69G1AC-LCS/JL69G1AD-LCSD LCS Lot-Sample#: H6L270000-376					
	100	(90 - 110)			KNOX 0050/26A Mod	12/18/06	6361376
	100	(90 - 110)	0.51	(0-20)	KNOX 0050/26A Mod	12/18/06	6361376
		Dilution Factor: 105.3					

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE DATA REPORT

General Chemistry

Lot-Sample #...: H6L110105

Matrix.....: AIR

PARAMETER	SPIKE AMOUNT	MEASURED AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
WO#:JLWCC1AC-LCS/JLWCC1AD-LCSD LCS Lot-Sample#: H6L200000-402								
Bromine	75.0	75.6	ug	101		KNOX 0050/26A Mod	12/18/06	6354402
	75.0	76.0	ug	101	0.63	KNOX 0050/26A Mod	12/18/06	6354402
Dilution Factor: 100								
WO#:JLWAA1AC-LCS/JLWAA1AD-LCSD LCS Lot-Sample#: H6L200000-401								
Chlorine	75.0	75.8	ug	101		KNOX 0050/26A Mod	12/18/06	6354401
	75.0	76.0	ug	101	0.22	KNOX 0050/26A Mod	12/18/06	6354401
Dilution Factor: 100								
WO#:JL69F1AC-LCS/JL69F1AD-LCSD LCS Lot-Sample#: H6L270000-375								
Hydrogen bromide	76.0	73.1	ug	96		KNOX 0050/26A Mod	12/18/06	6361375
	76.0	75.0	ug	99	2.6	KNOX 0050/26A Mod	12/18/06	6361375
Dilution Factor: 101.2								
WO#:JL8TM1AC-LCS/JL8TM1AD-LCSD LCS Lot-Sample#: H6L290000-098								
Hydrogen chloride	77.1	77.2	ug	100		KNOX 0050/26A Mod	12/18/06	6363098
	77.1	78.1	ug	101	1.2	KNOX 0050/26A Mod	12/18/06	6363098
Dilution Factor: 102.8								
WO#:JL9AA1AC-LCS/JL9AA1AD-LCSD LCS Lot-Sample#: H6L290000-147								
Hydrogen chloride	77.1	77.1	ug	100		KNOX 0050/26A Mod	12/28/06	6363147
	77.1	77.8	ug	101	0.82	KNOX 0050/26A Mod	12/28/06	6363147
Dilution Factor: 102.8								
WO#:JLV9M1AC-LCS/JLV9M1AD-LCSD LCS Lot-Sample#: H6L200000-400								
Hydrogen fluoride	79.0	79.4	ug	101		KNOX 0050/26A Mod	12/18/06	6354400
	79.0	79.5	ug	101	0.06	KNOX 0050/26A Mod	12/18/06	6354400
Dilution Factor: 105.3								
WO#:JL69G1AC-LCS/JL69G1AD-LCSD LCS Lot-Sample#: H6L270000-376								
Hydrogen fluoride	79.0	78.8	ug	100		KNOX 0050/26A Mod	12/18/06	6361376
	79.0	79.2	ug	100	0.51	KNOX 0050/26A Mod	12/18/06	6361376
Dilution Factor: 105.3								

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE EVALUATION REPORT

General Chemistry

Client Lot #...: H6L110105

Matrix.....: AIR

Date Sampled...: 11/30/06

Date Received...: 12/06/06

<u>PARAMETER</u>	<u>PERCENT RECOVERY</u>	<u>RECOVERY LIMITS</u>	<u>METHOD</u>	<u>PREPARATION- ANALYSIS DATE</u>	<u>PREP BATCH #</u>
Hydrogen chloride	105	Work Order #...: JK7JR1AJ (75 - 125)	KNOX 0050/26A Mod	MS Lot-Sample #: H6L110105-001 12/18/06	6363098
		Dilution Factor: 9872.			

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE DATA REPORT

General Chemistry

Client Lot #...: H6L110105

Matrix.....: AIR

Date Sampled...: 11/30/06

Date Received...: 12/06/06

PARAMETER	SAMPLE AMOUNT	SPIKE AMT	MEASURED AMOUNT	UNITS	PERCENT RECOVERY	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Hydrogen chloride	ND	1970	2070	ug	105	KNOX 0050/26A	12/18/06	6363098

Work Order #...: JK7JR1AJ MS Lot-Sample #: H6L110105-001
Dilution Factor: 9872.

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE EVALUATION REPORT

General Chemistry

Client Lot #...: H6L110105

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
Bromine			WO#: JK7JW1AJ-MS/JK7JW1AK-MSD MS Lot-Sample #: H6L110105-002				
	106	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6354402
	103	(75 - 125)	3.2	(0-20)	KNOX 0050/26A Mod	12/18/06	6354402
			Dilution Factor: 2400				
Chlorine			WO#: JK7JW1AG-MS/JK7JW1AH-MSD MS Lot-Sample #: H6L110105-002				
	114	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6354401
	118	(75 - 125)	1.8	(0-20)	KNOX 0050/26A Mod	12/18/06	6354401
			Dilution Factor: 2400				
Hydrogen bromide			WO#: JK7JR1AE-MS/JK7JR1AF-MSD MS Lot-Sample #: H6L110105-001				
	94	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6361375
	94	(75 - 125)	0.25	(0-20)	KNOX 0050/26A Mod	12/18/06	6361375
			Dilution Factor: 4860.				
Hydrogen chloride			WO#: JK7JX1AE-MS/JK7JX1AF-MSD MS Lot-Sample #: H6L110105-003				
	109	(75 - 125)			KNOX 0050/26A Mod	12/28/06	6363147
	99	(75 - 125)	9.9	(0-20)	KNOX 0050/26A Mod	12/28/06	6363147
			Dilution Factor: 19128				
Hydrogen fluoride			WO#: JK7JR1AG-MS/JK7JR1AH-MSD MS Lot-Sample #: H6L110105-001				
	103	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6361376
	104	(75 - 125)	0.94	(0-20)	KNOX 0050/26A Mod	12/18/06	6361376
			Dilution Factor: 5054.				
Hydrogen fluoride			WO#: JK7JW1AE-MS/JK7JW1AF-MSD MS Lot-Sample #: H6L110105-002				
	99	(75 - 125)			KNOX 0050/26A Mod	12/18/06	6354400
	98	(75 - 125)	0.59	(0-20)	KNOX 0050/26A Mod	12/18/06	6354400
			Dilution Factor: 2527.				

NOTE (S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE DATA REPORT

General Chemistry

Client Lot #...: H6L110105

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

PARAMETER	SAMPLE AMOUNT	SPIKE AMT	MEASRD AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD	PREPARATION- ANALYSIS DATE	PREP BATCH #
WO#: JK7JW1AJ-MS/JK7JW1AK-MSD MS Lot-Sample #: H6L110105-002									
Bromine	ND	480	510	ug	106		KNOX 0050/26A	12/18/06	6354402
	ND	480	494	ug	103	3.2	KNOX 0050/26A	12/18/06	6354402
Dilution Factor: 2400									
WO#: JK7JW1AG-MS/JK7JW1AH-MSD MS Lot-Sample #: H6L110105-002									
Chlorine	440	480	987	ug	114		KNOX 0050/26A	12/18/06	6354401
	440	480	1000	ug	118	1.8	KNOX 0050/26A	12/18/06	6354401
Dilution Factor: 2400									
WO#: JK7JR1AE-MS/JK7JR1AF-MSD MS Lot-Sample #: H6L110105-001									
Hydrogen bromide	ND	972	913	ug	94		KNOX 0050/26A	12/18/06	6361375
	ND	972	910	ug	94	0.25	KNOX 0050/26A	12/18/06	6361375
Dilution Factor: 4860.									
WO#: JK7JX1AE-MS/JK7JX1AF-MSD MS Lot-Sample #: H6L110105-003									
Hydrogen chloride	ND	3830	4170	ug	109		KNOX 0050/26A	12/28/06	6363147
	ND	3830	3780	ug	99	9.9	KNOX 0050/26A	12/28/06	6363147
Dilution Factor: 19128									
WO#: JK7JR1AG-MS/JK7JR1AH-MSD MS Lot-Sample #: H6L110105-001									
Hydrogen fluoride	ND	1010	1040	ug	103		KNOX 0050/26A	12/18/06	6361376
	ND	1010	1050	ug	104	0.94	KNOX 0050/26A	12/18/06	6361376
Dilution Factor: 5054.									
WO#: JK7JW1AE-MS/JK7JW1AF-MSD MS Lot-Sample #: H6L110105-002									
Hydrogen fluoride	ND	505	499	ug	99		KNOX 0050/26A	12/18/06	6354400
	ND	505	496	ug	98	0.59	KNOX 0050/26A	12/18/06	6354400
Dilution Factor: 2527.									

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Raw Data

Anions

STL Knoxville IC Initial Calibration Data Review / Narrative Checklist
Methods: 300.0, 9056, 9057 and 26A, SOP: KNOX-WC-0005, Rev. 8

Page 1 of 1

(ICS-1500)

Analysis Date:	10/18/06	File ID:	J18-LOWLEVEL-FLN02BRND3-101806
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Initial Calibration Review Items	N/A	Yes	No	If No, why is data reportable?	2nd ✓
1. Were at least 5 levels of each analyte analyzed?		✓			✓
2. Is low level standard concentration $\leq$ RL?		✓			✓
3. Are the correlation coefficients (r) ≥ 0.995 ; $r^2 \geq 0.990$?		✓			✓
4. For method 300.0, was the calibration curve processed using linear regression?	✓				NA
5. For manual integrated standards, are before/after chromatograms provided with initials/date/reason?	✓			Reasons: S=Split peak, U=Undetected peak, I=Incorrect peak integration, B=Baseline correction, W=Wrong peak chosen by data system	NA

Analyst:	CWK	Date:	10/19/06
Comments:			
Range: 0.075 - 2.0 mg/L			
- 2 nd order calibration using peak hgt. vs amount.			
LOW LEVEL			
2 nd Level Reviewer:	Dowhul	Date:	10/19/06
Comments:	Cal std (5) = ICWS-8919 (CL)		
$\text{peak height} = 0 + 2.19733(.9966) + 0.033578(.9966)^2$ $= 0 + 2.1899 + 0.0334$ $= 2.223$			

Scanned
10/19/06
DKW

1 CAL STD #1 ICWS-8915

Sample Name: CAL STD #1 ICWS-8915
Vial Number: 1292
Sample Type: standard
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 10/18/2006 9:14
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.26	Fluoride	0.20347	0.035	16.69	0.0752	BMB
2	4.61	Chloride	0.21212	0.036	16.87	0.0964	BMB
3	5.37	Nitrite-N	0.30167	0.057	26.98	0.0791	BMB
4	6.67	Bromide	0.05610	0.011	5.39	0.0791	BMB
5	7.47	Nitrate-N	0.28758	0.072	34.07	0.0828	BMB

2 CAL STD #2 ICWS-8916

Sample Name: CAL STD #2 ICWS-8916
Vial Number: 1293
Sample Type: standard
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 10/18/2006 9:32
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.25	n.a.	0.09910	0.019	6.45	n.a.	BMB
2	3.26	Fluoride	0.26277	0.046	15.73	0.0970	BMB
3	4.61	Chloride	0.23228	0.052	17.83	0.1055	BMB
4	5.37	Nitrite-N	0.38584	0.072	24.74	0.1012	BMB
5	6.68	Bromide	0.06928	0.015	5.09	0.0977	BMB
6	7.47	Nitrate-N	0.35086	0.088	30.16	0.1009	BMB

3 CAL STD #3 ICWS-8917

Sample Name: CAL STD #3 ICWS-8917
Vial Number: 1293
Sample Type: standard
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 10/18/2006 9:49
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.25	n.a.	0.09667	0.019	2.79	n.a.	BMB
2	3.26	Fluoride	0.66838	0.127	18.21	0.2438	BMB
3	4.60	Chloride	0.56206	0.103	14.73	0.2548	BMB
4	5.37	Nitrite-N	0.95211	0.184	26.44	0.2484	BMB
5	6.66	Bromide	0.17667	0.040	5.79	0.2488	BMB
6	7.46	Nitrate-N	0.87649	0.223	32.04	0.2502	BMB

4 CAL STD #4 ICWS-8918

Sample Name: CAL STD #4 ICWS-8918
Vial Number: 1295
Sample Type: standard
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 10/18/2006 10:07
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.25	n.a.	0.10012	0.018	1.29	n.a.	BMB
2	3.26	Fluoride	1.39754	0.256	18.63	0.4996	BMB
3	4.61	Chloride	1.09898	0.191	13.89	0.4964	BM
4	5.37	Nitrite-N	1.94194	0.385	27.97	0.5022	M
5	6.67	Bromide	0.35570	0.078	5.68	0.4998	MB
6	7.46	Nitrate-N	1.76858	0.448	32.55	0.4985	BMB

5 CAL STD #5 ICWS-8919

Sample Name: CAL STD #5 ICWS-8919
Vial Number: 1295
Sample Type: standard
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 10/18/2006 10:24
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.25	n.a.	0.13527	0.026	0.94	n.a.	BMB
2	3.26	Fluoride	2.91620	0.530	19.16	1.0032	BM
3	4.61	Chloride	2.22320	0.373	13.49	0.9966	M
4	5.37	Nitrite-N	3.92501	0.773	27.95	0.9983	MB
5	6.67	Bromide	0.71491	0.156	5.62	1.0005	Ru
6	7.45	Nitrate-N	3.63765	0.908	32.83	0.9998	BMB

6 CAL STD #6 ICWS-8920

Sample Name: CAL STD #6 ICWS-8920
Vial Number: 1295
Sample Type: standard
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 10/18/2006 10:41
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.25	n.a.	0.15975	0.030	0.53	n.a.	BMB
2	3.25	Fluoride	6.24513	1.086	19.22	1.9994	BM
3	4.60	Chloride	4.53115	0.754	13.35	2.0009	M
4	5.37	Nitrite-N	8.12633	1.598	28.28	2.0003	M
5	6.66	Bromide	1.44051	0.306	5.42	1.9999	Ru
6	7.43	Nitrate-N	7.63891	1.876	33.19	2.0001	MB

~~4 CAL STD #4 ICWS-8918~~Dfn
10/19/06

Sample Name: CAL STD #4 ICWS-8918
 Vial Number: 1295
 Sample Type: standard
 Control Program: AS14A ANIONS METHOD
 Quantif. Method: AS4A-SC ANION METHOD
 Recording Time: #####
 Run Time (min): 15.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret. Time min	Peak Name	Cal. Type	Points	R-Square	Offset	Slope	Curve
1	2.25	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	3.26	Fluoride	Quad	6	✓ 1.0000	0.000000	2.68877	0.217432
3	4.61	Chloride	Quad	6	0.9998	0.000000	2.19733	0.033578
4	5.37	Nitrite-N	Quad	6	1.0000	0.000000	3.80119	0.130678
5	6.67	Bromide	Quad	6	1.0000	0.000000	0.70878	0.005755
6	7.46	Nitrate-N	Quad	6	1.0000	0.000000	3.45770	0.180759
Average:					1.0000	0.0000	2.5708	0.1136

4 CAL STD #4 ICWS-8918Dkw
10/19/06

Sample Name: CAL STD #4 ICWS-8918
 Vial Number: 1295
 Sample Type: standard
 Control Program: AS14A ANIONS METHOD
 Quantif. Method: AS4A-SC ANION METHOD
 Recording Time: #####
 Run Time (min): 15.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	R-Square	Offset	Slope	Curve
1	2.25	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	3.26	Fluoride	Quad	6	1.0000	0.000000	2.68877	0.217432
3	4.61	Chloride	Quad	6	✓ 0.9998	0.000000	2.19733	0.033578
4	5.37	Nitrite-N	Quad	6	1.0000	0.000000	3.80119	0.130678
5	6.67	Bromide	Quad	6	1.0000	0.000000	0.70878	0.005755
6	7.46	Nitrate-N	Quad	6	1.0000	0.000000	3.45770	0.180759
Average:					1.0000	0.0000	2.5708	0.1136

4 CAL STD #4 ICWS-8918DFW
10/19/06

Sample Name: CAL STD #4 ICWS-8918
 Vial Number: 1295
 Sample Type: standard
 Control Program: AS14A ANIONS METHOD
 Quantif. Method: AS4A-SC ANION METHOD
 Recording Time: #####
 Run Time (min): 15.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	R-Square	Offset	Slope	Curve
1	2.25	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	3.26	Fluoride	Quad	6	1.0000	0.000000	2.68877	0.217432
3	4.61	Chloride	Quad	6	0.9998	0.000000	2.19733	0.033578
4	5.37	Nitrite-N	Quad	6	1.0000	0.000000	3.80119	0.130678
5	6.67	Bromide	Quad	6	1.0000	0.000000	0.70878	0.005755
6	7.46	Nitrate-N	Quad	6	1.0000	0.000000	3.45770	0.180759
Average:					1.0000	0.0000	2.5708	0.1136

4 CAL STD #4 ICWS-8918DKW
10/19/06

Sample Name: CAL STD #4 ICWS-8918
 Vial Number: 1295
 Sample Type: standard
 Control Program: AS14A ANIONS METHOD
 Quantif. Method: AS4A-SC ANION METHOD
 Recording Time: #####
 Run Time (min): 15.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	R-Square	Offset	Slope	Curve
1	2.25	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	3.26	Fluoride	Quad	6	1.0000	0.000000	2.68877	0.217432
3	4.61	Chloride	Quad	6	0.9998	0.000000	2.19733	0.033578
4	5.37	Nitrite-N	Quad	6	1.0000	0.000000	3.80119	0.130678
5	6.67	Bromide	Quad	6	✓ 1.0000	0.000000	0.70878	0.005755
6	7.46	Nitrate-N	Quad	6	1.0000	0.000000	3.45770	0.180759
Average:					1.0000	0.0000	2.5708	0.1136

4 CAL STD #4 ICWS-8918		<i>DFW</i> <i>10/19/06</i>	
Sample Name:	CAL STD #4 ICWS-8918	Injection Volume:	50.0
Vial Number:	1295	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	#####	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	R-Square	Offset	Slope	Curve
1	2.25	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	3.26	Fluoride	Quad	6	1.0000	0.000000	2.68877	0.217432
3	4.61	Chloride	Quad	6	0.9998	0.000000	2.19733	0.033578
4	5.37	Nitrite-N	Quad	6	1.0000	0.000000	3.80119	0.130678
5	6.67	Bromide	Quad	6	1.0000	0.000000	0.70878	0.005755
6	7.46	Nitrate-N	Quad	6	✓ 1.0000	0.000000	3.45770	0.180759
Average:					1.0000	0.0000	2.5708	0.1136

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 9/25/06 Chemist: DFW Expiration Date: 12/25/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWTI-8837	F-	17125	ERA	12/31/07	1000 ppm	5.	50	100. mg/L (ppm)
2. (intermed.)	Cl-	36065		6/30/07				
3. (calib.)	NO ₃ N	17075		7/31/07				
4. (source)	BR-	27025		2/28/07				
5.	NO ₃ N-	17026		2/28/08				
6. ICWTI-8838	F-	1-385-2	SPEX	8/15/07	1000 ppm	5.	50	100. ppm (mg/L)
7. (intermed.)	Cl-	1-5CL-2		3/15/07				
8. (2nd source)	NO ₃ N-	1-13NO ₃ N-2		9/15/07				
9.	BR-	1-1BR-2		4/30/07				
10.	NO ₃ N-	1-27NO ₃ N-2		5/15/07				
11.								
12.								
13.								
14.								

Reviewed By: _____

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 10/18/06 Chemist: WY Expiration Date: 10/19/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. 10W3-8915	F-	ICWI-	8838-8837 WY 10/18/06	12/25/06	100 ppm	0.075	100ml	0.075 ppm
2. (Cal std (1))	Cl ⁻							
3.	NO ₂ -N							
4.	Br ⁻							
5.	NO ₃ -N							
6. 10W3-8916	F-					0.100		0.100 ppm
7. (Cal std (2))	Cl ⁻							
8.	NO ₂ -N							
9.	Br ⁻							
10.	NO ₃ -N							
11. 10W3-8917	F-					0.250		0.250 ppm
12. (Cal std (3))	Cl ⁻							
13.	NO ₂ -N							
14.	Br ⁻							
NO ₃ -N								
Reviewed By _____								

WC031R3.DOC, 8/28/03

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 10/18/06 Chemist: WVK Expiration Date: 10/19/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. 1WVS-8918	F-	ICWI-	8837	12/25/06	100 ppm	0.500	100 ml	0.50 ppm
2. (CAL STD (4))	Cl-							
3.	NO ₃ -N							
4.	Br-							
5.	NO ₃ -N							
6. 1WVS-8919	F-					1.00		1.0 ppm
7. (CAL STD (5))	Cl-							
8.	NO ₃ -N							
9.	Br-							
10.	NO ₃ -N							
11. 1WVS-8920	F-					2.00		2.0 ppm
12. (CAL STD (6))	Cl-							
13.	NO ₃ -N							
14.	Br-							
NO ₃ -N								

Reviewed By: _____

STL Knoxville IC Initial Calibration Data Review / Narrative Checklist
Methods: 300.0, 9056, 9057 and 26A, SOP: KNOX-WC-0005, Rev. 8

Page 1 of 1

DX600 (ARAGORN)

Analysis Date:	12/14/06	File ID:	L14A-LOW_AIR-ANIONS-121406
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Initial Calibration Review Items	N/A	Yes	No	If No, why is data reportable?	2nd ✓
1. Were at least 5 levels of each analyte analyzed?		✓			✓
2. Is low level standard concentration $\leq$ RL?		✓			✓
3. Are the correlation coefficients (r) ≥ 0.995 ; $r^2 \geq 0.990$?		✓			✓
4. For method 300.0, was the calibration curve processed using linear regression?	✓				N/A
5. For manual integrated standards, are before/after chromatograms provided with initials/date/reason?		✓		Reasons: S=Split peak, U=Undetected peak, I=Incorrect peak integration, B=Baseline correction, W=Wrong peak chosen by data system	✓

Analyst: D. Whitham | Date: 12/15/06
Comments: low level anion calibration for air analysts -
Range = 0.075 - 2 ppm F⁻; Cl⁻; NO₂N⁻; NO₃N⁻; BR⁻
- Quad fit using peak height vs. amount -

2nd Level Reviewer: R. M. Zuercher | Date: 12/15/06
Comments:

1 CAL STD 1 = ICWS-9045 @ (0.075ppm)

Sample Name:	CAL STD 1 = ICWS-9045 @ (0.075ppm)	Injection Volume:	50.0
Vial Number:	98	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/14/2006 16:54	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.23417	0.030	19.30	0.0748	BMB
2	4.70	Chloride	0.16248	0.024	15.76	0.0868	BMB
3	5.54	Nitrite-N	0.25345	0.043	27.70	0.0748	BMB
4	7.00	Bromide	0.04768	0.010	6.42	0.0837	BMB*
5	7.88	Nitrate-N	0.20803	0.048	30.83	0.0756	BMB

1 CAL STD 1 = ICWS-9045 @ (0.075ppm)

Sample Name:	CAL STD 1 = ICWS-9045 @ (0.075ppm)	Injection Volume:	50.0
Vial Number:	98	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/14/2006 16:54	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.23417	0.030	20.62	n.a.	BMB
2	4.70	Chloride	0.16248	0.024	16.84	n.a.	BMB
3	5.54	Nitrite-N	0.25345	0.043	29.60	n.a.	BMB
4	7.88	Nitrate-N	0.20803	0.048	32.94	n.a.	BMB

2 CAL STD 2 = ICWS-9046 @ (0.10ppm)

Sample Name:	CAL STD 2 = ICWS-9046 @ (0.10ppm)	Injection Volume:	50.0
Vial Number:	99	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/14/2006 17:11	Sample Weight:	1.0000
Run Time (min):	10.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.31346	0.037	18.04	0.0999	BMB
2	4.69	Chloride	0.21253	0.030	14.47	0.1134	BMB
3	5.53	Nitrite-N	0.34978	0.059	28.59	0.1031	BMB
4	6.98	Bromide	0.05646	0.011	5.19	0.0991	BMB
5	7.87	Nitrate-N	0.28533	0.070	33.71	0.1036	BMB

3 CAL STD 3 = ICWS-9047 @ (0.25ppm)

Sample Name:	CAL STD 3 = ICWS-9047 @ (0.25ppm)	Injection Volume:	50.0
Vial Number:	100	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/14/2006 17:24	Sample Weight:	1.0000
Run Time (min):	10.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (μS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.78262	0.100	19.79	0.2477	BMB
2	4.70	Chloride	0.47425	0.066	13.11	0.2518	BMB
3	5.54	Nitrite-N	0.84353	0.144	28.39	0.2473	BMB
4	7.01	Bromide	0.14435	0.029	5.64	0.2526	BMB
5	7.87	Nitrate-N	0.68927	0.167	33.06	0.2483	BMB

4 CAL STD 4 = ICWS-9048 @ (0.50ppm)

Sample Name:	CAL STD 4 = ICWS-9048 @ (0.50ppm)	Injection Volume:	50.0
Vial Number:	101	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/14/2006 17:36	Sample Weight:	1.0000
Run Time (min):	10.00	Sample Amount:	1.0000

No.	Ret. Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel. Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	1.60279	0.210	20.40	0.5010	BMB
2	4.69	Chloride	0.94632	0.132	12.83	0.4981	BMB
3	5.53	Nitrite-N	1.71930	0.302	29.30	0.4988	BMB
4	6.99	Bromide	0.28167	0.054	5.25	0.4908	BMB
5	7.84	Nitrate-N	1.39855	0.332	32.22	0.4972	BMB

5 CAL STD 5 = ICWS-9049 @ (1.ppm)

Sample Name: CAL STD 5 = ICWS-9049 @ (1.ppm)
Vial Number: 102
Sample Type: standard
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/14/2006 17:48
Run Time (min): 10.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	3.27751	0.412	19.61	1.0002	BMB
2	4.69	Chloride	1.92630	0.278	13.23	0.9967	BMB
3	5.53	Nitrite-N	3.52256	0.606	28.87	1.0015	BMB
4	6.99	Bromide	0.58187	0.122	5.80	1.0046	BM
5	7.83	Nitrate-N	2.89372	0.682	32.48	1.0020	MB

6 CAL STD 6 = ICWS-9050 @ (2.ppm)

Sample Name:	CAL STD 6 = ICWS-9050 @ (2.ppm)	Injection Volume:	50.0
Vial Number:	103	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/14/2006 18:01	Sample Weight:	1.0000
Run Time (min):	10.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	6.86489	0.858	19.88	1.9999	BMB
2	4.69	Chloride	3.99899	0.564	13.08	2.0008	BMB
3	5.53	Nitrite-N	7.31424	1.247	28.92	1.9998	BMB
4	6.99	Bromide	1.17848	0.240	5.56	1.9994	BM
5	7.82	Nitrate-N	6.07244	1.404	32.55	1.9997	MB

~~6 CAL STD 6 = ICWS-9050 @ (2.ppm)~~Drw
12/15/06

Sample Name: CAL STD 6 = ICWS-9050 @ (2.ppm)
 Vial Number: 103
 Sample Type: standard
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: #####
 Run Time (min): 10.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	Corr.Coeff. (R)	Offset	Slope	Curve
1	3.23	Fluoride	Quad	6	0.9997	0.0000	3.120830	0.155880
2	4.69	Chloride	Quad	6	0.9997	0.0000	1.867234	0.065694
3	5.53	Nitrite-N	Quad	6	0.9998	0.0000	3.376824	0.140386
4	6.99	Bromide	Quad	6	0.9999	0.0000	0.568855	0.010287
5	7.82	Nitrate-N	Quad	6	0.9997	0.0000	2.738783	0.148955
Average:					0.9998	0.0000	2.3345	0.1042

~~6 CAL STD 6 = ICWS-9050 @ (2.ppm) →~~DKW
12/15/06

Sample Name: CAL STD 6 = ICWS-9050 @ (2.ppm)
 Vial Number: 103
 Sample Type: standard
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: #####
 Run Time (min): 10.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	Corr.Coeff. (R)	Offset	Slope	Curve
1	3.23	Fluoride	Quad	6	0.9997	0.0000	3.120830	0.155880
2	4.69	Chloride	Quad	6	0.9997	0.0000	1.867234	0.065694
3	5.53	Nitrite-N	Quad	6	0.9998	0.0000	3.376824	0.140386
4	6.99	Bromide	Quad	6	0.9999	0.0000	0.568855	0.010287
5	7.82	Nitrate-N	Quad	6	0.9997	0.0000	2.738783	0.148955
Average:					0.9998	0.0000	2.3345	0.1042

~~6~~ CAL STD 6 = ICWS-9050 @ (2.ppm) →OK
12/15/06

Sample Name: CAL STD 6 = ICWS-9050 @ (2.ppm)
 Vial Number: 103
 Sample Type: standard
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: #####
 Run Time (min): 10.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	Corr.Coeff. (R)	Offset	Slope	Curve
1	3.23	Fluoride	Quad	6	0.9997	0.0000	3.120830	0.155880
2	4.69	Chloride	Quad	6	0.9997	0.0000	1.867234	0.065694
3	5.53	Nitrite-N	Quad	6	0.9998	0.0000	3.376824	0.140386
4	6.99	Bromide	Quad	6	0.9999	0.0000	0.568855	0.010287
5	7.82	Nitrate-N	Quad	6	0.9997	0.0000	2.738783	0.148955
Average:					0.9998	0.0000	2.3345	0.1042

~~6 CAL STD 6 = ICWS-9050 @ (2.ppm)~~D/W
12/15/06

Sample Name: CAL STD 6 = ICWS-9050 @ (2.ppm)
 Vial Number: 103
 Sample Type: standard
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: #####
 Run Time (min): 10.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	Corr.Coeff. (R)	Offset	Slope	Curve
1	3.23	Fluoride	Quad	6	0.9997	0.0000	3.120830	0.155880
2	4.69	Chloride	Quad	6	0.9997	0.0000	1.867234	0.065694
3	5.53	Nitrite-N	Quad	6	0.9998	0.0000	3.376824	0.140386
4	6.99	Bromide	Quad	6	0.9999	0.0000	0.568855	0.010287
5	7.82	Nitrate-N	Quad	6	0.9997	0.0000	2.738783	0.148955
Average:					0.9998	0.0000	2.3345	0.1042

~~6 CAL STD 6 = ICWS-9050 @ (2.ppm)~~DFW
12/15/06

Sample Name: CAL STD 6 = ICWS-9050 @ (2.ppm)
 Vial Number: 103
 Sample Type: standard
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: #####
 Run Time (min): 10.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	Corr.Coeff. (R)	Offset	Slope	Curve
1	3.23	Fluoride	Quad	6	0.9997	0.0000	3.120830	0.155880
2	4.69	Chloride	Quad	6	0.9997	0.0000	1.867234	0.065694
3	5.53	Nitrite-N	Quad	6	0.9998	0.0000	3.376824	0.140386
4	6.99	Bromide	Quad	6	0.9999	0.0000	0.568855	0.010287
5	7.82	Nitrate-N	Quad	6	0.9997	0.0000	2.738783	0.148955
Average:					0.9998	0.0000	2.3345	0.1042

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 9/25/06 Chemist: DKW Expiration Date: 12/25/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWT-8837	F-	17125	ERA	12/31/07	1000 ppm	5.	50	100. mg/L (ppm) ✓
2. (intermed.)	Cl-	36065		6/30/07				
3. (calib.)	NO ₃ N	17075		7/31/07				
4. (source)	BR-	27025		2/28/07				
5.	NO ₃ N-	17026		2/28/08				
6. ICWT-8838	F-	1-38F-2	SPEX	8/15/07	1000 ppm	5.	50	100. ppm (mg/L) ✓
7. (intermed)	Cl-	1-5CL-2		3/15/07				
8. (2nd source)	NO ₃ N-	1-13NO ₃ N-2		9/15/07				
9.	BR-	1-1BR-2		4/30/07				
10.	NO ₃ N-	1-27NO ₃ N-2		5/15/07				
11.								
12.								
13.								
14.								

Reviewed By: DKW

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 12/14/06 Chemist: DW Expiration Date: 12/15/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWS-9045	F-	ICW I-	8837	12/25/06	100.8 ppm	0.075	100,	0.075 ppm ✓
2. (CAL ①)	Cl-							
3.	NO ₃ N-							
4.	BR-							
5.	NO ₃ N-							
6. ICWS-9046	F-					0.100		0.100 ppm ✓
7. (CAL ③)	Cl-							
8.	NO ₃ N-							
9.	BR-							
10.	NO ₃ N-							
11. ICWS-9047	F-					0.250		0.250 ppm ✓
12. (CAL ③)	Cl-							
13.	NO ₃ N-							
14. (D ⁵ W 12/14/06)	NO ₃ -BR							
15.	NO ₃ N-							

Reviewed By: DW 12/15/06

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 12/14/06 Chemist: DFW Expiration Date: 12/15/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWS-9048	F-	ICWI -	8837	12/25/06	100 PPM	0.500	100,	0.500 ppm
2. (CAL (4))	Cl-							
3.	NO ₃ N-							
4.	Br-							
5.	NO ₃ N-							
6. ICWS-9049	F-					1.		1. ppm
7. (CAL (5))	Cl-							
8. (+ cew)	NO ₃ N-							
9.	Br-							
10.	NO ₃ N-							
11. ICWS-9050	F-					2.		2. pp-
12. (CAL (6))	Cl-							
13.	NO ₃ N-							
14.	Br-							
15.	NO ₃ N-							

Reviewed By:

WC031R3.DOC, 8/28/03

Lot #:	Analysis Date:	File ID:	ICAL File ID:	2 nd ✓
HL110105, HL110106 <i>Front Hq</i>	12/18/06	HL110106	HL110106	✓
Review Items				
1. Were PM checklists (L40), Lot Summary and any applicable QAS reviewed?				✓
2. ICV within 90-110%R?				✓
3. ICV/CCB < 1/2 RL?				✓
4. CCVs/CCBs run after every 10 samples, and at end of sequence?				✓
5. Is %D ≤ 10% for each CCV?				✓
6. If CCV failed, was it rerun only once?				✓
7. LCS/LCSD analytes within 90-110%R? If no, list LCS ID:				N/A
8. Method blank < 1/2 RL? If no, list blank ID:				✓
9. Matrix spikes run at required frequency?				✓
10. Matrix spikes within 75-125% recovery? If no, list MS ID:				✓
11. Were MS run #'s assigned to all matrix spikes except reagent blanks?				✓
12. Sample analyses done within holding time (HT)? If no, list samples:				✓
13. Were results processed using correct ICAL?				✓
14. Are positive results within the calibration range?				✓
15. Is integration acceptable for all samples, QC samples and standards?				✓
16. For manual integrated standards and QC samples, are before/after chromatograms provided with initials/date/reason?				✓
17. Calculations checked for error? (Document manual calculation checks.)				✓
18. Were spreadsheets checked for transcription errors?				✓
19. Final report/F6 correct? (Verify results, RLs, units, qualifiers, DFs, dates, spikes.)				✓
20. Are all nonconformances documented and discussed in narrative?				✓
21. Appropriate air train autotext selected for narrative?				✓
22. Sample pH adjustment included in narrative?				N/A
23. Audit sample results included in narrative?				N/A
1 st Level Reviewer: <i>D. D. D.</i>				Date: 12/28/06
2 nd Level Reviewer: <i>JKTIR - 1/5-MS (B.0.0)</i>				Date: 80.919/79.904 = 73.1066
p. height = 0 + 0.568855(1.878) + 0.010287(1.878) ²				
= 0 + 0.1068 + 0.0004				
= 0.1072				

Nonconformance memos are required for bold and italicized [autotext] statements: **Bold** = deficiency, *italicized* = anomaly.

WC081R3.DOC, 6/16/06

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (ug/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (ug/mL)	LIMS DF	True Spike Amount (ug)
LCS	ICWI-8838	100.00	0.750	100.0	JL69G1AC	0.75	105.31	78.98
LCSD	ICWI-8838	100.00	0.750	100.0	JL69G1AD	0.75	105.31	78.98
MS (1)	ICWI-8838	100.00	0.020	10.0	JK7JR1AG	0.20	5,054.65	1,010.93
MSD (1)	ICWI-8838	100.00	0.020	10.0	JK7JR1AH	0.20	5,054.65	1,010.93
MS (2)	ICWI-8838	100.00	0.020	10.0	JK7J71AG	0.20	4,475.47	895.09
MSD (2)	ICWI-8838	100.00	0.020	10.0	JK7J71AH	0.20	4,475.47	895.09
MS (3)	ICWI-8838	100.00	0.020	10.0	JK7K01AF	0.20	1,053.05	210.61
MSD (3)								
MS (4)	ICWI-8838	100.00	0.020	10.0	JK7K41AF	0.20	1,053.05	210.61
MSD (4)								
MS (5)								
MSD (5)								

Comments:

True Spike Amount (ug) = Standard Concentration (ug/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

[illegible]

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (µg/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (µg/mL)	LIMS DF	True Spike Amount (µg)
LCS	ICWI-8838	100.00	0.750	100.0	JL8TM1AC	0.75	102.84	77.13
LCSD	ICWI-8838	100.00	0.750	100.0	JL8TM1AD	0.75	102.84	77.13
MS (1)	ICWI-8838	100.00	0.020	10.0	JK7JR1AJ	0.20	9,872.92	1,974.58
MSD (1)								
MS (2)	ICWI-8838	100.00	0.020	10.0	JK7K41AG	0.20	1,028.43	205.69
MSD (2)								
MS (3)								
MSD (3)								
MS (4)								
MSD (4)								
MS (5)								
MSD (5)								

True Spike Amount (µg) = Standard Concentration (µg/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

Comments:

STL Knoxville

SOP KNOX-WC-0005

Anions in Air Data Worksheet

Prep Date: 12/18/2006 0800

Prep Date: 12/18/2006 0800

Comp Date: 12/18/2006 0800

Analyte: Hydrogen Bromide

CAS #: 10035-10-6

QuantIMS #: 5645

Analyst Initials: DFW

Analyst LIMS Code: 072000

Instr. ID: 600

Reviewed by:

Date:

MW Factor: 1.012613887

[illegible]

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (µg/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (µg/mL)	LIMS DF	True Spike Amount (µg)
LCS	ICWI-8838	100.00	0.750	100.0	JL69F1AC	0.75	101.26	75.95
LCSD	ICWI-8838	100.00	0.750	100.0	JL69F1AD	0.75	101.26	75.95
MS (1)	ICWI-8838	100.00	0.020	10.0	JK7JR1AE	0.20	4,860.55	972.11
MSD (1)	ICWI-8838	100.00	0.020	10.0	JK7JR1AF	0.20	4,860.55	972.11
MS (2)	ICWI-8838	100.00	0.020	10.0	JK7J71AE	0.20	4,303.61	860.72
MSD (2)	ICWI-8838	100.00	0.020	10.0	JK7J71AF	0.20	4,303.61	860.72
MS (3)	ICWI-8838	100.00	0.020	10.0	JK7K01AE	0.20	1,012.61	202.52
MSD (3)								
MS (4)	ICWI-8838	100.00	0.020	10.0	JK7K41AE	0.20	1,012.61	202.52
MSD (4)								
MS (5)								
MSD (5)								

Comments:

True Spike Amount (µg) = Standard Concentration (µg/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

STL Knoxville

Dionex IC Runlog Cover Page

Analyst: DMW Date: 12/18/06 Sequence ID: LIBA-LOW_AIR_ANIONS-121806

Instrument: "Arasorn" ☒ DX-600 ☐ ICS-1500 ☐ DX-320 Method: ☐ KNOX-WC-0003, SW-846 0061/7199 ☐ KNOX-WC-0005, ☐ SW-846 9056 ☐ EPA 300.0 ☐ SW-846 9057-Mod ☒ EPA 26A-Mod ☐ KNOX-WC-0014, EPA 314.0

Preventive Maintenance	Instrument Conditions
Daily:	Flow Rate = <u>1.00</u> mL/min
☐ Check pump and gas pressure	Pressure = <u>2200.</u> psi
☐ Check all lines for crimping, leaks and discoloration	Conductance = <u>22.8</u> μ S
As Needed:	Suppressor Current = <u>43.</u> mA
☐ Change column and guard column	Eluent Generator = <u>N/A</u> mM KOH
☐ Change column and/or guard column bed support	
☐ Clean conductivity cell	
☐ De-gas pump head when flow is erratic	
☐ Check/replace eluant end line filter	

MS/MSD Spike Information

WO #	Compound	Spike ID	Parent Conc.	Spike Added (mL)	Final Volume (mL)	Final Conc.
JK7JR	F ⁻	Jcwt-8838	100. ppm	0.02	10 mL	0.20 ppm
	Cl ⁻					
	Br ⁻					
JK7J7	F ⁻					
	Cl ⁻					
	Br ⁻					
JK7K0	F ⁻					
	Cl ⁻					
	Br ⁻					
JK7K4	F ⁻					
	Cl ⁻					
	Br ⁻					
				<u>DMW 12/28/06</u>		

Comments:

HF Batch - 6361376

HBr Batch - 6361375

☐ Sodium Thiosulfate added to NaOH impinger samples.

Sequence: L18A_LOW_AIR_ANIONS_121806
Operator: wheelerd

Page 1 of 2
Printed: 12/19/2006 7:35:58 AM

Title:
Datasource: Aragorn_net
Location: IC_ARAGORN
Timebase: IC_Aragorn
#Samples: 36

Created: 12/18/2006 10:16:29 AM by wheelerd
Last Update: 12/19/2006 7:35:45 AM by wheelerd

DFW
12/19/06

No.	Name	Sample ID	Inj. Vol.	Inj. Date/Time	Dil. Factor	*Multiplier [Liters]	Weight
1	CAL STD 1 = ICWS-9045 @ (0.075ppm)		50.0	12/14/2006 4:54:12 PM	1.0000		1.0000
2	CAL STD 2 = ICWS-9046 @ (0.10ppm)		50.0	12/14/2006 5:11:38 PM	1.0000		1.0000
3	CAL STD 3 = ICWS-9047 @ (0.25ppm)		50.0	12/14/2006 5:24:03 PM	1.0000		1.0000
4	CAL STD 4 = ICWS-9048 @ (0.50ppm)		50.0	12/14/2006 5:36:29 PM	1.0000		1.0000
5	CAL STD 5 = ICWS-9049 @ (1.ppm)		50.0	12/14/2006 5:48:54 PM	1.0000		1.0000
6	CAL STD 6 = ICWS-9050 @ (2.ppm)		50.0	12/14/2006 6:01:20 PM	1.0000		1.0000
7	ICV/LCS= ICWS-9056		50.0	12/18/2006 10:17:27 AM	1.0000		1.0000
8	ICV/LCSD= ICWS-9057		50.0	12/18/2006 10:34:53 AM	1.0000		1.0000
9	ICB/ METHOD BLANK		50.0	12/18/2006 10:52:18 AM	1.0000		1.0000
10	H6L110105-JK7JR-1/10		50.0	12/18/2006 11:26:40 AM	10.0000		1.0000
11	H6L110106-JK7J7-1/10		50.0	12/18/2006 11:44:06 AM	10.0000		1.0000
12	H6L110105-JK7JR-1/20		50.0	12/18/2006 12:08:40 PM	20.0000		1.0000
13	H6L110105-JK7JR-1/10-MS		50.0	12/18/2006 12:43:28 PM	10.0000		1.0000
14	H6L110105-JK7JR/1/10-MSD		50.0	12/18/2006 1:00:54 PM	10.0000		1.0000
15	H6L110105-JK7JR-1/20-MS		50.0	12/18/2006 1:18:20 PM	20.0000		1.0000
16	CCV = ICWS-9058		50.0	12/18/2006 1:35:45 PM	1.0000		1.0000
17	CCB		50.0	12/18/2006 1:53:11 PM	1.0000		1.0000
18	H6L110106-JK7J7-1/10-MS		50.0	12/18/2006 2:10:37 PM	10.0000		1.0000
19	H6L110106-JK7J7-1/10-MSD		50.0	12/18/2006 2:28:03 PM	10.0000		1.0000
20	H6L110105-JK7JX-1/10		50.0	12/18/2006 2:47:03 PM	10.0000		1.0000
21	H6L110105-JK7J1-1/10		50.0	12/18/2006 3:04:28 PM	10.0000		1.0000
22	H6L110106-JK7KG-1/10		50.0	12/18/2006 3:21:54 PM	10.0000		1.0000
23	H6L110105-JK7KT-1/10		50.0	12/18/2006 3:39:19 PM	10.0000		1.0000
24	H6L110106-JK7K0-1/10		50.0	12/18/2006 3:56:45 PM	10.0000		1.0000
25	H6L110106-JK7K0-1/10-MS		50.0	12/18/2006 4:14:11 PM	10.0000		1.0000
26	H6L110106-JK7K4-1/10		50.0	12/18/2006 4:31:36 PM	10.0000		1.0000
27	H6L110106-JK7K4-1/10-MS		50.0	12/18/2006 4:49:02 PM	10.0000		1.0000
28	CCV= ICWS-9058		50.0	12/18/2006 5:06:27 PM	1.0000		1.0000
29	CCB		50.0	12/18/2006 5:23:52 PM	1.0000		1.0000
30	H6L110106-JK7K0-1/20		50.0	12/18/2006 5:41:18 PM	20.0000		1.0000
31	H6L110106-JK7K0-1/20-MS		50.0	12/18/2006 5:58:43 PM	20.0000		1.0000
32	H6L110106-JK7K0-1/40		50.0	12/18/2006 6:16:09 PM	40.0000		1.0000
33	H6L110106-JK7K0-1/40-MS		50.0	12/18/2006 6:33:34 PM	40.0000		1.0000
34	CCV= ICWS-9058		50.0	12/18/2006 6:50:59 PM	1.0000		1.0000
35	CCB		50.0	12/18/2006 7:08:24 PM	1.0000		1.0000
36	SHUTDOWN		50.0	12/18/2006 7:25:50 PM	1.0000		1.0000

7 ICV/LCS= ICWS-9056

Sample Name: ICV/LCS= ICWS-9056
 Vial Number: 104
 Sample Type: unknown
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: 12/18/2006 10:17
 Run Time (min): 15.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	2.42157	0.305	19.82	0.7480	BMB ✓
2	4.71	Chloride	1.43770	0.207	13.45	0.7502	BMB ✓
3	5.55	Nitrite-N	2.59076	0.450	29.23	0.7442	BMB ✓
4	7.01	Bromide	0.41601	0.083	5.39	0.7219	BMB ✓
5	7.87	Nitrate-N	2.11264	0.495	32.11	0.7415	BMB

HF - JL68-1AC
 HBr - JL69F-1AC
 HCl - JL8TM-1AC

8 ICV/LCSD= ICWS-9057

Sample Name: ICV/LCSD= ICWS-9057
 Vial Number: 105
 Sample Type: unknown
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: 12/18/2006 10:34
 Run Time (min): 15.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	2.43474	0.307	20.23	0.7519	BMB ✓
2	4.71	Chloride	1.45569	0.205	13.51	0.7593	BMB ✓
3	5.55	Nitrite-N	2.56761	0.424	27.92	0.7377	BMB ✓
4	7.01	Bromide	0.42719	0.086	5.70	0.7410	BMB ✓
5	7.86	Nitrate-N	2.12412	0.495	32.64	0.7454	BMB

HF-JL69G-1AD
 HBr-JL69F-1AD
 HCl-JL8TM-1AD

9 ICB/ METHOD BLANK

Sample Name: ICB/ METHOD BLANK
Vial Number: 139
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 10:52
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret. Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel. Area (%)	Amount (mg/L)	Peak Type
-----	---------------------	-----------	----------------	--	------------------	------------------	--------------

ND

HF- JLG9G-1AA
HB- JLG9F-1AA
HCL- JLG8TM-1AA

10 H6L110105-JK7JR-1/10

Sample Name: H6L110105-JK7JR-1/10
Vial Number: 140
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 11:26
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 10.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.84	Chloride	0.22437	0.101	0.17	1.1966	BMB
2	7.89	Nitrate-N	0.27174	0.062	0.10	0.9869	BMB
3	11.88	n.a.	#####	59.905	99.73	n.a.	BMB

HF-ND ✓
HBr-ND ✓
See '120 for Cl⁻

12 H6L110105-JK7JR-1/20

Sample Name: H6L110105-JK7JR-1/20
Vial Number: 142
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 12:08
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 20.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.78	Chloride	0.01857	0.002	0.01	0.1989	BMB*
2	5.04	n.a.	0.09017	0.030	0.11	n.a.	bMB*
3	7.90	Nitrate-N	0.13289	0.031	0.11	0.9679	BMB
4	11.98	n.a.	87.71361	28.254	99.78	n.a.	BMB

✓ < MDL

12 H6L110105-JK7JR-1/20

Sample Name: H6L110105-JK7JR-1/20
Vial Number: 142
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 12:08
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 20.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	5.04	n.a.	0.09017	0.030	0.11	n.a.	BMB
2	7.90	Nitrate-N	0.13289	0.031	0.11	0.9679	BMB
3	11.98	n.a.	87.71361	28.254	99.78	n.a.	BMB

13 H6L110105-JK7JR-1/10-MS

Sample Name:	H6L110105-JK7JR-1/10-MS	Injection Volume:	50.0
Vial Number:	143	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/18/2006 12:43	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.25	Fluoride	0.64968	0.098	0.17	2.0606	BMB ✓
2	3.78	n.a.	0.04771	0.005	0.01	n.a.	Rd
3	4.81	Chloride	0.50954	0.129	0.22	2.7031	BM
4	5.58	Nitrite-N	0.70996	0.114	0.20	2.0844	MB
5	7.03	Bromide	0.10718	0.020	0.04	1.8777	BMB ✓
6	7.89	Nitrate-N	0.81102	0.190	0.33	2.9150	BMB
7	11.90	n.a.	#####	57.455	99.04	n.a.	BMB

(Cl⁻ @ 1/20)

14 H6L110105-JK7JR/1/10-MSD

Sample Name:	H6L110105-JK7JR/1/10-MSD	Injection Volume:	50.0
Vial Number:	143	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/18/2006 13:00	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	1.63	n.a.	0.05595	0.061	0.10	n.a.	BMB
2	3.25	Fluoride	0.65594	0.080	0.13	2.0802	BMB ✓
3	4.81	Chloride	0.59188	0.145	0.24	3.1352	BM
4	5.58	Nitrite-N	0.76124	0.129	0.21	2.2336	MB
5	7.03	Bromide	0.10691	0.019	0.03	1.8730	BMB ✓
6	7.89	Nitrate-N	0.83533	0.189	0.31	3.0010	BMB
7	11.89	n.a.	#####	60.336	98.98	n.a.	BMB

(Cl⁻ @ 1/20)

15 H6L110105-JK7JR-1/20-MSCl⁻

Sample Name:	H6L110105-JK7JR-1/20-MS	Injection Volume:	50.0
Vial Number:	144	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	20.0000 ✓
Recording Time:	12/18/2006 13:18	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.24	Fluoride	0.68741	0.083	0.27	4.3579	BMB
2	4.76	Chloride	0.39494	0.093	0.31	4.1992	BMB
3	5.58	Nitrite-N	0.76522	0.122	0.40	4.4903	bMB
4	7.02	Bromide	0.12440	0.025	0.08	4.3565	BMB
5	7.89	Nitrate-N	0.75269	0.177	0.58	5.4168	BMB
6	11.97	n.a.	92.95436	30.056	98.36	n.a.	BMB

16 CCV = ICWS-9058

Sample Name:	CCV = ICWS-9058	Injection Volume:	50.0
Vial Number:	147	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/18/2006 13:35	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret. Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel. Area (%)	Amount (mg/L)	Peak Type
1	2.85	n.a.	0.18302	0.106	4.79	n.a.	BMB*
2	3.25	Fluoride	3.26791	0.404	18.23	0.9974	Rd*
3	4.73	Chloride	1.95319	0.274	12.36	1.0101	BMB
4	5.57	Nitrite-N	3.51969	0.608	27.45	1.0007	BMB
5	7.03	Bromide	0.58477	0.123	5.55	1.0095	BMB
6	7.88	Nitrate-N	2.90661	0.677	30.56	1.0062	BMB
7	12.05	n.a.	0.07024	0.023	1.05	n.a.	BMB

16 CCV = ICWS-9058

Sample Name: CCV = ICWS-9058
 Vial Number: 147
 Sample Type: unknown
 Control Program: ANIONS_AS14A
 Quantif. Method: ANIONS
 Recording Time: 12/18/2006 13:35
 Run Time (min): 15.00

Injection Volume: 50.0
 Channel: ECD_1
 Wavelength: n.a.
 Bandwidth: n.a.
 Dilution Factor: 1.0000
 Sample Weight: 1.0000
 Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.85	n.a.	0.18302	0.052	2.35	n.a.	BM
2	3.25	Fluoride	3.36406	0.458	20.68	1.0254	MB
3	4.73	Chloride	1.95319	0.274	12.36	1.0101	BMB
4	5.57	Nitrite-N	3.51969	0.608	27.45	1.0007	BMB
5	7.03	Bromide	0.58477	0.123	5.55	1.0095	BMB
6	7.88	Nitrate-N	2.90661	0.677	30.56	1.0062	BMB
7	12.05	n.a.	0.07024	0.023	1.05	n.a.	BMB

17 CCB

Sample Name:	CCB	Injection Volume:	50.0
Vial Number:	148	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/18/2006 13:53	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
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ND

20 H6L110105-JK7JX-1/10

Sample Name:	H6L110105-JK7JX-1/10	Injection Volume:	50.0
Vial Number:	151	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	10.0000
Recording Time:	12/18/2006 14:47	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.90	Chloride	0.21936	0.099	0.16	1.1700	BMB
2	7.92	Nitrate-N	0.10116	0.021	0.03	0.3686	BMB
3	10.78	n.a.	0.15002	0.046	0.07	n.a.	BMB
4	11.89	n.a.	#####	61.095	99.73	n.a.	BMB

HF - (ND) ✓
HBr - (ND) ✓

21 H6L110105-JK7J1-1/10

Sample Name: H6L110105-JK7J1-1/10
Vial Number: 152
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 15:04
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 10.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.93	Chloride	0.17515	0.073	0.15	0.9350	BMB^
2	7.92	Nitrate-N	0.11589	0.025	0.05	0.4222	BMB
3	11.92	n.a.	#####	47.743	99.79	n.a.	BMB

HF - ND ✓
HBr - ND ✓

28 CCV= ICWS-9058

Sample Name: CCV= ICWS-9058
Vial Number: 166
Sample Type: unknown
Control Program: ANIONS_AS14A
Quantif. Method: ANIONS
Recording Time: 12/18/2006 17:06
Run Time (min): 15.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 1.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area µS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.25	Fluoride	3.29330	0.422	19.95	1.0048	BMB ✓
2	4.73	Chloride	1.92845	0.274	12.94	0.9978	BMB ✓
3	5.58	Nitrite-N	3.53011	0.610	28.81	1.0035	BMB ✓
4	7.06	Bromide	0.58345	0.124	5.88	1.0073	BM ✓
5	7.92	Nitrate-N	2.89375	0.686	32.42	1.0020	MB ✓

29 CCB

Sample Name:	CCB	Injection Volume:	50.0
Vial Number:	167	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	ANIONS_AS14A	Bandwidth:	n.a.
Quantif. Method:	ANIONS	Dilution Factor:	1.0000
Recording Time:	12/18/2006 17:23	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (µS)	Area µS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
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ND

Lot #:	File ID:	Analysis Date:	File ID:	ICAL File ID:	2 nd ✓
H6 L110105 (BH)	12/18/06	12/18/06	L18-LowLevel-FC1N02BrN03-121806	J18-LowLevel-FC1N02BrN03-101806	
Review Items					
1. Were PM checklists (L40), Lot Summary and any applicable QAS reviewed?	NA	Yes	No	If No, why is data reportable?	2 nd ✓
2. ICV within 90-110%R?	✓	✓			✓
3. ICB/CCB < 1/2 RL?	✓	✓		□ [ccb1] No analyte > MDL in associated samples.	✓
4. CCVs/CCBs run after every 10 samples, and at end of sequence?	✓	✓			✓
5. Is %D ≤ 10% for each CCV?	✓	✓			✓
6. If CCV failed, was it rerun only once?	✓	✓			NA
7. LCS/LCSD analytes within 90-110%R? If no, list LCS ID:	✓	✓		□ [lcs3] LCS recovery > upper control limit & sample results < RL.	✓
8. Method blank < 1/2 RL? If no, list blank ID:	✓	✓		□ [mb3] No analyte > RL in associated samples.	✓
9. Matrix spikes run at required frequency?	✓	✓		□ [mb7] Sample results > 10x higher than blank.	✓
10. Matrix spikes within 75-125% recovery? If no, list MS ID:	✓	✓		□ [air ms1] MS %R slightly outside limits for 1 sample.	✓
11. Were MS run #'s assigned to all matrix spikes except reagent blanks?	✓	✓		□ [air ms2] MS %R slightly outside limits for > 1 sample.	✓
12. Sample analyses done within holding time (HT)? If no, list samples:	✓	✓		□ Air train reagent blank - spike result not reported.	✓
13. Were results processed using correct ICAL?	✓	✓		□ [ht1] HT expired upon receipt.	✓
14. Are positive results within the calibration range?	✓	✓		□ [ht2] Analysis requested after HT expired.	✓
15. Is integration acceptable for all samples, QC samples and standards?	✓	✓			✓
16. For manual integrated standards and QC samples, are before/after chromatograms provided with initials/date/reason?	✓	✓		Reasons: S=Split peak, U=Undetected peak, I=Incorrect peak integration, B=Baseline correction, W=Wrong peak chosen by data system.	✓
17. Calculations checked for error? (Document manual calculation checks.)	✓	✓			✓
18. Were spreadsheets checked for transcription errors?	✓	✓			✓
19. Final report/F6 correct? (Verify results, RLs, units, qualifiers, DPs, dates, spikes.)	✓	✓			✓
20. Are all nonconformances documented and discussed in narrative?	✓	✓		List NCM #:	✓
21. Appropriate air train autotext selected for narrative?	✓	✓		□ [air1] Cl ⁻ reported as HCl and Cl ₂ .	✓
				□ [air2] Cl ⁻ reported as HCl only.	
				□ [air3] Cl ⁻ , F ⁻ reported as HCl, Cl ₂ , HF.	
				□ [air4] Cl ⁻ , F ⁻ , Br ⁻ reported as HCl, Cl ₂ , HF, HBr, Br ₂ .	
				□ [air5] Cl ⁻ , F ⁻ , NO ₂ ⁻ , NO ₃ ⁻ reported as HCl, Cl ₂ , HF, HNO ₂ , HNO ₃ .	
				□ [air6] Cl ⁻ , F ⁻ , Br ⁻ , I ⁻ reported as HCl, Cl ₂ , HF, HBr, Br ₂ , I ₂ .	
				□ [air7] Cl ⁻ , F ⁻ , NO ₂ ⁻ , NO ₃ ⁻ reported as Cl ⁻ , F ⁻ , NO ₂ ⁻ , NO ₃ ⁻ .	
22. Sample pH adjustment included in narrative?	✓	✓		□ [air pH] Sample pH adjusted prior to analysis.	NA
23. Audit sample results included in narrative?	✓	✓		□ [audit2] Audit results in mg/L.	NA
1st Level Reviewer: <i>Dawson</i> 2nd Level Reviewer: <i>KW</i> Date: 12/28/06					
<i>Height = 2.19733(0.7584) + 0.033598(0.7584)² = 1.68577</i>					
<i>SLWAAIAC(CO⁻)</i>					
<i>498.8 ug</i>					

Nonconformance memos are required for **bold** and *italicized* [autotext] statements: **Bold** = deficiency, *italicized* = anomaly.

Batch #: 6354400
Prep Date: 12/18/2006 0000
Comp Date: 12/18/2006 0000

Reviewed by:
Date: 12/28/06
MW Factor: 1.053051836

Analyte: Hydrogen Fluoride	Analyst Initials: DFW
CAS #: 7664-39-3	Analyst LIMS Code: 072000
QuantIMS #: 5646	Instr. ID: 1500

Batch #: 0554400
Prep Date: 12/18/2006 0000
Comp Date: 12/18/2006 0000

[illegible]

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (ug/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (ug/mL)	LIMS DF	True Spike Amount (ug)
LCS	ICWI-8838	100.00	0.750	100.0	JLV9M1AC	0.75	105.31	78.98
LCSD	ICWI-8838	100.00	0.750	100.0	JLV9M1AD	0.75	105.31	78.98
MS (1)	ICWI-8838	100.00	0.020	10.0	JK7JW1AE	0.20	2,527.32	505.46
MSD (1)	ICWI-8838	100.00	0.020	10.0	JK7JW1AF	0.20	2,527.32	505.46
MS (2)								
MSD (2)								
MS (3)								
MSD (3)								
MS (4)								
MSD (4)								
MS (5)								
MSD (5)								

True Spike Amount (ug) = Standard Concentration (ug/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

Comments:

STL Knoxville

SOP KNOX-WC-0005

Anions in Air Data Worksheet

Batch #: 6354401

Prep Date: 12/18/2006 0000

Comp Date: 12/18/2006 0000

Analyte: Chlorine

CAS #: 7782-50-5

QuantIMS #: 515

Analyst Initials: DFW

Analyst LIMS Code: 072000

Inst. ID: 1500

Reviewed by:

Date:

MW Factor: 1.0

[illegible]

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (ug/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (ug/mL)	LIMS DF	True Spike Amount (ug)
LCS	ICWI-8838	100.00	0.750	100.0	JLWAA1AC	0.75	100.00	75.00
LCSD	ICWI-8838	100.00	0.750	100.0	JLWAA1AD	0.75	100.00	75.00
MS (1)	ICWI-8838	100.00	0.020	10.0	JK7JW1AG	0.20	2,400.00	480.00
MSD (1)	ICWI-8838	100.00	0.020	10.0	JK7JW1AH	0.20	2,400.00	480.00
MS (2)								
MSD (2)								
MS (3)								
MSD (3)								
MS (4)								
MSD (4)								
MS (5)								
MSD (5)								

True Spike Amount (ug) = Standard Concentration (ug/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

Comments:

STL Knoxville

SOP KNOX-WC-0005

Anions in Air Data Worksheet

Rep Date: 12/18/2006 0000

Rep Date: 12/18/2006 0000

Print Date: 12/18/2006 0000

CAS #: 7726-95-6

QuantIMS #: 3450

Analyst LIMS Code: 072000

Instr. ID: 1500

Date:

MW Factor: 1.0

[illegible]

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (µg/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (µg/mL)	LIMS DF	True Spike Amount (µg)
LCS	ICWI-8838	100.00	0.750	100.0	JLWCC1AC	0.75	100.00	75.00
LCSD	ICWI-8838	100.00	0.750	100.0	JLWCC1AD	0.75	100.00	75.00
MS (1)	ICWI-8838	100.00	0.020	10.0	JK7JW1AJ	0.20	2,400.00	480.00
MSD (1)	ICWI-8838	100.00	0.020	10.0	JK7JW1AK	0.20	2,400.00	480.00
MS (2)								
MSD (2)								
MS (3)								
MSD (3)								
MS (4)								
MSD (4)								
MS (5)								
MSD (5)								

Comments:

True Spike Amount (µg) = Standard Concentration (µg/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

[illegible]

Comments: Caustic impinger fractions —

(F- Batch # 6354400
Cl- " # 6354401
Br- " # 6354402)

☒ Sodium Thiosulfate added to NaOH impinger samples.

Sequence: L18_LOWLEVEL_FCLNO2BRNO3_121806
 Operator: wheelerd

Page 1 of 3
 Printed: 12/18/2006 4:41:28 PM

Title:
 Datasource: ICS_1500_net
 Location: ICS1500
 Timebase: ICS1500
 #Samples: 18

Created: 12/18/2006 10:07:19 AM by wheelerd
 Last Update: 12/18/2006 4:41:08 PM by wheelerd

(DFW)
 (12/18/06)

No.	Name	Sample ID	Inj. Vol.	Inj. Date/Time	Dil. Factor	*Multiplier [Liters]	Weight
1	CAL STD #1 ICWS-8915		50.0	10/18/2006 9:14:56 AM	1.0000		1.0000
2	CAL STD #2 ICWS-8916		50.0	10/18/2006 9:32:20 AM	1.0000		1.0000
3	CAL STD #3 ICWS-8917		50.0	10/18/2006 9:49:45 AM	1.0000		1.0000
4	CAL STD #4 ICWS-8918		50.0	10/18/2006 10:07:09 AM	1.0000		1.0000
5	CAL STD #5 ICWS-8919		50.0	10/18/2006 10:24:33 AM	1.0000		1.0000
6	CAL STD #6 ICWS-8920		50.0	10/18/2006 10:41:57 AM	1.0000		1.0000
7	ICV/LCS= ICWS-9056		50.0	12/18/2006 10:08:03 AM	1.0000		1.0000
8	ICV/LCSD= ICWS-9057		50.0	12/18/2006 10:25:28 AM	1.0000		1.0000
9	ICB/METHOD BLANK		50.0	12/18/2006 10:42:51 AM	1.0000		1.0000
10	H6L110105-JK7JW-1/10		50.0	12/18/2006 11:24:20 AM	10.0000		1.0000
11	H6L110105-JK7JW-1/20		50.0	12/18/2006 12:04:01 PM	20.0000		1.0000
12	H6L110105-JK7JW-1/10-MS		50.0	12/18/2006 12:55:50 PM	10.0000		1.0000
13	H6L110105-JK7JW-1/10-MSD		50.0	12/18/2006 1:25:14 PM	10.0000		1.0000
14	H6L110105-JK7J0-1/10		50.0	12/18/2006 2:21:35 PM	10.0000		1.0000
15	H6L110105-JK7J2-1/10		50.0	12/18/2006 2:50:59 PM	10.0000		1.0000
16	CCV= ICWS-9058		50.0	12/18/2006 3:42:58 PM	1.0000		1.0000
17	CCB		50.0	12/18/2006 4:00:23 PM	1.0000		1.0000
18	SHUTDOWN		50.0	12/11/2006 6:12:53 PM	1.0000		1.0000

7 ICV/LCS= ICWS-9056

Sample Name:	ICV/LCS= ICWS-9056	Injection Volume:	50.0
Vial Number:	1296	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/18/2006 10:08	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.22	Fluoride	2.15196	0.402	19.55	0.7543	BMB ✓
2	4.52	Chloride	1.68575	0.272	13.22	0.7584	BMB ✓
3	5.26	Nitrite-N	3.02418	0.590	28.69	0.7749	BMB ✓
4	6.50	Bromide	0.53885	0.114	5.54	0.7556	BM ✓
5	7.25	Nitrate-N	2.77486	0.679	33.00	0.7714	MB

F⁻ = JLV9M1AC

Cl⁻ = JLWAA1AC

Br⁻ = JLWCC1AC

8 ICV/LCSD= ICWS-9057

Sample Name:	ICV/LCSD= ICWS-9057	Injection Volume:	50.0
Vial Number:	1297	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/18/2006 10:25	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.22	Fluoride	2.15346	0.399	19.43	0.7548	BMB ✓
2	4.52	Chloride	1.68956	0.275	13.40	0.7601	BM ✓
3	5.26	Nitrite-N	3.01778	0.579	28.25	0.7733	MB
4	6.50	Bromide	0.54226	0.115	5.60	0.7604	Ru ✓
5	7.25	Nitrate-N	2.78137	0.684	33.33	0.7732	BMB

F- = JLV9MIAD

Cl- = JLVAAIAD

Br- = JLVCCIAD

9 ICB/ METHOD BLANK

Sample Name:	ICB/ METHOD BLANK	Injection Volume:	50.0
Vial Number:	1298	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/18/2006 10:42	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
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ND

F- = JLV9M1AA

Cl- = JLWAA1AA

Br- = JLWCC1AA

10 H6L110105-JK7JW-1/10

Sample Name:	H6L110105-JK7JW-1/10	Injection Volume:	50.0
Vial Number:	1294	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS_CI2 METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	10.0000
Recording Time:	12/18/2006 11:24	Sample Weight:	1.0000
Run Time (min):	27.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	1.86348	0.365	0.39	n.a.	BMB
2	3.21	Fluoride	0.04144	0.006	0.01	0.1539	BMB*
3	4.61	Chloride	0.40372	0.157	0.17	1.8322	BM ✓
4	5.26	Nitrite-N	0.22267	0.065	0.07	0.5846	MB
5	11.21	n.a.	69.83583	22.220	24.01	n.a.	BMB
6	20.05	n.a.	74.82854	69.717	75.35	n.a.	BMB

Br⁻ = ND

10 H6L110105-JK7JW-1/10

Sample Name:	H6L110105-JK7JW-1/10	Injection Volume:	50.0
Vial Number:	1294	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS_CI2 METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	10.0000
Recording Time:	12/18/2006 11:24	Sample Weight:	1.0000
Run Time (min):	27.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	1.86348	0.365	0.39	n.a.	BMB
2	4.61	Chloride	0.40372	0.157	0.17	1.8322	BM ✓
3	5.26	Nitrite-N	0.22267	0.065	0.07	0.5846	MB
4	11.21	n.a.	69.83583	22.220	24.02	n.a.	BMB
5	20.05	n.a.	74.82854	69.717	75.35	n.a.	BMB

11 H6L110105-JK7JW-1/20

Sample Name:	H6L110105-JK7JW-1/20	Injection Volume:	50.0
Vial Number:	1294	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS_C12 METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	20.0000
Recording Time:	12/18/2006 12:04	Sample Weight:	1.0000
Run Time (min):	27.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	1.26942	0.250	0.32	n.a.	BMB
2	4.74	Chloride	0.16018	0.071	0.09	1.4563	BM
3	5.25	Nitrite-N	0.09131	0.020	0.03	0.4800	MB
4	11.24	n.a.	32.26087	10.131	12.85	n.a.	BMB
5	20.06	n.a.	73.77920	68.344	86.71	n.a.	BMB

(Not used)
Report %

12 H6L110105-JK7JW-1/10-MS

Sample Name:	H6L110105-JK7JW-1/10-MS	Injection Volume:	50.0
Vial Number:	1316	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS_CI2 METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	10.0000
Recording Time:	12/18/2006 12:55	Sample Weight:	1.0000
Run Time (min):	27.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	1.85981	0.362	0.39	n.a.	BM
2	3.21	Fluoride	0.53915	0.100	0.11	1.9737	MB ✓
3	4.59	Chloride	0.90957	0.224	0.24	4.1136	BM ✓
4	5.26	Nitrite-N	1.06034	0.222	0.24	2.7633	MB
5	6.49	Bromide	0.15083	0.031	0.03	2.1243	BM ✓
6	7.25	Nitrate-N	0.73745	0.176	0.19	2.1095	MB
7	11.20	n.a.	70.20606	22.386	23.92	n.a.	BMB
8	20.03	n.a.	75.25857	70.079	74.89	n.a.	BMB

$$\textcircled{\text{Cl}^-} \left(\frac{4.1136 - 1.8322}{\text{ppm}} = \frac{2.2814}{\text{ppm}} \right) / 2 \text{ ppm} = 114\% \quad \textcircled{\text{Cl}^-} \text{mw}$$

13 H6L110105-JK7JW-1/10-MSD

Sample Name:	H6L110105-JK7JW-1/10-MSD	Injection Volume:	50.0
Vial Number:	1317	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS_C12 METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	10.0000
Recording Time:	12/18/2006 13:25	Sample Weight:	1.0000
Run Time (min):	27.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	1.87485	0.366	0.39	n.a.	BM
2	3.21	Fluoride	0.53591	0.099	0.11	1.9620	MB ✓
3	4.59	Chloride	0.92603	0.232	0.25	4.1875	BM ✓
4	5.26	Nitrite-N	1.07515	0.236	0.25	2.8015	MB
5	6.49	Bromide	0.14608	0.031	0.03	2.0576	BMB ✓
6	7.25	Nitrate-N	0.75239	0.181	0.19	2.1518	BMB
7	11.20	n.a.	70.38196	22.422	23.82	n.a.	BMB
8	20.02	n.a.	75.60729	70.554	74.96	n.a.	BMB

14 H6L110105-JK7J0-1/10

Sample Name:	H6L110105-JK7J0-1/10	Injection Volume:	50.0
Vial Number:	1317	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS_C12 METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	10.0000
Recording Time:	12/18/2006 14:21	Sample Weight:	1.0000
Run Time (min):	27.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	1.95991	0.383	0.39	n.a.	BMB*
2	3.21	Fluoride	0.02778	0.003	0.00	0.1032	BMB*
3	4.61	Chloride	0.42305	0.155	0.16	1.9197	BM *
4	5.24	Nitrite-N	0.10530	0.023	0.02	0.2767	MB*
5	11.17	n.a.	81.46681	26.162	26.90	n.a.	BMB
6	20.00	n.a.	75.82434	70.516	72.52	n.a.	BMB

Br- = ND

14 H6L110105-JK7J0-1/10

Sample Name: H6L110105-JK7J0-1/10
Vial Number: 1317
Sample Type: unknown
Control Program: AS14A ANIONS_CI2 METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 12/18/2006 14:21
Run Time (min): 27.00

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 10.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	1.96014	0.384	0.39	n.a.	BM
2	3.43	n.a.	0.05222	0.011	0.01	n.a.	MB
3	4.14	n.a.	0.12638	0.031	0.03	n.a.	BMB
4	4.61	Chloride	0.40312	0.126	0.13	1.8295	BMB
5	11.17	n.a.	81.46681	26.162	26.91	n.a.	BMB
6	20.00	n.a.	75.82434	70.516	72.53	n.a.	BMB

15 H6L110105-JK7J2-1/10

Sample Name: H6L110105-JK7J2-1/10
Vial Number: 1318
Sample Type: unknown
Control Program: AS14A ANIONS METHOD
Quantif. Method: AS4A-SC ANION METHOD
Recording Time: 12/18/2006 14:50
Run Time (min): 27.01

Injection Volume: 50.0
Channel: ECD_1
Wavelength: n.a.
Bandwidth: n.a.
Dilution Factor: 10.0000
Sample Weight: 1.0000
Sample Amount: 1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	1.83224	0.353	0.38	n.a.	BMB
2	3.20	Fluoride	0.02288	0.004	0.00	0.0850	BMB*
3	4.61	Chloride	0.39417	0.149	0.16	1.7890	BM
4	5.25	Nitrite-N	0.29412	0.064	0.07	0.7717	MB
5	7.27	Nitrate-N	0.06279	0.016	0.02	0.1814	BMB
6	11.19	n.a.	70.42751	22.416	23.99	n.a.	BMB
7	20.00	n.a.	75.72053	70.444	75.39	n.a.	BMB

Br- = ND

15 H6L110105-JK7J2-1/10

Sample Name:	H6L110105-JK7J2-1/10	Injection Volume:	50.0
Vial Number:	1318	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS_C12 METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	10.0000
Recording Time:	12/18/2006 14:50	Sample Weight:	1.0000
Run Time (min):	27.01	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	1.83224	0.353	0.38	n.a.	BMB
2	4.61	Chloride	0.39417	0.149	0.16	1.7890	BM
3	5.25	Nitrite-N	0.29412	0.064	0.07	0.7717	MB
4	7.27	Nitrate-N	0.06279	0.016	0.02	0.1814	BMB
5	11.19	n.a.	70.42751	22.416	23.99	n.a.	BMB
6	20.00	n.a.	75.72053	70.444	75.39	n.a.	BMB

16 CCV= ICWS-9058

Sample Name:	CCV= ICWS-9058	Injection Volume:	50.0
Vial Number:	1370	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/18/2006 15:42	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.21	Fluoride	2.86013	0.531	19.13	0.9852	BM ✓
2	4.51	Chloride	2.24631	0.369	13.32	1.0068	M ✓
3	5.24	Nitrite-N	4.01998	0.788	28.41	1.0217	M ✓
4	6.48	Bromide	0.72019	0.152	5.49	1.0078	Ru ✓
5	7.22	Nitrate-N	3.76823	0.934	33.65	1.0339	MB

17 CCB

Sample Name:	CCB	Injection Volume:	50.0
Vial Number:	1371	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/18/2006 16:00	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
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ND

STL, Knoxville Anions in Air Data Review / Narrative Checklist for Methods 9056/9057/26A, SOP KNOX-WC-0005, Rev. 8

Lot #:	Analysis Date:	File ID:	LCS Level	FU/LV	ICAL File ID:	2nd ✓
H6L10105 H6L10106	12/28/06	12/28/06	Low Level	FU/LV	ICAL File ID: J18-LowLevel-FU/LV-BRN-4-10106	✓
Review Items						
1. Were PM checklists (L40), Lot Summary and any applicable QAS reviewed?						
2. ICV within 90-110%R?						
3. ICB/CCB < 1/2 RL?						
4. CCVs/CCBs run after every 10 samples, and at end of sequence?						
5. Is %D ≤ 10% for each CCV?						
6. If CCV failed, was it rerun only once?						
7. LCS/LCSD analytes within 90-110%R? If no, list LCS ID:						
8. Method blank < 1/2 RL? If no, list blank ID:						
9. Matrix spikes run at required frequency?						
10. Matrix spikes within 75-125% recovery? If no, list MS ID:						
11. Were MS run #'s assigned to all matrix spikes except reagent blanks?						
12. Sample analyses done within holding time (HT)? If no, list samples:						
13. Were results processed using correct ICAL?						
14. Are positive results within the calibration range?						
15. Is integration acceptable for all samples, QC samples and standards?						
16. For manual integrated standards and QC samples, are before/after chromatograms provided with initials/date/reason?						
17. Calculations checked for error? (Document manual calculation checks.)						
18. Were spreadsheets checked for transcription errors?						
19. Final report/F6 correct? (Verify results, RLs, units, qualifiers, DFs, dates, spikes.)						
20. Are all nonconformances documented and discussed in narrative?						
21. Appropriate air train autotext selected for narrative?						
22. Sample pH adjustment included in narrative?						
23. Audit sample results included in narrative?						
1st Level Reviewer:	Date: 12/29/06	2nd Level Reviewer:	Date: 12/29/06			
JL9AA (LCS)	Dawhul	Murphy				
Height = $2.19733(0.7501) + 0.033578(0.7501)^2 = 1.667$						
JK 757(ms) HCL: $7.9 \text{ } \mu\text{g/ml} \times 4.25 \text{ ml} \times (1.0079 + 35.453) = 346.69 \text{ } \mu\text{s}$						

Batch #: 6363147
Prep Date: 12/28/2006 0000
Comp Date: 12/28/2006 0000

Comp Date: 12/28/2006 0000

CAS #: 7647-01-0

Analyst LIMS Code: 072000

Date: 12/29/06

instr. ID: 1500

H6L110105, H6L110106 Batch 6363147.xls

STL Knoxville
SOP KNOX-WC-0005
Anions in Air Data Worksheet

Spike Information:

Spike	Std. ID	Std. Conc. (µg/mL)	Spike Added (mL)	Final Volume (mL)	Work Order	True Spike Conc. (µg/mL)	LIMS DF	True Spike Amount (µg)
LCS	ICWI-9087	100.00	0.750	100.0	JL9AA1AC	0.75	102.84	77.13
LCSD	ICWI-9087	100.00	0.750	100.0	JL9AA1AD	0.75	102.84	77.13
MS (1)	ICWI-9087	100.00	0.020	10.0	JK7JX1AE	0.20	19,128.78	3,825.76
MSD (1)	ICWI-9087	100.00	0.020	10.0	JK7JX1AF	0.20	19,128.78	3,825.76
MS (2)	ICWI-9087	100.00	0.020	10.0	JK7J71AJ	0.20	17,483.30	3,496.66
MSD (2)	ICWI-9087	100.00	0.020	10.0	JK7J71AK	0.20	17,483.30	3,496.66
MS (3)								
MSD (3)								
MS (4)								
MSD (4)								
MS (5)								
MSD (5)								

True Spike Amount (µg) = Standard Concentration (µg/mL) x Spike Added (mL) / Final Volume (mL) x LIMS DF

Comments:

Instrument:	☐ DX-600	Method:	☐ KNOX-WC-0003, SW-846 0061/7199
	☒ ICS-1500		☐ KNOX-WC-0005, ☐ SW-846 9056 ☐ EPA 300.0 ☐ SW-846 9057-Mod ☒ EPA 26A-Mod
	☐ DX-320		☐ KNOX-WC-0014, EPA 314.0

Preventive Maintenance	Instrument Conditions	
<u>Daily:</u>	Flow Rate =	1.00 mL/min
☒ Check pump and gas pressure	Pressure =	1840. psi
☒ Check all lines for crimping, leaks and discoloration	Conductance =	24.9 μ S
<u>As Needed:</u>	Suppressor Current =	43 mA
☐ Change column and guard column	Eluent Generator =	N/A mM KOH
☐ Change column and/or guard column bed support		
☐ Clean conductivity cell		
☐ De-gas pump head when flow is erratic		
☐ Check/replace eluant end line filter		

[illegible]

Comments: HCL Batch 6363147

☐ Sodium Thiosulfate added to NaOH impinger samples.

Sequence: L28_LOWLEVEL_FCLNO2BRNO3_122806
 Operator: wheelerd

Page 1 of 2
 Printed: 12/29/2006 8:55:10 AM

Title:

Datasource: ICS_1500_net

Location: ICS1500

Timebase: ICS1500

#Samples: 34

Created: 12/28/2006 10:49:27 AM by wheelerd

Last Update: 12/28/2006 4:28:05 PM by wheelerd

(DFW)
 12/29/06

No.	Name	Sample ID	Inj. Vol.	Inj. Date/Time	Dil. Factor	*Multiplier [Liters]	Weight
1	ICAL STD #1 ICWS-8915		50.0	10/18/2006 9:14:56 AM	1.0000		1.0000
2	ICAL STD #2 ICWS-8916		50.0	10/18/2006 9:32:20 AM	1.0000		1.0000
3	ICAL STD #3 ICWS-8917		50.0	10/18/2006 9:49:45 AM	1.0000		1.0000
4	ICAL STD #4 ICWS-8918		50.0	10/18/2006 10:07:09 AM	1.0000		1.0000
5	ICAL STD #5 ICWS-8919		50.0	10/18/2006 10:24:33 AM	1.0000		1.0000
6	ICAL STD #6 ICWS-8920		50.0	10/18/2006 10:41:57 AM	1.0000		1.0000
7	ICV/LCS= ICWS-9088		50.0	12/28/2006 1:24:09 PM	1.0000		1.0000
8	ICV/LCSD= ICWS-9089		50.0	12/28/2006 1:41:33 PM	1.0000		1.0000
9	ICB/ METHOD BLANK		50.0	12/28/2006 1:58:57 PM	1.0000		1.0000
10	H6L110106-JK7J7-1/20		50.0	12/28/2006 2:16:22 PM	20.0000		1.0000
11	H6L110106-JK7J7-1/20-MS@0.2ppm Cl		50.0	12/28/2006 2:40:20 PM	20.0000		1.0000
12	H6L110106-JK7J7-1/20-MSD@0.2ppm Cl		50.0	12/28/2006 2:57:44 PM	20.0000		1.0000
13	H6L110106-JK7J7-1/40		50.0	12/28/2006 3:15:08 PM	40.0000		1.0000
14	H6L110106-JK7J7-1/40-MS@0.2ppm Cl		50.0	12/28/2006 3:34:42 PM	40.0000		1.0000
15	H6L110106-JK7J7-1/40-MSD@0.2ppm Cl		50.0	12/28/2006 3:52:06 PM	40.0000		1.0000
16	CCV= ICWS-9090		50.0	12/28/2006 4:09:30 PM	1.0000		1.0000
17	CCB		50.0	12/28/2006 4:26:54 PM	1.0000		1.0000
18	H6L110105-JK7JX-1/20		50.0	12/28/2006 4:44:18 PM	20.0000		1.0000
19	H6L110105-JK7JX-1/40		50.0	12/28/2006 5:01:43 PM	40.0000		1.0000
20	H6L110105-JK7J1-1/20		50.0	12/28/2006 5:19:07 PM	20.0000		1.0000
21	H6L110105-JK7J1-1/40		50.0	12/28/2006 5:36:31 PM	40.0000		1.0000
22	H6L110106-JK7KG-1/20		50.0	12/28/2006 5:53:56 PM	20.0000		1.0000
23	H6L110106-JK7KG-1/40		50.0	12/28/2006 6:11:20 PM	40.0000		1.0000
24	H6L110106-JK7KT-1/20		50.0	12/28/2006 6:28:44 PM	20.0000		1.0000
25	H6L110106-JK7KT-1/40		50.0	12/28/2006 6:46:08 PM	40.0000		1.0000
26	CCV= ICWS-9090		50.0	12/28/2006 7:03:32 PM	1.0000		1.0000
27	CCB		50.0	12/28/2006 7:20:56 PM	1.0000		1.0000
28	H6L110105-JK7JX-1/20-MS@0.2ppm Cl		50.0	12/28/2006 7:38:20 PM	20.0000		1.0000
29	H6L110105-JK7JX-1/20-MSD@0.2ppm Cl		50.0	12/28/2006 7:55:44 PM	20.0000		1.0000
30	H6L110105-JK7JX-1/40-MS@0.2ppm Cl		50.0	12/28/2006 8:13:09 PM	40.0000		1.0000
31	H6L110105-JK7JX-1/40-MSD@0.2ppm Cl		50.0	12/28/2006 8:30:33 PM	40.0000		1.0000
32	CCV= ICWS-9090		50.0	12/28/2006 8:47:58 PM	1.0000		1.0000
33	CCB		50.0	12/28/2006 9:05:22 PM	1.0000		1.0000
34	SHUTDOWN		50.0	12/28/2006 9:22:46 PM	1.0000		1.0000

7 ICV/LCS= ICWS-9088

Sample Name:	ICV/LCS= ICWS-9088	Injection Volume:	50.0
Vial Number:	1296	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 13:24	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	2.32322	0.397	19.53	0.8109	BMB
2	4.55	Chloride	1.66709	0.273	13.44	0.7501	BM
3	5.30	Nitrite-N	3.02897	0.586	28.80	0.7761	MB
4	6.56	Bromide	0.54320	0.115	5.64	0.7617	BMB
5	7.32	Nitrate-N	2.77714	0.663	32.59	0.7720	bMB

HCL JL9AA-1AC

8 ICV/LCSD= ICWS-9089

Sample Name:	ICV/LCSD= ICWS-9089	Injection Volume:	50.0
Vial Number:	1297	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 13:41	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	0.06095	0.013	0.61	n.a.	BMB
2	3.23	Fluoride	2.32775	0.399	19.45	0.8124	BMB
3	4.55	Chloride	1.68114	0.274	13.35	0.7563	BM ✓
4	5.29	Nitrite-N	3.03772	0.587	28.59	0.7783	M
5	6.55	Bromide	0.53922	0.114	5.54	0.7561	MB
6	7.31	Nitrate-N	2.78963	0.666	32.46	0.7754	BMB

HCL JL9AA-1A9D
Rw 12/28/04

9 ICB/ METHOD BLANK

Sample Name:	ICB/ METHOD BLANK	Injection Volume:	50.0
Vial Number:	1298	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 13:58	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
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ND

HCl JL9AA-1AA

16 CCV= ICWS-9090

Sample Name:	CCV= ICWS-9090	Injection Volume:	50.0
Vial Number:	1370	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 16:09	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.23	n.a.	0.06059	0.011	0.42	n.a.	BMB
2	3.23	Fluoride	3.09242	0.528	19.53	1.0594	BMB
3	4.55	Chloride	2.21582	0.356	13.19	0.9933	BM ✓
4	5.29	Nitrite-N	4.00209	0.777	28.76	1.0173	MB
5	6.55	Bromide	0.72968	0.151	5.60	1.0210	BMB
6	7.30	Nitrate-N	3.71828	0.878	32.50	1.0209	BMB

17 CCB

Sample Name:	CCB	Injection Volume:	50.0
Vial Number:	1371	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 16:26	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret. Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel. Area (%)	Amount (mg/L)	Peak Type
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ND

18 H6L110105-JK7JX-1/20

Sample Name:	H6L110105-JK7JX-1/20	Injection Volume:	50.0
Vial Number:	1393	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	20.0000
Recording Time:	12/28/2006 16:44	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.79	Chloride	0.11696	0.048	0.13	1.0637	BMB
2	7.33	Nitrate-N	0.06450	0.014	0.04	0.3727	BMB
3	10.34	n.a.	0.08770	0.024	0.06	n.a.	BMB
4	11.43	n.a.	#####	37.681	99.77	n.a.	BMB

Peak not split.
See 1/40.

19 H6L110105-JK7JX-1/40

Sample Name:	H6L110105-JK7JX-1/40	Injection Volume:	50.0
Vial Number:	1394	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 17:01	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.58	Chloride	0.02208	0.003	0.01	0.4018	BM *
2	4.84	n.a.	0.06881	0.028	0.16	n.a.	MB*
3	11.47	n.a.	55.60983	17.227	99.82	n.a.	BMB

19 H6L110105-JK7JX-1/40

Sample Name:	H6L110105-JK7JX-1/40	Injection Volume:	50.0
Vial Number:	1394	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 17:01	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	11.47	n.a.	55.60983	17.227	100.00	n.a.	BMB

20 H6L110105-JK7J1-1/20

Sample Name:	H6L110105-JK7J1-1/20	Injection Volume:	50.0
Vial Number:	1395	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	20.0000
Recording Time:	12/28/2006 17:19	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	4.84	Chloride	0.10600	0.048	0.16	0.9641	BMB
2	7.35	Nitrate-N	0.06416	0.015	0.05	0.3708	BMB
3	11.44	n.a.	91.75063	29.118	99.78	n.a.	BMB

Peak not split.
See 1/40

21 H6L110105-JK7J1-1/40

Sample Name:	H6L110105-JK7J1-1/40	Injection Volume:	50.0
Vial Number:	1396	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 17:36	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret. Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel. Area (%)	Amount (mg/L)	Peak Type
1	4.58	Chloride	0.01719	0.003	0.02	0.3128	BM *
2	4.84	n.a.	0.05852	0.023	0.18	n.a.	MB*
3	11.49	n.a.	43.00368	13.267	99.80	n.a.	BMB

CMBL

21 H6L110105-JK7J1-1/40

Sample Name:	H6L110105-JK7J1-1/40	Injection Volume:	50.0
Vial Number:	1396	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 17:36	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S} \cdot \text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	11.49	n.a.	43.00368	13.267	100.00	n.a.	BMB

26 CCV= ICWS-9090

Sample Name:	CCV= ICWS-9090	Injection Volume:	50.0
Vial Number:	1401	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 19:03	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	0.07266	0.013	0.48	n.a.	BMB
2	3.23	Fluoride	3.10205	0.520	19.26	1.0624	BMB
3	4.55	Chloride	2.21173	0.358	13.26	0.9915	BM
4	5.30	Nitrite-N	4.02336	0.768	28.45	1.0225	MB
5	6.55	Bromide	0.73552	0.155	5.74	1.0291	BMB
6	7.31	Nitrate-N	3.73776	0.886	32.82	1.0260	BMB

27 CCB

Sample Name:	CCB	Injection Volume:	50.0
Vial Number:	1402	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 19:20	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
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ND

28 H6L110105-JK7JX-1/20-MS@0.2ppm Cl

Sample Name:	H6L110105-JK7JX-1/20-MS@0.2ppm Cl	Injection Volume:	50.0
Vial Number:	1403	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	20.0000
Recording Time:	12/28/2006 19:38	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.59844	0.105	0.27	4.3741	BMB
2	4.59	Chloride	0.43381	0.118	0.31	3.9367	BM
3	5.30	Nitrite-N	0.84863	0.169	0.44	4.4313	MB
4	6.56	Bromide	0.14527	0.030	0.08	4.0922	BMB
5	7.33	Nitrate-N	0.80123	0.191	0.50	4.5796	BMB
6	10.33	n.a.	0.08327	0.025	0.06	n.a.	BMB
7	11.43	n.a.	#####	37.595	98.33	n.a.	BMB

29 H6L110105-JK7JX-1/20-MSD@0.2ppm Cl

Sample Name:	H6L110105-JK7JX-1/20-MSD@0.2ppm Cl	Injection Volume:	50.0
Vial Number:	1404	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	20.0000
Recording Time:	12/28/2006 19:55	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area μS*min	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.24	Fluoride	0.59858	0.107	0.28	4.3750	BMB
2	4.59	Chloride	0.42985	0.118	0.31	3.9008	BM
3	5.31	Nitrite-N	0.86030	0.171	0.45	4.4918	MB
4	6.56	Bromide	0.14284	0.028	0.07	4.0240	BMB
5	7.33	Nitrate-N	0.79967	0.191	0.50	4.5709	BMB
6	10.34	n.a.	0.08231	0.024	0.06	n.a.	BMB
7	11.44	n.a.	#####	37.550	98.33	n.a.	BMB

30 H6L110105-JK7JX-1/40-MS@0.2ppm Cl

Sample Name:	H6L110105-JK7JX-1/40-MS@0.2ppm Cl	Injection Volume:	50.0
Vial Number:	1405	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 20:13	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.59636	0.107	0.60	8.7182	BMB
2	4.57	Chloride	0.48090	0.110	0.62	8.7252	BM
3	5.30	Nitrite-N	0.84211	0.196	1.10	8.7951	MB
4	6.55	Bromide	0.14384	0.030	0.17	8.1041	Rd
5	7.32	Nitrate-N	0.76578	0.183	1.03	8.7586	BMB
6	11.48	n.a.	55.30554	17.095	96.47	n.a.	BMB

31 H6L110105-JK7JX-1/40-MSD@0.2ppm Cl

Sample Name:	H6L110105-JK7JX-1/40-MSD@0.2ppm Cl	Injection Volume:	50.0
Vial Number:	1406	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	40.0000
Recording Time:	12/28/2006 20:30	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	3.23	Fluoride	0.58874	0.103	0.58	8.6087	BMB
2	4.57	Chloride	0.43521	0.102	0.58	7.8986	BM
3	5.30	Nitrite-N	0.83691	0.163	0.92	8.7411	MB
4	6.56	Bromide	0.14881	0.031	0.17	8.3841	BMB
5	7.33	Nitrate-N	0.76523	0.185	1.04	8.7524	BMB
6	11.48	n.a.	55.36865	17.161	96.70	n.a.	BMB

32 CCV= ICWS-9090

Sample Name:	CCV= ICWS-9090	Injection Volume:	50.0
Vial Number:	1407	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 20:47	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
1	2.24	n.a.	0.07895	0.012	0.46	n.a.	BMB
2	3.23	Fluoride	3.10738	0.524	19.32	1.0641	BMB
3	4.55	Chloride	2.20398	0.361	13.32	0.9881	BM
4	5.29	Nitrite-N	4.04019	0.762	28.10	1.0266	MB
5	6.55	Bromide	0.74338	0.158	5.82	1.0400	Ru
6	7.30	Nitrate-N	3.74585	0.894	32.97	1.0281	BMB

33 CCB

Sample Name:	CCB	Injection Volume:	50.0
Vial Number:	1408	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS14A ANIONS METHOD	Bandwidth:	n.a.
Quantif. Method:	AS4A-SC ANION METHOD	Dilution Factor:	1.0000
Recording Time:	12/28/2006 21:05	Sample Weight:	1.0000
Run Time (min):	15.00	Sample Amount:	1.0000

No.	Ret.Time (min.)	Peak Name	Height (uS)	Area $\mu\text{S}\cdot\text{min}$	Rel.Area (%)	Amount (mg/L)	Peak Type
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ND

STL Knoxville Source Air Analysis Sample Information

[illegible]

Comments: (*) Adjustments made w/ ICR-NaOH-1010 (IN NaOH)

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 12/18/06 Chemist: DFW Expiration Date: 12/19/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWS-9056	F-	ICWI-	8838	12/25/06	100. PPM	0.750	100.	0.75 PPM
2. (ICV/LCS)	CI-							
3.	NO2N-							
4.	BR-							
5.	NO3N-							
6. ICWS-9057	F-							
7. (ICV/LCS)	CI-							
8.	NO2N-							
9.	BR-							
10.	NO3N-							
11. ICWS-9058	F-	ICWI-	8837			1.		1. ppm
12. (CCV)	CI-							
13.	NO2N-							
14.	BR-							
15.	NO3N-							

Reviewed By: _____

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 12/28/06 Chemist: DKW Expiration Date: 3/28/07

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWT-9086	F-	17125	ERA	12/31/07	1000. PPM	5.	50.	100. mg/L (ppm)
2. (Intermediate)	Cl-	36065		6/30/07				
3. (Cal. Source)	NO ₂ N-	17075		7/31/07				
4.	Br-	27025		2/28/07				
5.	NO ₃ N-	17026		2/28/08				
6. ICWT-9087	F-	1-38F-2	SPEX	8/15/07		5.	50.	100. mg/L (ppm)
7. (Intermediate)	Cl-	1-5CL-2		3/15/07				
8. (2nd Source)	NO ₂ N-	1-13NDN-2		9/15/07				
9.	Br-	1-1BR-2		4/30/07				
10.	NO ₃ N-	1-27NDN-2		5/15/07				
11.								
12.			DKW	12/28/07				
13.								
14.								

Reviewed By: _____

WC031R3.DOC, 8/28/03

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 12/28/06 Chemist: DKW Expiration Date: 12/29/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWS-9088	F-	ICWI-	9087	3/28/07	100. PPM	0.750	100.	0.75 ppm
2. (ICV/LCS)	Cl-							
3.	NO ₂ N-							
4.	Br-							
5.	NBN-							
6. ICWS-9089	F-							
7. (ICV/LCS)	Cl-							
8.	NO ₂ N-							
9.	Br-							
10.	NBN-							
11. ICWS-9090	F-	ICWI-9086				1.		1. ppm
12. (CCV)	Cl-							
13.	NBN-							
14.	Br-							
15.	NBN-							

Reviewed By: _____

STL KNOXVILLE
PREPARATION OF FINAL WORKING STANDARD SOLUTIONS FROM VENDOR PREPARED STOCKS
WET CHEMISTRY

Date: 9/25/06 Chemist: DKW Expiration Date: 12/25/06

ID Number	Compound Name	Parent Lot Number	Parent Source	Parent Exp. Date	Parent Conc.	Aliquot Volume (ml)	Dilution Volume (ml)	Final Conc.
1. ICWI-8837	F-	17125	ERA	12/31/07	1000 ppm	5.	50	100. mg/L (ppm)
2. (Interned. calib.)	Cl-	36065		6/30/07				
3. (Source)	NO ₃ N	17075		7/31/07				
4.	BR-	27025		2/28/07				
5.	NO ₃ N-	17026		2/28/08				
6. ICWI-8838	F-	1-38F-2	SPEX	8/15/07	1000 ppm	5.	50	100. ppm (mg/L)
7. (Interned)	Cl-	1-5CL-2		3/15/07				
8. (2nd Source)	NO ₃ N-	1-13NO ₃ N-2		9/15/07				
9.	BR-	1-1BR-2		4/30/07				
10.	NO ₃ N-	1-2NO ₃ N-2		5/15/07				
11.								
12.								
13.								
14.								

Reviewed By: _____

Sample Receipt Documentation

AIR
SAMPLING
ASSOCIATES, INC.

11/10/05

Chain of Custody Record

Client		Project No.		Page		of		Analysis	
Address		Unit No.		Lab		Lab Contact		Lab Phone No.	
City		State		Zip Code		Project Manager		Test Method	
Run No.		Sample I.D.		Date		Time		Absorbing Solution	
								No. of Containers	
								Comments	
ADA-ES		8100 Southpark Way		CO		80120		Hardin Stack	
Littleton		CO		80120		Bill Mullins		Bill Mullins	
1		26A							
Cont. 1		11-30-06		1924		—		1	
Cont. 2		11-30-06		1926		—		1	
Cont. 3		11-30-06		1928		0.1N H ₂ SO ₄		1	
Cont. 4		11-30-06		1924		0.1N NaOH		1	
Reed temp. Ambient						MP#126106			
Coolers Read Fedex		696769459203		9199		69459188			
No Custody Seals				9214		9144			
MP# 12-6-06				9133		9157			
				9166					
Special Instructions:									
Cont. Nos. 1 & 2 retained by ASAI. HF: HBr are primary analytes for the ZGA analysis.									
Turn Around Time Required:		Normal		Rush		Sample Disposal:		Return to ASAI	
1. Recovered By		Bill Wym		11-30-06		1928		1. Relinquished By	
2. Received By		Bill Wym		12/3/06		0900		2. Relinquished By	
3. Received By		Bill Wym		12/3/06		1330		3. Relinquished By	
Comments:		Alan P. Polance		12/3/06		1330		Alan P. Polance	
		Frank Bull		12/4/06		0820		Frank Bull	
				12/5/06		1400

HVL 110105

Chain of Custody Record

[illegible]

P.O. Box 1175 · Lewisville, TX 75067 · Office: (972) 492-1400 · Fax: (972) 492-1402 · Toll-Free: (866) 311-9940

Reed Bay: Nuttall 7 November, 12-6-66, 09:15

**AIR
SAMPLING
ASSOCIATES, INC.**

HVL110105

Chain of Custody Record

Client		Project No.		Page		of		Analysis	
Address		Unit No.		Lab		Lab Contact		Lab Phone No.	
City		State		Zip Code		Project Manager		Test Method	
Run No.		Sample I.D.		Date		Time		Absorbing Solution	
No. of Containers		Comments		No. of Containers		Absorbing Solution		Time	
Cent. 1	12-2-06	2219	—	1	Filter No. A113	1	Filter No. A113	X	Hydrogen Halide
Cent. 2	12-2-06	2232	—	1	ACE FW	1	ACE FW	X	Hydrogen Halide
Cent. 3	12-2-06	2235	0.1N H ₂ SO ₄	1	Imps 1, 2 + Hot Line	1	Imps 1, 2 + Hot Line	X	Hydrogen Halide
Cent. 4	12-2-06	2226	0.1N NaOH	1	Imps 3, 4	1	Imps 3, 4	X	Hydrogen Halide
Special Instructions: Cont. Nos. 1 & 2 retained by ASAI. HF & HBr are primary analytes for the 26A analysis.									
Turn Around Time Required:		Normal		Rush		Sample Disposal:		Return to ASAI	
1. Received By		Date		Time		1. Relinquished By		Date	
Bill Mullins		12-2-06		2235		Bill Mullins		12/3/06 0900	
2. Received By		Date		Time		2. Relinquished By		Date	
Bill Mullins		12/3/06		0900		Bill Mullins		12/3/06 1330	
3. Received By		Date		Time		3. Relinquished By		Date	
Alan D. Roylance		12/3/06		1330		Alan D. Roylance		12/4/06 0820	
Comments:		Date		Time		Date		Time	
Bill Mullins		12/4/06		0820		Bill Mullins		12/5/06 1400	

STL KNOXVILLE SAMPLE RECEIPT/CONDITION UPON RECEIPT ANOMALY CHECKLIST

Client: Air Sampling Associates Project: Lot Number: HALLWOODS

Review Items	Yes	No	NA	If No, what was the problem?	Comments/Actions Taken
1. Do sample container labels match COC? (IDs, Dates, Times)				☐ 1a Do not match COC ☐ 1b Incomplete information ☐ 1c Marking smeared ☐ 1d Label torn ☐ 1e No label ☐ 1f COC not received ☐ 1g Other:	HA
2. Is the cooler temperature within limits? (> freezing temp. of water to 6 °C; NC, 1668, 1613B: 0-4 °C; VOST: 10 °C; MA: 2-6 °C)	✓			☐ 2a Temp Blank = ☐ 2b Cooler Temp = ☐ 3a Sample preservative =	
3. Were samples received with correct chemical preservative (excluding Encore)?	✓			☒ 4a Not present ☐ 4b Not intact ☐ 4c Other:	
4. Were custody seals present/intact on cooler and/or containers?		✓		☐ 5a Samples received-not on COC ☐ 5b Samples not received-on COC ☐ 6a Leaking ☐ 6b Broken ☐ 7a Headspace (VOA only) ☐ 8a Improper container ☐ 9a Could not be determined due to matrix interference ☐ 10a Holding time expired ☐ Incomplete information If yes & appears to be >1%, was SOG notified?	
5. Were all of the samples listed on the COC received?	✓			☐ 13a Leaking ☐ 13b Other:	
6. Were all of the sample containers received intact?	✓			☐ 14a Not relinquished ☐ 15a Incomplete information ☐ 15a Incomplete information ☐ 15a Incomplete information ☐ 15a Incomplete information	
7. Were VOA samples received without headspace?			✓		
8. Were samples received in appropriate containers?	✓				
9. Did you check for residual chlorine, if necessary?			✓		
10. Were samples received within holding time?	✓				
11. For rad samples, was sample activity info. provided?			✓		
12. For SOG water samples (1613B, 1668A, 8290, LR PAHs), do samples have visible solids present?			✓		
13. Are the shipping containers intact?	✓				
14. Was COC relinquished? (Signed/Dated/Timed)	✓				
15. Are tests/parameters listed for each sample?	✓				
16. Is the matrix of the samples noted?	✓				
17. Is the date/time of sample collection noted?	✓				
18. Is the client and project name/# identified?	✓				
19. Was the sampler identified on the COC?	✓				

Quote #: _____ PM Instructions: _____

Sample Receiving Associate: Matthew Howard Date: 12-6-06

Appendix H:

**EPA Test Methods 5, 17 (Particulate Matter), and ASTM D6784-02
(Ontario Hydro) Mercury Speciation Test Method Analytical Data**

Air Sampling Associates, Inc.

Particulate Analysis Summary

Project Number: 06-057

Date Analysis Completed: 12-15-06

Project Name: ADA-ES

Unit Tested: SDA Inlet

Project Location: Hardin, MT

Run Number:

Particulate Matter on Filter (mg):

Particulate Matter in Front Wash (mg):

Total Particulate Matter in "Front-Half" – MF (mg):

Particulate Matter in "Back-Half" (mg):

Total Particulate Matter in Sample – MT (mg):

1	2	3
<u>7,409.2</u>	<u>9,115.7</u>	<u>9,593.7</u>
<u>3,232.6</u>	<u>2,925.7</u>	<u>730.5</u>
<u>10,641.8</u>	<u>12,041.4</u>	<u>10,324.2</u>
<u>—</u>	<u>—</u>	<u>—</u>
<u>—</u>	<u>—</u>	<u>—</u>

STL Knoxville
Analyst

Bill Hyl Date: 1-17-06

Data Checked By

Particulate Analysis EPA Method 17

Stack Filters

Project No. 06-057
Project Name ADA-ES

Location Hardin, MT
Unit Tested SDA Inlet

Desiccator Time In					
Desiccator Time Out					

Run No. <u>1</u>	Filter No. <u>53</u>	Sample I.D.			
Filter & Particulate (g)					

Filter & Particulate Average (g) 10.1444
Initial Filter Weight (g) 2.7352
Total Particulate (mg) 7,409.2

Run No. <u>2</u>	Filter No. <u>54</u>	Sample I.D.			
Filter & Particulate (g)					

Filter & Particulate Average (g) 12.6952
Initial Filter Weight (g) 3.5795
Total Particulate (mg) 9,115.7

Run No. <u>3</u>	Filter No. <u>55</u>	Sample I.D.			
Filter & Particulate (g)					

Filter & Particulate Average (g) 12.4725
Initial Filter Weight (g) 2.8788
Total Particulate (mg) 9,593.7

STL Knoxville
Analyst

**Thimble Tare Weight Log
EPA Method 17**

Filter No.	Into Desicator	Weight	Weight	Weight	Weight	Weight	Weight Used
	Date	Date	Date	Date	Date	Date	
	Time	Time	Time	Time	Time	Time	
45		2.7941	2.7944				2.7944
	9/29/06	10/2/06	10/3/06				
	1200	1635	1100				
46		2.7987	2.7990				2.7990
		10/2/06	10/3/06				
		1636	1101				
47		2.5514	2.5514				2.5514
		10/2/06	10/3/06				
		1637	1102				
48		2.7781	2.7785				2.7785
		10/2/06	10/3/06				
		1638	1103				
49		2.7795	2.7799				2.7799
		10/2/06	10/3/06				
		1639	1104				
50		2.6485	2.6487				2.6487
		10/2/06	10/3/06				
		1640	1105				
51		2.8600	2.8605				2.8605
		10/2/06	10/3/06				
		1641	1106				
52		2.8470	2.8474				2.8474
		10/2/06	10/3/06				
		1642	1107				
53		2.7349	2.7352				2.7352
		10/2/06	10/3/06				
		1643	1108				
54		3.5794	3.5795				3.5795
	11/20/06	11/21/06	11/22/06				
	1360	1350	0745				
55		2.8785	2.8788				2.8788
		11/21/06	11/22/06				
		1351	0746				
56		2.4725	2.4724				2.4724
		11/21/06	11/22/06				
		1352	0747				
57		2.9916	2.9911				2.9911
		11/21/06	11/22/06				
		1353	0748				
58		3.4660	3.4656				3.4656
		11/21/06	11/22/06				
		1354	0749				
59		3.1165	3.1160				3.1160
		11/21/06	11/22/06				
		1355	0750				

Particulate Analysis EPA Method 17
Front Wash

Project No. 06-057

Location Hardin, MT

Project Name ADA-ES

Unit Tested SDA Inlet

Desiccator Time In					
Desiccator Time Out					

Run No.	<u>1</u>	Volume (ml)	<u>209</u>	Sample I.D.	
Final Weight (g)	<u>69.8884</u>				
Initial Weight (g)	<u>66.6558</u>				
Particulate Weight (g)	<u>3.2326</u>				

Particulate Average (mg) 3,232.6

Less Acetone Blank (mg) -

Total Particulate (mg) 3,232.6

Run No.	<u>2</u>	Volume (ml)	<u>152</u>	Sample I.D.	
Final Weight (g)	<u>68.8045</u>				
Initial Weight (g)	<u>65.8788</u>				
Particulate Weight (g)					

Particulate Average (mg) 2,925.7

Less Acetone Blank (mg) -

Total Particulate (mg) 2,925.7

Run No.	<u>3</u>	Volume (ml)	<u>87</u>	Sample I.D.	
Final Weight (g)	<u>67.9099</u>				
Initial Weight (g)	<u>67.1794</u>				
Particulate Weight (g)					

Particulate Average (mg) 730.5

Less Acetone Blank (mg) -

Total Particulate (mg) 730.5

Acetone Blank		Volume (ml)		Sample I.D.	
Final Weight (g)					
Initial Weight (g)					
Particulate Weight (g)					

Average (mg) _____

* mg/l _____

* Note: if greater than 7.9 mg/l, use 7.9 mg/l

STL Knoxville Date: 12-15-06

Analyst

Air Sampling Associates, Inc.

Particulate Analysis Summary

Project Number: 06-057

Date Analysis Completed: 12/15/06

Project Name: ADA-ES

Unit Tested: Stack

Project Location: Hardin, MT

Run Number:

1 2 3

Particulate Matter on Filter (mg):

22.5 19.4 26.3

Particulate Matter in Front Wash (mg):

16.3 13.9 12.1

Total Particulate Matter in "Front-Half" – MF (mg):

38.8 33.3 38.4

Particulate Matter in "Back-Half" (mg):

— — —

Total Particulate Matter in Sample – MT (mg):

— — —

STL Knoxville

Analyst

Phil Byer

Date: 1-17-07

Data Checked By

Particulate Analysis EPA Method 5

Stack Filters

Project No. 06-057
Project Name ADA-ES

Location Hardin, MT
Unit Tested Stack

Desiccator Time In					
Desiccator Time Out					

Run No. <u>1</u>	Filter No. <u>A117</u>	Sample I.D.			
Filter & Particulate (g)					

Filter & Particulate Average (g) 0.3869

Initial Filter Weight (g) 0.3644

Total Particulate (mg) 22.5

Run No. <u>2</u>	Filter No. <u>A118</u>	Sample I.D.			
Filter & Particulate (g)					

Filter & Particulate Average (g) 0.3829

Initial Filter Weight (g) 0.3635

Total Particulate (mg) 19.4

Run No. <u>3</u>	Filter No. <u>A119</u>	Sample I.D.			
Filter & Particulate (g)					

Filter & Particulate Average (g) 0.3918

Initial Filter Weight (g) 0.3655

Total Particulate (mg) 26.3

STL Knoxville
Analyst

**Filter Weight Log
EPA Method 5**

Filter No.	Into Desicator	Weight	Weight	Weight	Weight	Weight	Weight Used
	Date	Date	Date	Date	Date	Date	
	Time	Time	Time	Time	Time	Time	
A105		0.3801	0.3801				0.3801
	10/2/06	10/12/06	10/13/06				
	0800	1000	0826				
A106	10/2/06	0.3827	0.3825				0.3825
	0800	10/12/06	10/13/06				
		1001	0827				
A107		0.3808	0.3810				0.3810
	10/2/06	10/12/06	10/13/06				
	0800	1002	0828				
A108		0.3843	0.3845				0.3845
	10/2/06	10/12/06	10/13/06				
	0800	1003	0829				
A109		0.3872	0.3873				0.3873
	10/2/06	10/12/06	10/13/06				
	0800	1004	0830				
A110		0.3885	0.3886				0.3886
	10/2/06	10/12/06	10/13/06				
	0800	1005	0831				
A112		0.3833	0.3832				0.3832
	10/2/06	10/12/06	10/13/06				
	0800	1006	0832				
A113		0.3781	0.3778				0.3778
	10/2/06	10/12/06	10/13/06				
	0800	1007	0833				
A114		0.3814	0.3812				0.3812
	10/2/06	10/12/06	10/13/06				
	0800	1008	0834				
A115		0.3701	0.3700				0.3700
	10/2/06	10/12/06	10/13/06				
	0800	1009	0835				
A116		0.3678	0.3679				0.3679
	10/2/06	10/12/06	10/13/06				
	0800	1010	0836				
A117		0.3644	0.3644				0.3644
	10/2/06	10/12/06	10/13/06				
	0800	1011	0837				
A118		0.3636	0.3635				0.3635
	10/2/06	11/20/06	11/21/06				
	0800	1245	0807				
A119		0.3655	0.3655				0.3655
	10/2/06	11/20/06	11/21/06				
	0800	1246	0808				
A120		0.3616	0.3615				0.3615
	10/2/06	11/20/06	11/21/06				
	0800	1247	0809				

Particulate Analysis EPA Method 5
Front Wash

Project No. 06-057
Project Name ADA-ES

Location Hardin, MT
Unit Tested Stack

Desiccator Time In					
Desiccator Time Out					

Run No.	<u>1</u>	Volume (ml)	<u>56</u>	Sample I.D.	
Final Weight (g)	<u>68.1454</u>				
Initial Weight (g)	<u>68.1291</u>				
Particulate Weight (g)					

Particulate Average (mg) 16.3
Less Acetone Blank (mg) -
Total Particulate (mg) 16.3

Run No.	<u>2</u>	Volume (ml)	<u>87</u>	Sample I.D.	
Final Weight (g)	<u>66.2084</u>				
Initial Weight (g)	<u>66.1945</u>				
Particulate Weight (g)					

Particulate Average (mg) 13.9
Less Acetone Blank (mg) -
Total Particulate (mg) 13.9

Run No.	<u>3</u>	Volume (ml)	<u>43</u>	Sample I.D.	
Final Weight (g)	<u>67.5197</u>				
Initial Weight (g)	<u>67.5076</u>				
Particulate Weight (g)					

Particulate Average (mg) 12.1
Less Acetone Blank (mg) -
Total Particulate (mg) 12.1

Acetone Blank		Volume (ml)		Sample I.D.	
Final Weight (g)					
Initial Weight (g)					
Particulate Weight (g)					

Average (mg) _____
* mg/l _____

* Note: if greater than 7.9 mg/l, use 7.9 mg/l

STL Knoxville Date: 12-15-06
Analyst

H6L070246 Analytical Report.....	1
Sample Receipt Documentation	65
Metals	74
Sample Results	75
QC Summary	104
Quality Control Results Mercury	117
Raw Data Mercury	137
Miscellaneous Data.....	164
Wet Chemistry	174
Sample Summary	175
Raw Data	188
Sample Receipt Documentation	196
Total Number of Pages	204

STL

STL Knoxville
5815 Middlebrook Pike
Knoxville, TN 37921

Tel: 865 291 3000 Fax: 865 584 4315
www.stl-inc.com

ANALYTICAL REPORT

PROJECT NO. 06-057

Hardin, Montana

Lot #: H6L070246

Bill Hefley

Air Sampling Associates, Inc.
407-2B Holford's Prairie Road
Lewisville, TX 75056

SEVERN TRENT LABORATORIES, INC.

A handwritten signature in cursive script, appearing to read "Terry Wasmund".
Terry Wasmund
Project Manager

January 8, 2007

ANALYTICAL METHODS SUMMARY

H6L070246

<u>PARAMETER</u>	<u>ANALYTICAL METHOD</u>
Mercury (Ontario Hydro)	ASTM D6784-02
Particulate Emissions	CFR60A 5

References:

ASTM Annual Book Of ASTM Standards.

CFR60A "Test Methods", 40 CFR, Part 60, Appendix A, July 1, 1993.

SAMPLE SUMMARY

H6L070246

WO #	SAMPLE#	CLIENT	SAMPLE ID	SAMPLED DATE	SAMP TIME
JK1V2	001	HARDIN	STACK RUN 1 FILTER A117	12/01/06	13:58
JK1V7	002	HARDIN	STACK RUN 1 ACETONE	12/01/06	14:45
JK1WA	003	HARDIN	STACK RUN 1 FH	12/01/06	14:50
JK1WE	004	HARDIN	STACK RUN 1 KCL	12/01/06	14:20
JK1WF	005	HARDIN	STACK RUN 1 HNO3/H2O2	12/01/06	14:25
JK1WG	006	HARDIN	STACK RUN 1 KMNO4/H2SO4	12/01/06	14:36
JK1W8	007	HARDIN	STACK RUN 2 FILTER A118	12/02/06	13:05
JK1XA	008	HARDIN	STACK RUN 2 ACETONE	12/02/06	13:16
JK1XD	009	HARDIN	STACK RUN 2 FH	12/02/06	13:17
JK1XE	010	HARDIN	STACK RUN 2 KCL	12/02/06	13:45
JK1XR	011	HARDIN	STACK RUN 2 HNO3/H2O2	12/02/06	13:25
JK1XT	012	HARDIN	STACK RUN 2 KMNO4/H2SO4	12/02/06	13:38
JK1X1	013	HARDIN	STACK RUN 3 FILTER A119	12/02/06	21:14
JK1X4	014	HARDIN	STACK RUN 3 ACETONE	12/02/06	21:24
JK1X5	015	HARDIN	STACK RUN 3 FH	12/02/06	21:29
JK1X8	016	HARDIN	STACK RUN 3 KCL	12/02/06	21:11
JK10A	017	HARDIN	STACK RUN 3 HNO3/H2O2	12/02/06	20:51
JK10E	018	HARDIN	STACK RUN 3 KMNO4/H2SO4	12/02/06	20:04
JK10X	019	HARDIN	SDA INLET DUCT RUN 1 FILTER (THIMBLE 53)	12/01/06	12:53
JK101	020	HARDIN	SDA INLET DUCT RUN 1 ACETONE	12/01/06	13:03
JK105	021	HARDIN	SDA INLET DUCT RUN 1 FH	12/01/06	13:07
JK106	022	HARDIN	SDA INLET DUCT RUN 1 KCL	12/01/06	12:48
JK107	023	HARDIN	SDA INLET DUCT RUN 1 HNO3/H2O2	12/01/06	13:10
JK11A	024	HARDIN	SDA INLET DUCT RUN 1 KMNO4/H2SO4	12/01/06	13:23
JK11C	025	HARDIN	SDA INLET DUCT RUN 2 FILTER (THIMBLE 54)	12/02/06	12:28
JK11D	026	HARDIN	SDA INLET DUCT RUN 2 ACETONE	12/02/06	12:35
JK11F	027	HARDIN	SDA INLET DUCT RUN 2 FH	12/02/06	12:36
JK11K	028	HARDIN	SDA INLET DUCT RUN 2 KCL	12/02/06	12:10
JK11L	029	HARDIN	SDA INLET DUCT RUN 2 HNO3/H2O2	12/02/06	11:51
JK11Q	030	HARDIN	SDA INLET DUCT RUN 2 KMNO4/H2SO4	12/02/06	12:03
JK11X	031	HARDIN	SDA INLET DUCT RUN 3 FILTER (THIMBLE 55)	12/02/06	20:36
JK111	032	HARDIN	SDA INLET DUCT RUN 3 ACETONE	12/02/06	20:38
JK112	033	HARDIN	SDA INLET DUCT RUN 3 FH	12/02/06	20:40
JK113	034	HARDIN	SDA INLET DUCT RUN 3 KCL	12/02/06	20:18
JK114	035	HARDIN	SDA INLET DUCT RUN 3 HNO3/H2O2	12/02/06	20:04
JK117	036	HARDIN	SDA INLET DUCT RUN 3 KMNO4/H2SO4	12/02/06	20:29

(Continued on next page)

SAMPLE SUMMARY

H6L070246

WO #	SAMPLE#	CLIENT	SAMPLE ID	SAMPLED DATE	SAMP TIME
JK12A	037	HARDIN	SDA INLET+STACK RB 0.1N HNO3	12/01/06	09:14
JK12F	038	HARDIN	SDA INLET+STACK RB KCL	12/01/06	09:17
JK12G	039	HARDIN	SDA INLET+STACK RB HNO3/H2O2	12/01/06	09:20
JK12H	040	HARDIN	SDA INLET+STACK RB KMNO4/H2SO4/HYD	12/01/06	09:22

NOTE(S) :

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filter test, pH, porosity pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight.

QC DATA ASSOCIATION SUMMARY

H6L070246

Sample Preparation and Analysis Control Numbers

<u>SAMPLE#</u>	<u>MATRIX</u>	<u>ANALYTICAL METHOD</u>	<u>LEACH BATCH #</u>	<u>PREP BATCH #</u>	<u>MS RUN#</u>
001	AIR	CFR60A 5		6346334	
002	AIR	CFR60A 5		6346334	
003	AIR	ASTM D6784-02		7002025	
004	AIR	ASTM D6784-02		7002028	7002013
005	AIR	ASTM D6784-02		7002026	7002012
006	AIR	ASTM D6784-02		7002028	7002015
007	AIR	CFR60A 5		6346334	
008	AIR	CFR60A 5		6346334	
009	AIR	ASTM D6784-02		7002025	
010	AIR	ASTM D6784-02		7002028	
011	AIR	ASTM D6784-02		7002026	
012	AIR	ASTM D6784-02		7002028	
013	AIR	CFR60A 5		6346334	
014	AIR	CFR60A 5		6346334	
015	AIR	ASTM D6784-02		7002025	
016	AIR	ASTM D6784-02		7002028	
017	AIR	ASTM D6784-02		7002026	
018	AIR	ASTM D6784-02		7002028	
019	AIR	CFR60A 5		6346334	
020	AIR	CFR60A 5		6346334	
021	AIR	ASTM D6784-02		7002025	

(Continued on next page)

QC DATA ASSOCIATION SUMMARY

H6L070246

Sample Preparation and Analysis Control Numbers

<u>SAMPLE#</u>	<u>MATRIX</u>	<u>ANALYTICAL METHOD</u>	<u>LEACH BATCH #</u>	<u>PREP BATCH #</u>	<u>MS RUN#</u>
022	AIR	ASTM D6784-02		7002028	
023	AIR	ASTM D6784-02		7002026	
024	AIR	ASTM D6784-02		7002028	
025	AIR	CFR60A 5		6346334	
026	AIR	CFR60A 5		6346334	
027	AIR	ASTM D6784-02		7002025	
028	AIR	ASTM D6784-02		7002028	
029	AIR	ASTM D6784-02		7002026	
030	AIR	ASTM D6784-02		7002028	
031	AIR	CFR60A 5		6346334	
032	AIR	CFR60A 5		6346334	
033	AIR	ASTM D6784-02		7002025	
034	AIR	ASTM D6784-02		7002028	
035	AIR	ASTM D6784-02		7002026	
036	AIR	ASTM D6784-02		7002028	
037	AIR	ASTM D6784-02		7002025	
038	AIR	ASTM D6784-02		7002028	
039	AIR	ASTM D6784-02		7002026	
040	AIR	ASTM D6784-02		7002028	

PROJECT NARRATIVE

H6L070246

The results reported herein are applicable to the samples submitted for analysis only.

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The original chain of custody documentation is included with this report.

Sample Receipt

Custody seals were not present upon sample receipt at STL Knoxville.

Quality Control and Data Interpretation

Unless otherwise noted, all holding times and QC criteria were met and the test results shown in this report meet all applicable NELAC requirements.

Metals

These stack gas samples were prepared and analyzed using STL Knoxville standard operating procedure KNOX-IP-0006 which is based on ASTM Method D6784-02, "Standard Test Method for Elemental, Oxidized, Particle-Bound and Total Mercury in Flue Gas Generated from Coal-Fired Stationary Sources (Ontario Hydro Method)" with modifications from EPA Method 29. SW-846 Method 7470A, as incorporated in STL Knoxville standard operating procedure KNOX-MT-0009, was used to perform the final instrument analysis.

Acid digestion was performed on the front half particulate filter and the acetone and nitric acid probe rinse fractions separately using HNO₃, HCl and HF. After digestion, the HF was sequestered using H₃BO₃ followed by another heating cycle. These digestates were adjusted to final volume, combined and a portion was digested for CVAA analysis in order to determine the particle-bound mercury. Results were calculated using the following equation:

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PROJECT NARRATIVE

H6L070246

$$Hg, ug = (Hg, ug/L) * (Micr. Digestate Volume, L) * \left(\frac{Final Volume Hg Digestate (mL)}{Volume Micr. Digestate Used (mL)} \right) * Bench Dilution$$

Thimbles were received instead of filters for three of the front half samples. Each thimble, probe rinse and acetone particulate were combined and digested on a hot plate using HNO₃, HCL and 0.1 N HNO₃. After digestion the samples were filtered and brought to a final volume of 100 mL. A portion was digested for CVAA analysis in order to determine the particle-bound mercury. Results were calculated using the following equation:

$$Hg, ug = (Hg, ug/L) * (Micr. Digestate Volume, L) * \left(\frac{Final Volume Hg Digestate (mL)}{Volume Micr. Digestate Used (mL)} \right) * Bench Dilution$$

Please note that the dilution factor reported on the sample result form for the front half samples is actually a combination of preparation factors and bench dilution factors.

For the 5%HNO₃/10%H₂O₂ impinger samples, a 10 milliliter portion of the sample as received was processed for mercury. The KCl and 4% KMnO₄/10%H₂SO₄ impinger samples were treated with hydroxylamine hydrochloride, followed by removal of a 25 mL portion of sample for mercury processing. Results were calculated using the equation listed below. For the KCl and 4% KMnO₄/10%H₂SO₄ impinger samples, the sample volume includes the volume of hydroxylamine hydrochloride added to the sample.

$$Hg, ug = (Hg, ug/L) * (Sample Volume, L) * \left(\frac{Final Volume Hg Digestate (mL)}{Volume Sample Digested (mL)} \right) * Bench Dilution$$

Please note that the dilution factor reported on the sample result form for the back half impingers is actually the combination of preparation factors (not just a dilution factor) required by the method to convert the Hg reporting limits and method detection limits in concentration units from ug/L to a total ug unit:

$$Dilution Factor = (Volume, L) * \left(\frac{Final Volume Hg Digestate (mL)}{Volume Sample Digested (mL)} \right) * Bench Dilution$$

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PROJECT NARRATIVE

H6L070246

For the 5% HNO_3 /10% H_2O_2 impinger samples, a 10 milliliter portion of the sample as received was processed for mercury. The KCl and 4% KMnO_4 /10% H_2SO_4 impinger samples were treated with hydroxylamine hydrochloride, followed by removal of a 25 mL portion of sample for mercury processing. Results were calculated using the equation listed below. For the KCl and 4% KMnO_4 /10% H_2SO_4 impinger samples, the sample volume includes the volume of hydroxylamine hydrochloride added to the sample.

$$\text{Hg, ug} = (\text{Hg, ug/L}) * (\text{Sample Volume, L}) * \left(\frac{\text{Final Volume Hg Digestate (mL)}}{\text{Volume Sample Digested (mL)}} \right) * \text{Bench Dilution}$$

Please note that the dilution factor reported on the sample result form is actually the combination of preparation factors (not just a dilution factor) required by the method to convert the Hg reporting limits and method detection limits in concentration units from ug/L to a total ug unit:

$$\text{Dilution Factor} = (\text{Volume, L}) * \left(\frac{\text{Final Volume Hg Digestate (mL)}}{\text{Volume Sample Digested (mL)}} \right) * \text{Bench Dilution}$$

The matrix spike recoveries for sample Hardin Stack Run 1 KMN04/H2S04 were outside control limits for mercury because the native analyte concentration in the sample was at least four times greater than the spike level. The laboratory control samples showed acceptable results indicating that the analysis was in control.

Wet Chemistry

The measurement of the mass of particulate matter trapped by the particulate filter and probe rinse derived from an M-5 sampling train was performed using SOP number KNOX-WC-0006 (based on EPA Methods 0050 and 5). Microfiber filters, Petri dishes, and 150 mL beakers are carefully inspected and tare weighed to constant weight. After sample collection, the filters are dried, and then carefully weighed to constant weight to determine the mass of particulate matter trapped on the filters. The acetone probe rinse solution is evaporated to dryness, and then weighed to constant weight to determine the

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PROJECT NARRATIVE

H6L070246

total particulate mass collected in the rinse. The total particulate mass collected by an M-5 train is the sum of the particulate filter and the acetone probe rinse residue weights.

Filter thimbles and disks that were not prepared by STL Knoxville were submitted for analysis. The reported weight is the gross weight, which includes the total weight of the filter and the entrained particulate material. Unfortunately, the laboratory information system will not report sufficient digits to obtain a precise net particulate weight when the tare weight is subtracted from the gross weight. The actual raw data is tabulated below for the user's convenience.

Lot-Sample Number	Work Order Number	Client ID	Gross Weight Average (mg)
H6L070246-001	JK1V21AA	HARDIN STACK RUN 1 FILTER	382.9
H6L070246-007	JK1W81A A	HARDIN STACK RUN 2 FILTER	382.9
H6L070246-013	JK1X11AA	HARDIN STACK RUN 3 FILTER	391.8
H6L070246-019	JK10X1AA	HARDIN SDA INLET DUCT RUN 1 FILTER	10144.4
H6L070246-025	JK11C1AA	HARDIN SDA INLET DUCT RUN 2 FILTER	12695.2
H6L070246-031	JK1111AA	HARDIN SDA INLET DUCT RUN 3 FILTER	12472.5

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Sample Data Summary

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 1 FH

TOTAL Metals

Lot-Sample #...: H6L070246-003

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION- ANALYSIS DATE	WORK ORDER #
Prep Batch #...	7002025					
Mercury	0.038	0.010	ug	ASTM D6784-02	01/02-01/05/07	JKIWA1AA
		Dilution Factor: 0.1		Analysis Time...: 11:21	MDL.....: 0.0060	

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 1 KCL

TOTAL Metals

Lot-Sample #...: H6L070246-004

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION- ANALYSIS DATE	WORK ORDER #
Prep Batch #...	7002028					
Mercury	0.11 B	0.13	ug	ASTM D6784-02	01/04/07	JK1WE1AA
		Dilution Factor: 1.32		Analysis Time...: 10:51	MDL.....: 0.079	

NOTE(S):

B Estimated result. Result is less than RL.

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 1 HNO3/H2O2

TOTAL Metals

Lot-Sample #...: H6L070246-005

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION- ANALYSIS DATE	WORK ORDER #
Prep Batch #...	7002026					
Mercury	0.041 B	0.060	ug	ASTM D6784-02	01/03-01/05/07	JK1WF1AA
		Dilution Factor: 0.6		Analysis Time...: 11:46	MDL.....: 0.036	

NOTE(S) :

B Estimated result. Result is less than RL.

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 1 KMNO4/H2SO4

TOTAL Metals

Lot-Sample #...: H6L070246-006

Matrix.....: AIR

Date Sampled...: 12/01/06

Date Received...: 12/06/06

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION- ANALYSIS DATE	WORK ORDER #
Prep Batch #...: 7002028						
Mercury	6.8	0.078	ug	ASTM D6784-02	01/04/07	JK1WG1AA
		Dilution Factor: 0.78		Analysis Time...: 11:00	MDL.....: 0.047	

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 2 PH

TOTAL Metals

Lot-Sample #...: H6L070246-009

Matrix.....: AIR

Date Sampled...: 12/02/06

Date Received...: 12/06/06

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION- ANALYSIS DATE	WORK ORDER #
Prep Batch #...	7002025					
Mercury	ND	0.010	ug	ASTM D6784-02	01/02-01/05/07	JK1XD1AA
		Dilution Factor: 0.1		Analysis Time...: 11:25	MDL.....: 0.0060	

Air Sampling Associates, Inc.

Client Sample ID: HARDIN STACK RUN 2 KCL

TOTAL Metals

Lot-Sample #...: H6L070246-010

Matrix.....: AIR

Date Sampled...: 12/02/06

Date Received...: 12/06/06

<u>PARAMETER</u>	<u>RESULT</u>	<u>REPORTING</u> <u>LIMIT</u>	<u>UNITS</u>	<u>METHOD</u>	<u>PREPARATION-</u> <u>ANALYSIS DATE</u>	<u>WORK</u> <u>ORDER #</u>
Prep Batch #...: 7002028						
Mercury	ND	0.15	ug	ASTM D6784-02	01/04/07	JK1XE1AA
		Dilution Factor: 1.47		Analysis Time...: 11:06	MDL.....: 0.088	