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**Report on the Air Emission
Test Program**

**Conducted for AlphaGen Power LLC
at their Facility Located at
2219 Chapin Street
Jackson, Michigan**

*Report No. 5323
July 27, 2015*

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Project Overview

General

Airtech Environmental Services Inc. (Airtech) was contracted by AlphaGen Power LLC (AlphaGen) to perform an air emissions test program at the Jackson Power Facility located in Jackson, Michigan. The Jackson Power Facility consists of seven (7) natural gas-fired, combined-cycle turbines (CTs). CT unit's 1-6 use steam injection for nitrogen oxides (NO_x) reduction and unit 7EA has a dry, low NO_x (DLN) system. Compliance testing was performed at the exhausts of CT-5 and CT-7EA.

The specific objectives of this test program were as follows:

- Perform compliance testing to determine the concentration of particulate matter emissions equal to or less than a nominal aerodynamic diameter of 10 micrometers (PM₁₀) and condensable particulate matter (CPM)
- Perform compliance testing to determine the visual determination of opacity emissions (VE)
- Perform compliance testing to determine the concentration of volatile organic compounds (VOC)
- Perform compliance testing to determine the concentration of formaldehyde (HCHO)

Testing was conducted to meet the requirements of AlphaGen Power; Jackson Power Facility; the Michigan Department of Environmental Quality (MDEQ); the United States Environmental Protection Agency (U.S. EPA); and 40 CFR Parts 60 and 75, as applicable.

Testing was performed on June 16 through June 18, 2015. Coordinating the field portion of the test program were:

Jason Ricketts – AlphaGen Power LLC
Timothy Giffin – Airtech Environmental Services Inc.

Methodology

EPA Method 5 combined with EPA Method 202 was used to determine the filterable PM and condensable PM (CPM) concentrations each test location for a combined total particulate. In EPA Method 5/202, a sample of the gas stream was withdrawn isokinetically from the stack and the filterable PM (FPM) was collected in a glass lined probe and on a glass fiber filter. The CPM passed through the probe and filter and collected in a dry impinger system. With this approach the total PM was considered to be the sum of the filterable PM and the CPM. Three test runs were performed at the test location.

To convert the concentrations of the PM to mass emission rates, the volumetric flow rate through the stack was determined in conjunction with each Methods 5/202 test run using EPA Methods 1, 2, 3 and 4.

EPA Method 9 was used to conduct VE at the exhaust of each test location. VE determinations were conducted by a certified observer positioned with a line of sight perpendicular to the plume direction. The observer viewed the plume with the sun oriented in the 140° sector of the observer's back. A minimum distance equal to three times the height of the emission point above grade was maintained between the observer and the potential emission point. The observer's line of sight did include more than one potential emission point. Readings were taken at 15-second intervals. Between readings the observer looked away from the plume to rest his eyes. Wind speed and direction were recorded as well as descriptions of the plume and background.

Three (3) sixty (60) minute observations were taken at the test location in conjunction with PM testing. Results for VE are reported in units of percent (%).

EPA 25A was used to determine the concentration of total hydrocarbons (THC) at the exhaust of the test location. In Method 25A, a sample of the gas stream was withdrawn from the test location at a constant rate through a stainless steel probe and Teflon sample line. The probe and sample line was maintained at a temperature of at least 250°F to prevent the condensation of moisture or organics. The sample gas then passed directly into a heated flame ionization analyzer (FIA). Because methane is included with Method 25A and is an exempt VOC, the methane concentration was determined using EPA Method 18. The methane emission rate was subtracted from the THC emission rate to give a total non-methane hydrocarbon (TNMHC) emission rate. Analysis for methane was performed on-site using EPA Method 320.

EPA Method 320 was used to determine the concentration of carbon dioxide (CO₂), methane and HCHO concentrations and the moisture content at each test location. These constituents were measured on a "wet" volume basis using a temporary Continuous Emission Monitoring System (CEMS) which utilizes Fourier Transform Infrared (FTIR) spectroscopy.

Testing for VOCs and formaldehyde was conducted at two (2) different load scenarios consisting of an upper (full load duct burner operation) and lower (part load without duct burner operation) load level.

Parameters

The following parameters were determined at each test location:

- gas velocity
- gas temperature
- moisture content
- oxygen concentration
- carbon dioxide concentration
- filterable particulate concentration
- opacity of emissions
- methane concentration
- total hydrocarbon concentration
- condensable particulate concentration
- formaldehyde concentration


Results

A complete summary of test results is presented in Tables 1 through 6 on Pages 5 through 10.

In order to calculate the pounds per million Btu (lb/mmBtu) emission rate, an Fc factor of 1,040 dscf/mmBtu was used as per EPA Method 19.

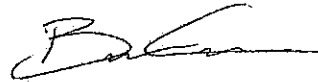
Process data supplied by the plant was used to calculate the pound per hour emissions rates of TNMHC and HCHO.

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Summary of Results

Table 1 – Summary of PM and Opacity Results, CT-5

<u>Test Parameters</u>	Run 1	Run 2	Run 3	Average
Date	6/18/2015	6/18/2015	6/18/2015	
Start Time	9:15	11:15	13:25	
Stop Time	10:50	12:51	15:00	
<u>Gas Conditions</u>				
Temperature (°F)	286	287	288	287
Volumetric Flow Rate (acfm)	358,400	365,300	367,300	363,700
Volumetric Flow Rate (scfm)	244,500	248,900	250,200	247,900
Volumetric Flow Rate (dscfm)	211,010	213,000	213,400	212,500
Carbon Dioxide (% dry)	4.18	4.01	4.32	4.17
Oxygen (% dry)	13.9	14.1	14.1	14.0
Moisture (%)	13.7	14.5	14.7	14.3
<u>Filterable PM Results</u>				
Concentration (grains/dscf)	0.000660	0.000453	0.000624	0.000579
Emission Rate, Fc (lb/MMBtu)	0.00235	0.00168	0.00215	0.00206
Emission Rate (lb/hr)	1.19	0.827	1.14	1.05
<u>Condensable PM Results</u>				
Concentration (grains/dscf)	0.00158	0.00116	0.00118	0.00131
Emission Rate, Fc (lb/MMBtu)	0.00561	0.00431	0.00407	0.00466
Emission Rate (lb/hr)	2.86	2.12	2.17	2.38
<u>Total PM Results</u>				
Concentration (grains/dscf)	0.00224	0.00161	0.00181	0.00189
Emission Rate, Fc (lb/MMBtu)	0.00796	0.00598	0.00622	0.00672
Emission Rate (lb/hr)	4.05	2.95	3.31	3.44
<u>Opacity Results</u>				
Average Opacity (%)*	0.00	0.00	0.00	0.00
Minimum Opacity (%)	0	0	0	
Maximum Opacity (%)	0	0	0	

* The average opacity is based on the highest six-minute reading.

Table 2 – Summary of PM and Opacity Results, CT-7EA

<u>Test Parameters</u>	Run 1	Run 2	Run 3	Average
Date	6/16/2015	6/16/2015	6/16/2015	
Start Time	14:05	16:42	19:18	
Stop Time	16:16	18:50	21:26	
<u>Gas Conditions</u>				
Temperature (°F)	288	287	287	287
Volumetric Flow Rate (acfm)	774,300	762,800	763,500	766,900
Volumetric Flow Rate (scfm)	527,400	520,600	520,400	522,800
Volumetric Flow Rate (dscfm)	479,070	473,800	477,800	476,900
Carbon Dioxide (% dry)	4.16	4.03	4.12	4.10
Oxygen (% dry)	14.3	14.5	14.5	14.4
Moisture (%)	9.19	9.02	8.23	8.82
<u>Filterable PM Results</u>				
Concentration (grains/dscf)	0.000937	0.000922	0.000757	0.000872
Emission Rate, Fc (lb/MMBtu)	0.00335	0.00340	0.00273	0.00316
Emission Rate (lb/hr)	3.85	3.74	3.10	3.56
<u>Condensable PM Results</u>				
Concentration (grains/dscf)	0.000981	0.00115	0.00116	0.00110
Emission Rate, Fc (lb/MMBtu)	0.00350	0.00424	0.00418	0.00397
Emission Rate (lb/hr)	4.03	4.67	4.75	4.48
<u>Total PM Results</u>				
Concentration (grains/dscf)	0.00192	0.00207	0.00192	0.00197
Emission Rate, Fc (lb/MMBtu)	0.00685	0.00763	0.00691	0.00713
Emission Rate (lb/hr)	7.88	8.41	7.85	8.05
<u>Opacity Results</u>				
Average Opacity (%)*	0.00	0.00	0.00	0.00
Minimum Opacity (%)	0	0	0	
Maximum Opacity (%)	0	0	0	

* The average opacity is based on the highest six-minute reading.

Table 3 – Summary of VOC and Formaldehyde Results, CT-5 Low Load

<u>Test Parameters</u>	Run 1	Run 2	Run 3	Average
Date	6/17/2015	6/17/2015	6/17/2015	
Start Time	11:45	12:54	14:04	
Stop Time	12:45	13:54	15:04	
<u>Process Data</u>				
Fuel Factor (Fc)	1040	1040	1040	
Fuel Usage (Mbtu/Hr)	417.7	416.2	417.1	
<u>Gas Conditions</u>				
Carbon Dioxide (%)	3.13	3.13	3.14	3.13
<u>Pollutant Results</u>				
THC Concentration (ppmwv)	1.52	1.91	0.634	1.36
THC Emission Rate (lb/mmBtu)	0.00211	0.00264	0.000875	0.00187
THC Emission Rate (lb/hr)	0.879	1.10	0.365	0.782
Methane Concentration (ppmwv)	0.514	0.544	0.503	0.520
Methane Emission Rate (lb/mmBtu)	0.000710	0.000753	0.0006942	0.000719
Methane Emission Rate (lb/hr)	0.297	0.313	0.2896	0.300
TNMHC Emission Rate (lb/mmBtu)	0.00140	0.00189	0.000181	0.00116
TNMHC Emission Rate (lb/hr)	0.583	0.787	0.0754	0.482
Formaldehyde Concentration (ppmwv)	0.485	0.701	0.341	0.509
Formaldehyde lb/mmbtu	0.00125	0.00182	0.000880	0.00132
Formaldehyde lb/hr	0.524	0.756	0.367	0.549

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Table 4 – Summary of VOC and Formaldehyde Results, CT-5 High Load

<u>Test Parameters</u>	Run 1	Run 2	Run 3	Average
Date	6/18/2015	6/18/2015	6/18/2015	
Start Time	9:03	10:18	11:37	
Stop Time	10:03	11:18	12:37	
<u>Process Data</u>				
Fuel Factor (Fc)	1040	1040	1040	
Fuel Usage (Mbtu/Hr)	598.2	597.9	595.6	
<u>Gas Conditions</u>				
Carbon Dioxide (%)	4.40	4.40	4.41	4.40
<u>Pollutant Results</u>				
THC Concentration (ppmwv)	1.33	0.283	0.573	0.729
THC Emission Rate (lb/mmBtu)	0.00131	0.000278	0.000563	0.000717
THC Emission Rate (lb/hr)	0.784	0.166	0.335	0.428
Methane Concentration (ppmwv)	0.379	0.345	0.324	0.349
Methane Emission Rate (lb/mmBtu)	0.000373	0.000339	0.000318	0.000343
Methane Emission Rate (lb/hr)	0.223	0.203	0.189	0.205
TNMHC Emission Rate (lb/mmBtu)	0.000937	0.00	0.000245	0.000394
TNMHC Emission Rate (lb/hr)	0.561	0.00	0.146	0.235
Formaldehyde Concentration (ppmwv)	0.305	0.240	0.202	0.249
Formaldehyde lb/mmBtu	0.000561	0.000443	0.000372	0.000458
Formaldehyde lb/hr	0.335	0.265	0.221	0.274

Table 5 – Summary of VOC and Formaldehyde Results, CT-7EA Low Load

<u>Test Parameters</u>	Run 1	Run 2	Run 3	Average
Date	6/16/2015	6/16/2015	6/16/2015	
Start Time	8:25	10:38	12:17	
Stop Time	9:55	12:08	13:47	
<u>Process Data</u>				
Fuel Factor (Fc)	1040	1040	1040	
Fuel Usage (Mbtu/Hr)	786.3	722.6	815.8	
<u>Gas Conditions</u>				
Carbon Dioxide (%)	3.02	3.11	3.25	3.13
<u>Pollutant Results</u>				
THC Concentration (ppmwv)	2.79	2.70	0.541	2.01
THC Emission Rate (lb/mmBtu)	0.00400	0.00376	0.000720	0.00283
THC Emission Rate (lb/hr)	3.15	2.72	0.587	2.15
Methane Concentration (ppmwv)	0.130	2.04	0.0495	0.741
Methane Emission Rate (lb/mmBtu)	0.000186	0.00285	0.0000659	0.00103
Methane Emission Rate (lb/hr)	0.147	2.06	0.0537	0.752
TNMHC Emission Rate (lb/mmBtu)	0.00381	0.000917	0.000654	0.00180
TNMHC Emission Rate (lb/hr)	3.00	0.663	0.533	1.40
Formaldehyde Concentration (ppmwv)	0.220	0.120	0.0820	0.141
Formaldehyde lb/mmbtu	0.000591	0.000314	0.000204	0.000370
Formaldehyde lb/hr	0.465	0.227	0.167	0.286

Table 6 – Summary of VOC and Formaldehyde Results, CT-7EA High Load

<u>Test Parameters</u>	Run 4	Run 5	Run 6	Average
Date	6/16/2015	6/16/2015	6/16/2015	
Start Time	15:05	17:42	20:21	
Stop Time	17:05	19:42	22:20	
<u>Process Data</u>				
Fuel Factor (Fc)	1040	1040	1040	
Fuel Usage (Mbtu/Hr)	1122.7	1132.4	1112.3	
<u>Gas Conditions</u>				
Carbon Dioxide (%)	3.86	3.86	3.86	3.86
<u>Pollutant Results</u>				
THC Concentration (ppmwv)	0.389	0.0807	0.00	0.157
THC Emission Rate (lb/mmBtu)	0.000436	0.0000905	0.00	0.000176
THC Emission Rate (lb/hr)	0.490	0.102	0.00	0.197
Methane Concentration (ppmwv)	0.00	0.00	0.0139	0.00598
Methane Emission Rate (lb/mmBtu)	0.00	0.00000458	0.0000155	0.00000671
Methane Emission Rate (lb/hr)	0.00	0.00519	0.0173	0.00749
TNMHC Emission Rate (lb/mmBtu)	0.000436	0.0000859	0.00	0.000174
TNMHC Emission Rate (lb/hr)	0.490	0.0973	0.00	0.196
Formaldehyde Concentration (ppmwv)	0.114	0.107	0.0618	0.0941
Formaldehyde lb/mmbtu	0.000239	0.000224	0.000130	0.000198
Formaldehyde lb/hr	0.268	0.254	0.144	0.222

Test Procedures

Method Listing

The following EPA test methods were referenced for the test program. These methods can be found in 40 CFR Part 60 Appendix A and Part 51 Appendix M.

- Method 1 Sample and velocity traverse 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
- Method 5 Determination of particulate matter emissions from stationary sources
- Method 9 Visual determination of the opacity of emissions from stationary sources
- Method 19 Determination of sulfur dioxide removal efficiency and particulate matter, sulfur dioxide, and nitrogen oxides emission rates
- Method 25A Determination of total gaseous concentration using a flame ionization analyzer
- Method 202 Determination of condensible particulate emissions from stationary sources
- Method 320 Measurement of vapor phase organic and inorganic emissions by extractive fourier transform infrared (FTIR) spectroscopy

Method Descriptions

Method 1

Method 1 was used to determine the suitability of the test location and to determine the sample points used for the particulate concentration determinations. The test location conformed to the minimum requirements of being located at least 2.0 diameters downstream and at least 0.5 diameters upstream from the nearest flow disturbance.

The CT-5 test location was a round, vertical stack with a diameter of 114 inches. Three points were sampled for each of the four test ports. The test location was approximately 6.9 diameters downstream and approximately 1.2 diameters upstream from the nearest flow disturbances. A cross section of the sampling location, showing the sample points, can be found in Figure 1 of the Appendix.

The CT-7EA test location was a round, vertical stack with a diameter of 186 inches. Six points were sampled for each of the four test ports. The test location was approximately 2.9 diameters downstream and approximately 0.9 diameters upstream from the nearest flow disturbances. A cross section of the sampling location, showing the sample points, can be found in Figure 2 of the Appendix.

Method 2

Method 2 was used to determine the gas velocity through each test location using a Type-S pitot tube and an incline plane oil manometer. The values measured in Method 2, along with the measurements made in Methods 3A and 4, were used to calculate the volumetric flow rate through the test locations. A diagram of the Method 2 apparatus is shown as part of the Method 5/202 sampling train in Figure 3 of the Appendix.

The manometer was leveled and “zeroed” prior to each test run. The sample train was leak checked before and after each run by pressurizing the positive side, or “high” side, of the pitot tube, creating a deflection on the manometer of at least three inches H₂O. The leak check was considered valid if the manometer remained stable for 15 seconds. This procedure was repeated on the negative side by generating a vacuum of at least three inches H₂O. The velocity head pressure and gas temperature were then determined at each point specified in Method 1. The static pressure of the stack was measured using a water filled U-tube manometer. In addition, the barometric pressure was measured and recorded.

Method 3A

The carbon dioxide and oxygen contents were determined at the test location using EPA Method 3A. A gas sample was collected into a Tedlar bag from the back of each sample train for the duration of each test run. Analysis was performed using a Servomex 1440 infrared carbon dioxide analyzer/paramagnetic oxygen analyzer. The analyzers were calibrated immediately prior to analysis of the bag samples using the procedures outlined in Method 3A using EPA Protocol calibration gases.

The carbon dioxide content and oxygen content were used to calculate the dry molecular weight of the gas stream. The molecular weight was then used, along with the moisture content determined by EPA Method 4, for the calculation of the volumetric flow rate. For these calculations, the balance of the gas stream was assumed to be nitrogen since the other gas stream components are insignificant for the purposes of calculating molecular weight.

Method 4

The moisture content at each test location was determined using Method 4. A known volume of sample gas was withdrawn from the source and the moisture was condensed and measured. The dry standard volume of the sample gas was then compared to the volume of moisture collected to determine the moisture content of the sample gas. A diagram of the Method 4 apparatus is shown as part of the Methods 5/202 sampling train in Figure 3 of the Appendix.

To condense the water vapor, the gas sample was passed through a series of 4 impingers. The impingers were prepared as described in each individual method. The volume of dry gas exiting the gas condenser system was measured with a dry gas meter. After leaving the dry gas meter, the sample stream passed through an orifice used to meter the flow rate through the sample train. The pressure drop across the orifice was measured with an incline plane, oil manometer. The gas meter reading, gas meter inlet and outlet

temperatures, gas meter static pressure and pump vacuum were recorded for each sample point.

After the test run, the sample train was leak checked at the highest vacuum encountered during the test run. The tests were considered valid since the leak rate was less than 0.02 cfm. The amount of water collected in the condenser system was measured gravimetrically. The net weight gain of water was converted to a volume of wet gas and then compared to the amount of dry gas sampled to determine the moisture content.

Methods 5 and 202

The total PM concentration was determined at each test location using EPA Method 5/202. In EPA Method 5/202, a sample of the gas stream was withdrawn isokinetically from the test location. Filterable PM was collected in the nozzle, probe, connecting glassware and filter. CPM in the sample gas passed through the filter and collected in a gas condenser system. The weight of PM and CPM collected with the sample train combined with the volume of dry gas withdrawn from the stack was then used to calculate a total PM concentration.

To prevent contamination, all components of the sample trains were constructed of glass with no metal connections. Prior to testing all the components of the Method 5 sampling train were cleaned using detergent and then rinsed with tap water, deionized water and lastly with acetone. For the Method 202 sampling train all the components were cleaned using detergent and then rinsed with tap water, deionized water, acetone and lastly with hexane. After drying, all components were sealed with parafilm or Teflon tape.

The Method 5 portion of the sampling train consisted of a glass nozzle, a glass lined sample probe and a glass fiber filter. The probe and filter were maintained at a temperature of 248°F (+/- 25°F) to prevent the condensation of moisture. Sample gas passed through the nozzle, the glass lined heated probe and then through the heated filter.

After exiting the Method 5 portion of the sampling system, the sample gas passed through an EPA Method 23 type glass coil condenser and then through a series of four (4) glass impingers. The condenser was cooled with a water recirculation pump that was placed in a water bath. The recirculation pump and coiled condenser were then used to maintain the gas temperature between 65°F and 85°F at the exit of the CPM filter. Impingers 1 and 2 were initially empty. A Teflon fiber CPM filter followed impinger 2. Impinger 3 contained 100ml of water. The fourth impinger contained a known mass of silica gel to absorb any remaining water vapor. The dry gas exiting the moisture condenser system then passed through a sample pump and a dry gas meter to measure the gas volume.

After leaving the dry gas meter the sample stream passed through an orifice which was used to meter the flow rate through the sample train. The pressure drop across the orifice was measured with an incline plane oil manometer. The Method 5/202 sample train is shown in Figure 3 of the appendix.

Whatman 934-AH glass fiber filters were used as the substrate for the filterable PM sampling. The filter was loaded into a glass filter holder with a Teflon support



that was cleaned and prepared in the same manner as the other components of the Method 5 sample train. Prior to the test run, the filter was desiccated for at least 24 hours and then weighed to the nearest 0.0001 gram (g) until a constant weight was achieved. The weight of the filter was considered to be constant when two consecutive weights taken at least six hours apart were within 0.0005g of each other.

The probe liner was thoroughly pre-cleaned with acetone and the probe wash was saved as a quality assurance check. The sample train was leak checked prior to the test run by capping the probe tip and pulling a vacuum of at least 15 inches Hg. A leak test was considered valid if the leak rate was below 0.02 cfm. When not in operation or inside the stack, the nozzle was sealed with Teflon tape.

The probe tip was then placed at the first of the sample points determined in Method 1. The velocity at the sample point was determined using Method 2 by reading the velocity pressure from the oil manometer. Sample was withdrawn from the source at a rate such that the velocity in the nozzle matched the velocity of the stack gas at the sample point (isokinetically). During the test run the train was moved to each of the Method 1 sample points. The sample time at each point was calculated based on the number of sample points and the run time. The gas velocity pressure, gas meter reading, gas meter inlet and outlet temperatures, gas meter orifice pressure and pump vacuum was recorded for each sample point.

After the test run the sample train was leak checked at the highest vacuum encountered during the test run. The sampling train was then moved to the on-site lab and purged with zero grade nitrogen at a nominal flow rate of 14 liters per minute for a period of 60 minutes. The nozzle, probe and front half of the filter holder were washed with acetone and the rinse saved in a 250ml glass jar equipped with a Teflon lid. The glass fiber filter was removed from the filter holder, transferred to a Petri dish and sealed.

Upon completion of the purge, the contents of impingers one and two were transferred to a pre-cleaned 950 ml sample jar equipped with a Teflon lid. The condenser coil and all connecting glassware up to and including the front half of the CPM filter were rinsed twice with deionized ultra filtered (DUIF) water and added to the sample jar. An acetone rinse of the above glassware was performed and saved in a separate pre-cleaned 500ml sample jar equipped with a Teflon lid. Finally, two (2) rinses of the above components were performed with hexane and added to the acetone container. The CPM filter was removed from the filter holder and placed in a 40ml glass jar.

Analysis of all sample fractions was performed at the Airtech laboratory located in Elk Grove Village, Illinois. The acetone rinses from the Method 5 portion of the sampling train were transferred to tared beakers, evaporated to dryness under ambient temperature and pressure conditions, desiccated for 24 hours and weighed to a constant weight. A weight was considered constant when the difference between two consecutive weights, taken a minimum of six hours apart, was less than or equal to 0.0005 grams. The weight gain of the glassware rinses and glass fiber filter yielded the total weight of filterable particulate collected during sampling.

Inorganic extraction of the CPM filter was performed by placing the filter into an extraction tube with DIUF water and placing it into a sonication bath for a minimum of 2 minutes. This extraction was done a total of 3 times and the water used each time was added to the impinger water container. After inorganic extraction of the CPM filter, an organic extraction of the impinger water was performed. The entire contents of the impinger water sample fraction was placed in a separatory funnel. A 30 ml aliquot of Hexane was added to the funnel and the funnel contents were thoroughly mixed. The organic layer was then allowed to separate from the water and was decanted from the bottom of the funnel into the acetone and hexane sample jar. This procedure was conducted three (3) times to complete the extraction.

The final contents of the separatory funnel was then transferred into a beaker and evaporated down to not less than 10 ml final volume at an elevated temperature. The final volume was transferred to a 50 ml tared weighing tin and evaporated to dryness at ambient temperature. The beaker was desiccated for 24 hours and then weighed to a constant weight.

Organic CPM extraction of the filter was performed by placing the inorganic extracted filter into an extraction tube with hexane and placing it into a sonication bath for a minimum of 2 minutes. This extraction was done a total of 3 times and the hexane used was added to the acetone/hexane container. The contents of this container was transferred into a beaker and evaporated. The tin was desiccated for 24 hours and then weighed to a constant weight.

The weight differences for the organic and inorganic fractions were combined to determine the total condensible particulate collected. All fractions of the CPM analysis were adjusted for the appropriate blank values.

Method 9

The opacity of emissions from each test location was determined according to EPA Method 9. A certified observer from Airtech positioned with a line of sight perpendicular to the plume direction determined the opacity. The observer viewed the plume with the sun oriented in the 140o sector of the observer's back. A minimum distance equal to three times the height of the stack was maintained between the observer and the smoke plume. The observer's line of sight did not include more than one plume.

Readings were taken at 15-second intervals. Observations were recorded concurrently with the particulate testing. Between readings, the observer looked away from the plume to rest their eyes. Wind speed and direction were recorded as well as descriptions of the plume.

Method 19

EPA Method 19 was used to calculate the emission rates in units of lb/mmBtu. The calculations were based on the CO₂ concentration of the sample gas and an appropriate F

factor, which is the ratio of combustion gas volumes to heat inputs. An Fc factor of 1,040 dscf/mmBtu was used as per EPA Method 19.

Method 25A

The total hydrocarbon concentration at each location was determined using EPA Method 25A. A sample of the gas stream was continuously withdrawn from the test location and analyzed using a continuous gas analysis system. A diagram of the EPA Method 25A apparatus is shown in Figure 4 of the Appendix.

The sample gas was withdrawn from each each location at a constant rate through a stainless steel probe and a Teflon sample line. The sample line was operated at a temperature of 250 °F to prevent the condensation of moisture. The sample gas was vented to a J.U.M. Engineering Model 3-300A gas analyzer. This analyzer used a flame ionization detector for the determination of total hydrocarbons. Results from this analyzer were determined on a "wet" basis. Hydrogen was used to fuel the instrument. The flame ionization analyzer (FIA) was calibrated with zero nitrogen and three known concentrations of propane in a balance of nitrogen. Each calibration gas was certified according to EPA Protocol 1 procedures.

Prior to sampling, a calibration error test was performed for the FIA. The zero and high-range calibration gases were introduced into the sampling system prior to the filter. The gas was drawn through the entire sampling system and the FIA was adjusted to the appropriate values. The mid and low-range gases were then introduced to the FIA and the measured values were recorded. The measured values for each calibration gas were then compared to the calibration gas values and the differences were less than the method requirement of five percent of the actual value.

After each test run the instrument drift for each FIA was determined by introducing the zero and mid-range calibration gases into the sampling system. The gas was drawn through the entire sampling system. The measured responses were then compared to the values from the previous test run to determine the analyzer drift. For all test runs, the analyzer drift was less than the method requirement of three percent of the span value.

Method 320

The CO₂, methane and HCHO concentrations and the moisture content at each test location were determined using EPA Method 320. A sample of the gas stream was continuously withdrawn from the test location and analyzed using a continuous FTIR gas analysis system.

The sample gas was withdrawn from the test location at a constant rate through a stainless steel probe, a heated glass fiber filter and a heated Teflon sample line. The probe, filter and sample line were operated at a temperature of 370 oF to prevent the condensation of moisture. The wet gas was then directed to the FTIR spectrometer gas cell. Results from the analyzer were determined on a "wet" volume basis.

The FTIR gas analyzer that was used for this project is an MKS MultiGas FTIR analyzer and a schematic of the sampling system can be found in Figure 5 in the Appendix.

Prior to testing, the detection limit (DL) and analytical uncertainty (AU) were determined for each constituent. The potential interferants for the analytes being tested were determined. The optical configuration that can measure all of the analytes within the absorbance range of 0.01 and 1.0 was determined. The sample system was assembled and allowed to reach stable operating temperatures and flow rates. A sample interface leak check was performed. Nitrogen or zero air was directed to the FTIR gas cell in order to determine a background spectrum. A sample spectrum was then recorded in succession. The peak to peak and RMS noise in the resultant spectrum in the wavelength region(s) to be used for the target compound analysis was measured and recorded.

A Calibration Transfer Standard (CTS) was introduced into the system and two spectra were recorded at least two minutes apart. As long as the second spectrum was no greater than the first and within the uncertainty of the gas standard, it was used as the CTS spectrum.

A QA spike was performed by introducing a certified standard for each constituent (with the exception of H₂O) into the sampling system. A certified standard of propane was used as the QA spike for VOC. First, some of the effluent gas was sampled in order to determine the native concentration of target analytes. The analyte spike calibration gas was then introduced to the FTIR gas cell only, and the results were determined using the analytical algorithm. Results from the calibration gas were recorded and compared to the certified value of the calibration gas. For reactive condensable gases such as hydrogen chloride (HCl), ammonia (NH₃), and formaldehyde (HCHO), the results must be within 10% or 5 ppm. The analyte spike calibration gas was then directed through the entire sampling system and allowed to mix with effluent gas sample at a known flow rate. The flow ratio of calibration gas to ambient air or source effluent was no greater than 1:10 (one part calibration gas to ten parts total flow) for the determination of sample recovery. Spectra were recorded for three non-consecutive spiked samples and the concentration of the spike was calculated. The average spiked concentration was within 70% and 130% of the expected concentration.

After all required pre-test procedures were performed, stack gas was sampled continuously. Sample interferograms, processed absorbance spectra, background interferograms, CTS sample interferograms, and CTS absorbance spectra were recorded. Sample conditions, instrument settings, and test records were also recorded throughout the test. If signal transmittance changed by 5 percent or more in any analytical spectral region, a new background spectrum was obtained. A new CTS spectrum was obtained after each sampling run. The post-test CTS spectrum was compared to the pre-test spectrum. The peak absorbance from each spectra were within 5% of the mean value. A certified gas standard for each constituent was introduced into the system after each test run as an additional quality check.