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REPORT ON COMPLIANCE TESTING

Zug Island

Pushing Emissions Control System Stack

EES Coke Battery, LLC

1400 Zug Island Road

River Rouge, MI 48218

Client Reference No. 4701239002

CleanAir Project No. 13665-4

A2LA ISO 17025 Certificate No. 4342.01

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COMMITMENT TO QUALITY

To the best of our knowledge, the data presented in this report are accurate, complete, error free and representative of the actual emissions during the test program. Clean Air Engineering operates in conformance with the requirements of ASTM D7036-04 Standard Practice for Competence of Air Emission Testing Bodies.

Report Submittal:

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I hereby certify that the information contained within the final test report has been reviewed and, to the best of my ability, verified as accurate.

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PROJECT PERSONNEL

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ACRONYMS & ABBREVIATIONS

AAS (atomic absorption spectrometry)
acfm (actual cubic feet per minute)
ACI (activated carbon injection)
ADL (above detection limit)
AIG (ammonia injection grid)
APC (air pollution control)
AQCS (air quality control system(s))
ASME (American Society of Mechanical Engineers)
ASTM (American Society for Testing and Materials)
BDL (below detection limit)
Btu (British thermal units)
CAM (compliance assurance monitoring)
CARB (California Air Resources Board)
CCM (Controlled Condensation Method)
CE (capture efficiency)
°C (degrees Celsius)
CEMS (continuous emissions monitoring system(s))
CFB (circulating fluidized bed)
CFR (Code of Federal Regulations)
cm (centimeter(s))
COMS (continuous opacity monitoring system(s))
CT (combustion turbine)
CTI (Cooling Technology Institute)
CTM (Conditional Test Method)
CVAAS (cold vapor atomic absorption spectroscopy)
CVAFS (cold vapor atomic fluorescence spectrometry)
DI H_2O (de-ionized water)
%dv (percent, dry volume)
DLL (detection level limited)
DE (destruction efficiency)
DCI (dry carbon injection)
DGM (dry gas meter)
dscf (dry standard cubic feet)
dscfm (dry standard cubic feet per minute)
dscm (dry standard cubic meter)
ESP (electrostatic precipitator)
FAMS (flue gas adsorbent mercury speciation)
°F (degrees Fahrenheit)
FB (field blank)
FCC (fluidized catalytic cracking)
FCCU (fluidized catalytic cracking unit)
FEGT (furnace exit gas temperatures)
FF (fabric filter)
FGD (flue gas desulfurization)
FIA (flame ionization analyzer)
FID (flame ionization detector)
FPD (flame photometric detection)
FRB (field reagent blank)
FSTM (flue gas sorbent total mercury)
ft (feet or foot)
ft^2 (square feet)
ft^3 (cubic feet)
ft/sec (feet per second)
FTIR (Fourier Transform Infrared Spectroscopy)
FTRB (field train reagent blank)
g (gram(s))
GC (gas chromatography)
GFAAS (graphite furnace atomic absorption spectroscopy)
GFC (gas filter correlation)
gr/dscf (grains per dry standard cubic feet)
> (greater than)/ ≥ (greater than or equal to)
g/s (grams per second)
H_2O (water)
HAP(s) (hazardous air pollutant(s))
HI (heat input)
hr (hour(s))
HR GC/MS (high-resolution gas chromatography and mass spectrometry)
HRVOC (highly reactive volatile organic compounds)
HSRG(s) (heat recovery steam generator(s))
HVT (high velocity thermocouple)
IC (ion chromatography)
IC/PCR (ion chromatography with post column reactor)
ICP/MS (inductively coupled argon plasma mass spectroscopy)
ID (induced draft)
in. (inch(es))
in. H_2O (inches water)
in. Hg (inches mercury)
IPA (isopropyl alcohol)
ISE (ion-specific electrode)
kg (kilogram(s))
kg/hr (kilogram(s) per hour)
< (less than)/ ≤ (less than or equal to)
L (liter(s))
lb (pound(s))
lb/hr (pound per hour)
lb/MMBtu (pound per million British thermal units)
lb/TBtu (pound per trillion British thermal units)
lb/lb-mole (pound per pound mole)
LR GC/MS (low-resolution gas chromatography and mass spectrometry)
m (meter)
m^3 (cubic meter)
MACT (maximum achievable control technology)
MASS® (Multi-Point Automated Sampling System)
MATS (Mercury and Air Toxics Standards)
MDL (method detection limit)
µg (microgram(s))
min. (minute(s))
mg (milligram(s))
ml (milliliter(s))
MMBtu (million British thermal units)
MW (megawatt(s))
NCASI (National Council for Air and Stream Improvement)
ND (non-detect)
NDIR (non-dispersive infrared)
NDO (natural draft opening)
NESHAP (National Emission Standards for Hazardous Air Pollutants)
ng (nanogram(s))
Nm^3 (Normal cubic meter)
% (percent)
PEMS (predictive emissions monitoring systems)
PFGC (pneumatic focusing gas chromatography)
pg (picogram(s))
PJFF (pulse jet fabric filter)
ppb (parts per billion)
PPE (personal protective equipment)
ppm (parts per million)
ppmdv (parts per million, dry volume)
ppmwv (parts per million, wet volume)
PSD (particle size distribution)
psi (pound(s) per square inch)
PTE (permanent total enclosure)
PTFE (polytetrafluoroethylene)
QA/QC (quality assurance/quality control)
QI (qualified individual)
QSTI (qualified source testing individual)
QSTO (qualified source testing observer)
RA (relative accuracy)
RATA (relative accuracy test audit)
RB (reagent blank)
RE (removal or reduction efficiency)
RM (reference method)
scf (standard cubic feet)
scfm (standard cubic feet per minute)
SCR (selective catalytic reduction)
SDA (spray dryer absorber)
SNCR (selective non-catalytic reduction)
STD (standard)
STMS (sorbent trap monitoring system)
TBtu (trillion British thermal units)
TEOM (Tapered Element Oscillating Microbalance)
TEQ (toxic equivalency quotient)
ton/hr (ton per hour)
ton/yr (ton per year)
TSS (third stage separator)
USEPA or EPA (United States Environmental Protection Agency)
UVA (ultraviolet absorption)
WFGD (wet flue gas desulfurization)
%wv (percent, wet volume)

1. PROJECT OVERVIEW

Test Program Summary

EES Coke Battery, LLC contracted CleanAir Engineering (CleanAir) to complete compliance testing at the Zug Island plant located in River Rouge, Michigan. This program was a follow-up to the initial compliance testing mobilization as per report 13665-2. Due to $PM_{10}/PM_{2.5}$ results, methodology for this re-test was adjusted accordingly from Method 5/202 to Method 201A/202. The test program met the following objective:

- Perform compliance testing on the Pushing Emissions Control System (PECS) Stack to show it is in operating compliance with Michigan Permit to Install (MI-PTI) No. 51-08C utilizing various test methods.

All testing was conducted in accordance with the regulations set-forth by the United States Environmental Protection Agency (EPA) and the Michigan Department of Environmental Quality (MDEQ) and was performed at normal operating conditions throughout the test program.

The PECS Stack has a baghouse to control particulate emissions during each oven push and compliance testing was requested after receiving results from the initial compliance testing program.

A summary of the permit limits is shown below. Test program information, including the test parameters, on-site schedule and a project discussion, begins on page 2.

Table 1-1:
Summary of Results

Source / Constituent	Sampling Method	Average Emission	Permit Limit[1]
PECS Stack			
PM (lb/Ton Coke)	EPA 201A	0.01	0.02
PM (ton/yr)	EPA 201A	2.5	9.7
PM_{10} (lb/hr)[2]	EPA 201A/202	0.50	0.69
$PM_{2.5}$ (lb/hr)[2]	EPA 201A/202	0.23	0.69

[1] Permit limits obtained from Michigan Permit to Install number: MI-PTI-51-08C.

[2] The source does not emit continuously; lb/hr values are operating hour of the PECS exhaust fan.

Test Program Details

Parameters

The test program included the following measurements:

- filterable particulate matter (FPM)
- particulate matter less than 10 microns in diameter (PM_{10})
- particulate matter less than 2.5 microns in diameter ($PM_{2.5}$)
- condensable particulate matter (CPM)
- flue gas composition (e.g., O_2, CO_2, H_2O)
- flue gas temperature
- flue gas flow rate

Schedule

Testing was performed the week of December 17, 2018. The on-site schedule followed during the test program is outlined in Table 1-2.

Table 1-2:
Test Schedule

Run Number	Location	Method	Analyte	Date	Start Time	End Time
1	PECS Stack	USEPA Method 201A/202	PM10/PM2.5/CPM	12/18/18	09:35	18:46
2	PECS Stack	USEPA Method 201A/202	PM10/PM2.5/CPM	12/19/18	08:40	18:51
3	PECS Stack	USEPA Method 201A/202	PM10/PM2.5/CPM	12/20/18	08:18	18:50

Discussion

Emission Calculation Explanation

Due to the intermittent operations of the facility, the approach to the emission calculations was adjusted. Each PM test run consisted of approximately 120 minutes of sampling time. However, it required a minimum of 9 hours to obtain each sample since sampling can only occur while the PECS exhaust fan is operating. A ratio of the metered sample time to elapsed test time was applied to the emission rate values to ensure representative results based on the process operations. Emission rates shown in pound per hour are therefore corrected to be pound per hour (lb/hr) of clock time.

Test Program Summary

The test program was completed over the span of three test days with each day completing one test run. Due to the intermittent nature of the process at current operations, a minimum of 9 hours was required to complete one test run. This does not account for any delays in operations. A push occurred approximately every 10-20 minutes and during each push, roughly three minutes of sample was collected.

Each Method 201A/202 test run was completed so that 12 total points were sampled. Each point was sampled for approximately six minutes. Samples were collected isokinetically so that a minimum of 60 dry standard cubic feet (dscf) of sample was collected.

Following a previous-site discussion with Tom Gasloli of MDEQ in September 2018, it was determined that ambient readings for all analytes would be eliminated. The O_2/CO_2 values were displayed only when pushing gas was being measured and this was the same for the NO_x values. All CEMS results were provided with the non-push readings omitted from the average results calculations.

The extended nature of the testing was a potential concern. Typically, bias checks are completed only before and after a test run. However, CleanAir performed bias checks during each test since test runs were at least 6 hours in duration. CleanAir attempted to perform all bias checks between pushes in order to maximize the sample collected. These checks were required to monitor analyzer bias and drift over the day of sampling.

PM_{10} / $PM_{2.5}$ – USEPA Method 201A/202

EPA Method 201A, "Determination of PM_{10} and $PM_{2.5}$ Emissions", was used for the particulate matter measurements along with EPA Method 202, "Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources". These methods are contained in Appendix M of 40 CFR 51.

Method 201A defines PM_{10} as particulate emissions equal to or less than an aerodynamic diameter of nominally 10 microns, and $PM_{2.5}$ as particulate emissions equal to or less than an aerodynamic diameter of nominally 2.5 microns.

The sampling apparatus utilized stainless steel in-stack cyclones followed by a Gelman filter holder. The cyclones are constructed according to the design specifications provided in Method 201A. When operated at a specified flow rate, the first cyclone is designed to collect particles greater than 10 microns while allowing particles less than or equal to 10 microns to pass through. The second cyclone is designed to collect particles greater than 2.5 microns while allowing particles less than or equal to 2.5 microns to pass through. The exit of the second cyclone connects directly to a 45-mm stainless steel filter holder that contains a high-efficiency quartz fiber filter to collect the $PM_{2.5}$ particles.

Sampling was performed at a constant flow rate that maintains the 10/2.5-micron cut-points of the cyclones. The sampling time (dwell time) at each traverse point varied proportionally with the velocity at each point, as determined from a pre-test velocity traverse. All particulate analyses were performed gravimetrically following EPA Method 5 procedures.

The condensable particulate matter was collected in dry impingers after the gas has traveled through the Method 201A cyclone. Total CPM was represented by the impinger fractions and the CPM filter. Immediately following a test run, Method 202 sample trains were purged with Ultra High Purity Nitrogen at a rate of 14 liters per minute for 60 minutes to remove any potential dissolved sulfur dioxide gases from the impingers.

End of Section

2. RESULTS

This section summarizes the test program results. Additional results are available in the report appendices.

Table 2-1:
PECS Stack – Total PM

Run No.		1	2	3	Average
Date (2018)		Dec 18	Dec 19	Dec 20	
Start Time (approx.)		09:35	08:40	08:18	
Stop Time (approx.)		18:46	18:51	18:50	
Process Conditions					
R_P	Production rate (ton/hr)	108	110	108	**108**
P_1	Starting oven number	18	74	51	**48**
P_2	Elapsed pushing time (minutes)	551	611	632	**598**
P_3	Amount of coke pushed (tons)	992	1,117	1,133	**1,081**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	**8,760**
Gas Conditions					
O_2	Oxygen (dry volume %)	20.6	20.6	20.7	**20.6**
CO_2	Carbon dioxide (dry volume %)	0.0	0.0	0.0	**0.0**
T_s	Sample temperature (°F)	113	114	118	**115**
B_w	Actual water vapor in gas (% by volume)	0.7	1.0	1.0	**0.9**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	177,000	175,000	176,000	**176,000**
Q_s	Volumetric flow rate, standard (scfm)	160,000	158,000	157,000	**158,000**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	159,000	156,000	155,000	**157,000**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	62.57	67.46	62.43	**64.16**
%I	Isokinetic sampling (%)	111.3	94.4	94.3	**100.0**
Total PM Laboratory Data					
m_n	Total FPM (g)	0.00412	0.00439	0.01134	
m_{CPM}	Total CPM (g)	0.00193	0.00086	0.00177	
m_{Part}	Total PM (g)	0.00605	0.00525	0.01311	
n_{MDL}	Number of Non-Detectable Fractions	1 out of 6	N/A	N/A	
DLC	Detection Level Classification	DLL	ADL	ADL	
Total PM Results					
$E_{T/yr}$	Particulate Rate (Ton/yr)	8.9228	7.0464	18.8557	11.6083
E_{Rp}	Particulate Rate - Production-based (lb/ton)	0.0189	0.0147	0.0400	0.0245

Average includes 3 runs.

Detection level classifications are defined as follows:

ADL = Above Detection Level - all fractions are above detection limit

DLL = Detection Level Limited - some fractions are below detection limit

BDL = Below Detection Limit - all fractions are below detection limit

Table 2-2:
PECS Stack – $PM_{10}/PM_{2.5}$

Run No.		1	2	3	Average
Date (2018)		Dec 18	Dec 19	Dec 20	
Start Time (approx.)		09:35	08:40	08:18	
Stop Time (approx.)		18:46	18:51	18:50	
Process Conditions					
R_P	Production rate (ton/hr)	108	110	108	**108**
P_1	Starting oven number	18	74	51	**48**
P_2	Elapsed pushing time (minutes)	551	611	632	**598**
P_3	Amount of coke pushed (tons)	992	1,117	1,133	**1,081**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	**8,760**
Gas Conditions					
O_2	Oxygen (dry volume %)	20.6	20.6	20.7	**20.6**
CO_2	Carbon dioxide (dry volume %)	0.0	0.0	0.0	**0.0**
T_s	Sample temperature (°F)	113	114	118	**115**
B_w	Actual water vapor in gas (% by volume)	0.7	1.0	1.0	**0.9**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	177,000	175,000	176,000	**176,000**
Q_s	Volumetric flow rate, standard (scfm)	160,000	158,000	157,000	**158,000**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	159,000	156,000	155,000	**157,000**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	62.57	67.46	62.43	**64.16**
%I	Isokinetic sampling (%)	111.3	94.4	94.3	**100.0**
Total PM10 Laboratory Data					
$m_{n\text{-}10}$	Total FPM < 10 µm (g)	0.00128	0.00177	0.00970	
m_{CPM}	Total CPM (g)	0.00193	0.00086	0.00177	
$m_{Part\text{-}10}$	Total PM < 10 µm (g)	0.00321	0.00263	0.01147	
n_{MDL}	Number of Non-Detectable Fractions	1 out of 5	N/A	N/A	
DLC	Detection Level Classification	DLL	ADL	ADL	
Total PM10 Results					
$E_{lb/hr}$	Particulate Rate (lb/hr)	0.3187	0.2376	1.1101	0.5555
Total PM2.5 Laboratory Data					
$m_{n\text{-}2.5}$	Total FPM < 2.5 µm (g)	0.00074	0.00141	0.00120	
m_{CPM}	Total CPM (g)	0.00193	0.00086	0.00177	
$m_{Part\text{-}2.5}$	Total PM < 2.5 µm (g)	0.00267	0.00227	0.00297	
n_{MDL}	Number of Non-Detectable Fractions	1 out of 4	N/A	N/A	
DLC	Detection Level Classification	DLL	ADL	ADL	
Total PM2.5 Results					
$E_{lb/hr}$	Particulate Rate (lb/hr)	0.2651	0.2051	0.2876	0.2526

Average includes 3 runs.

Detection level classifications are defined as follows:

ADL = Above Detection Level - all fractions are above detection limit

DLL = Detection Level Limited - some fractions are below detection limit

BDL = Below Detection Limit - all fractions are below detection limit

End of Section

3. DESCRIPTION OF INSTALLATION

Process Description

EES Coke Battery, LLC is a facility located on Zug Island in River Rouge, Michigan. The testing described in this document will be performed at the pushing PECS Stack location. The process includes the PECS Baghouse, Pushing Stack (PECS Stack) and a Combustion Stack.

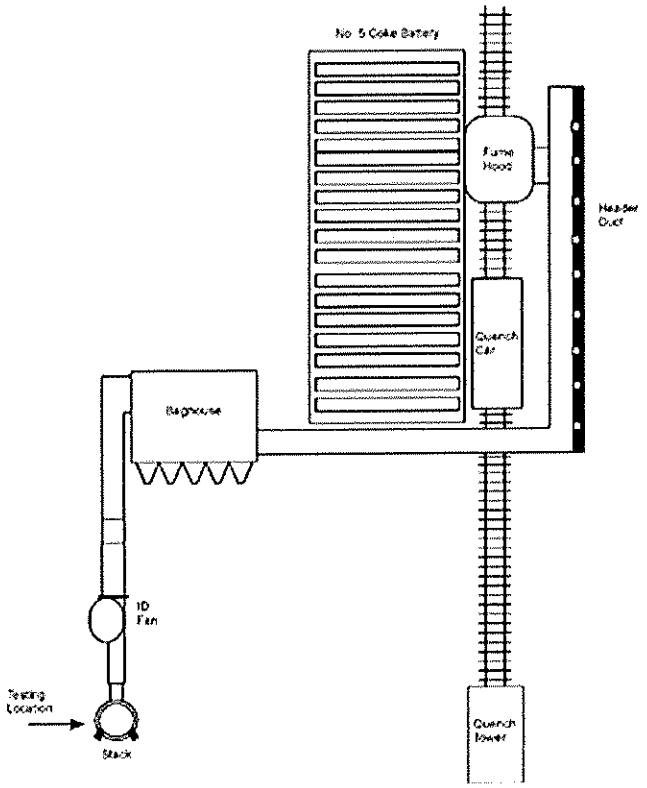
The No. 5 Coke Battery consists of 85, six-meter-high ovens producing furnace coke. A coal blend is used to charge each oven on timed intervals depending on the current production of the battery. Coking of the coal occurs in an oxygen free environment for 17 to 30 hours and the gases produced are collected, cleaned, and used to under fire the battery, supply fuel for other site sources, and sold to permitted off-site utilities.

The current permit limits allow for the charging of up to 1.420 million dry tons of coal per year. The design capacity heating requirement of the battery is approximately 375 MMBtu per hour. The heating requirements of the battery at the current production rate are approximately 325 MMBtu per hour.

Process source description information above was taken from written information provided by EES Coke.

A schematic of the process, indicating proposed sampling locations, is shown in Figure 3-1.

Figure 3-1:
Process Schematic



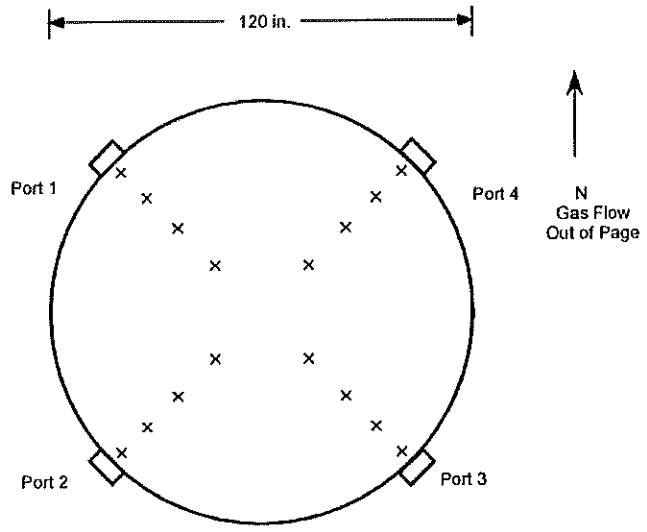
Test Location

EPA Method 1 specifications determined the sample point locations. Table 3-1 presents the sampling information for the test location. The figure shown on page 9 represents the layout of the test location.

Table 3-1:
Sampling Information

Source Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
PECS Stack							
$PM_{10}/PM_{2.5}$	EPA 201A/202	1-3	2	60	10	120	3-2

Figure 3-2:
PECS Stack Sample Point Layout (EPA Method 1)



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	95.6	114.7
2	85.4	102.5
3	70.4	84.5
4	29.6	35.5
5	14.6	17.5
6	4.4	5.3

Duct diameters upstream from flow disturbance (A): 2.0 Limit: 0.5

Duct diameters downstream from flow disturbance (B): 8.0 Limit: 2.0

End of Section

4. METHODOLOGY

Procedures and Regulations

The test program sampling measurements followed procedures and regulations outlined by the USEPA and Michigan Department of Environmental Quality (DEQ). These methods appear in detail in Title 40 of the CFR and at https://www.epa.gov/emc.

Appendix A includes diagrams of the sampling apparatus, as well as specifications for sampling, recovery, and analytical procedures. Any modifications to standard test methods are explicitly indicated in this appendix. In accordance with ASTM D7036 requirements, CleanAir included a description of any such modifications along with the full context of the objectives and requirements of the test program in the test protocol submitted prior to the measurement portion of this project. Modifications to standard methods are not covered by the ISO 17025 and TNI portions of CleanAir's A2LA accreditation.

CleanAir follows specific QA/QC procedures outlined in the individual methods and in USEPA "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III Stationary Source-Specific Methods," EPA/600/R-94/038C. Appendix D contains additional QA/QC measures, as outlined in CleanAir's internal Quality Manual.

Title 40 CFR Part 60, Appendix A

Method 1	"Sample and Velocity Traverses for Stationary Sources"
Method 2	"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)"
Method 3A	"Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)"
Method 4	"Determination of Moisture Content in Stack Gases"

Title 40 CFR Part 51, Appendix M

Method 201A	"Determination of PM_{10} and $PM_{2.5}$ Emissions from Stationary Sources (Constant Sampling Rate Procedure)"
Method 202	"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"

End of Section

5. APPENDIX

Appendix A: Test Method Specifications

Appendix B: Sample Calculations

Appendix C: Parameters

Appendix D: QA/QC Data

Appendix E: Field Data

Appendix F: Field Data Printouts

Appendix G: Laboratory Data

Appendix H: Facility Operating Data

Appendix I: CleanAir Resumes and Certifications