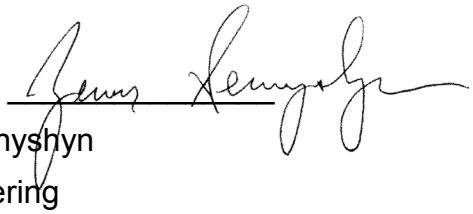
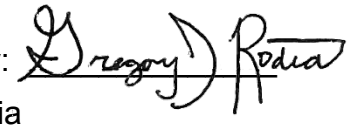
Covanta Durham York Renewable Energy Limited Partnership.

Acceptance Test Report

8-Hour Energy Recovery Test Report
8-Hour Residue Quality Test Report

Approved by: 
Zenon Semanyshyn
V.P., Engineering

Submitted by: 
Gregory Rodia
Senior Process Engineer

Approved by: 
Paul Ewald
Director, Process Engineering

Submitted by: 
Lambert Xiao
Principal Operations Engineer

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1 OBJECTIVE

1.1 Energy Recovery Test

The objective of the Energy Recovery Test was to demonstrate compliance with the Electricity Production Guarantees in Exhibit 2 to Appendix 19 of the Project Agreement, ("Agreement"). The Energy Recovery Test determined the Project gross and net electrical outputs per tonne of Reference Waste (kWh/Tonne), for comparison to values shown in item 3 of the table on page 6 of Exhibit 2 to Appendix 19. The table shows the guarantees varying with Waste HHV, so the test objective was to measure the actual kWh/Tonne values and compare the average As-Tested Energy Recovery in kWh/Tonne to the table guarantee value at same As-Tested average HHV. The only correction the Agreement allowed to the As-Tested kWh/Tonne values is the adjustment of the power outputs to annual average ambient conditions.

1.2 8-Hour Residue Quality Test

The objective of the 8-Hour portion of the Residue Quality Test was to demonstrate compliance with the Residue Quality Guarantee of 25% by weight moisture and 3% by dry weight unburned carbon in the residue, as noted in Appendix 10 of the Agreement. These 8-Hour test runs had more frequent sampling than the 5-Day Residue Quality Test. For purposes of the Residue Quality Test, the Agreement defines residue as bottom ash and grate siftings, but does not include any flyash, added reagents or recovered metals.

2 SUMMARY & CONCLUSIONS

Five, 8-Hour Energy Recovery Tests were performed on September 27 through October 1, 2015, at Covanta Durham York Renewable Energy Limited Partnership (Covanta). These tests measured energy recovery with the above-described objective. The Facility averaged over 35 tonnes/hr steam flow per boiler which is ~103% of MCR steam output over the five tests.

The guaranteed gross and net energy recovery values are dependent upon HHV. Therefore, the results from each test were compared to the guaranteed values per Item 3 of Exhibit 2, Appendix 19 of the Project Agreement. The measured average gross energy recovery of **961** kWh/Tonne surpassed the guarantee by **3.5%** (32 kWh/Tonne). The measured average net energy recovery of **840** kWh/Tonne surpassed the guarantee by **2.3%** (19 kWh/Tonne).

Bottom ash samples were collected throughout each 8-Hour energy recovery test to measure the unburned combustible and the moisture content. All five tests registered non-detectible unburned combustible (low limit of 0.83% dry weight) which was below the guaranteed value of 3% by dry weight. The individual test moisture contents were all below the guaranteed value of 25% by weight.

Table A, summarizes each test's gross and net kWh/Tonne compared to the guarantee and residue quality results. As shown, all five individual energy recovery tests surpassed the gross and net guarantees.

Table A: Overall Energy Recovery and Residue Quantity Test Summary

Energy Recovery: Test Summary							
	Start Time	9/27/15 8:00	9/28/15 8:00	9/29/15 9:00	9/30/15 8:00	10/1/15 9:00	
	End Time	9/27/15 16:00	9/28/15 16:00	9/29/15 17:00	9/30/15 16:00	10/1/15 17:00	
	Test	ER 1	ER 2	ER 3	ER 4	ER 5	AvG
% of MCR Steam Output	%	104%	101%	104%	103%	103%	103%
Actual Refuse Processed	tonnes	146	143	138	153	144	145
ER Test Waste HHV	KJ/Kg	13,792	14,044	14,257	13,184	13,411	13,738
As-Tested Gross ER	kWh/Tonne	966	974	1001	912	953	961
Gross Guarantee	kWh/Tonne	933	953	970	885	903	929
Gross Delta	kWh/Tonne	33	21	31	27	50	32
	%	3.6%	2.2%	3.2%	3.0%	5.5%	3.5%
As-Tested Net ER	kWh/Tonne	850	849	872	796	835	840
Net Guarantee	kWh/Tonne	826	844	859	782	799	822
Net Delta	kWh/Tonne	24	6	13	13	37	19
	%	2.9%	0.7%	1.5%	1.7%	4.6%	2.3%
Unburned Combustible	%, dry	0.83	0.83	0.83	0.83	0.83	0.83
Residue Moisture Content	%	19.6	18.0	17.4	15.0	16.5	17.3

3 TEST PROCEDURES & MODIFICATIONS

The test was performed in accordance with the Covanta Acceptance Test Procedures, Energy Recovery Tests and Residue Quality Test. The procedures governing this test were agreed to by the Regions and their consultant, HDR. Minor modifications made to these test procedures are described below.

3.1 Test Modifications

3.1.1 Assumption of Residue Weights

As agreed upon with HDR prior to the testing, the Residue weights for bottom ash, ferrous, non-ferrous, and grizzly used in the calculations of energy recovery were assumed to be equal to the average during the 5-Day period from September 27 to October 1. Per the Test Procedures, the fly ash quantity was assumed to be 10% of the total wet ash weight.

This simplified the logistics of measuring each 8-Hour test's residue quantity. A sensitivity analysis of the effect of Residue weights on energy recovery were presented to HDR prior to the tests. The analysis demonstrated that the impact was small enough to be deemed negligible.

3.1.2 Auxiliary Gas Burner Usage

During ER-1, Boiler 2's auxiliary burner was put in service to help raise the furnace temperature to meet the hourly 1000 degree C permit requirement. The burner was in service from approximately 11:58 to 12:30 at a reduced firing rate. This resulted in 154.9 cubic meters of natural gas burned, which was equivalent to 198 kg/hr of steam produced from the burner, based on the As-Tested boiler efficiency.

This was approximately 0.56% of the total heat input during the 8-Hour test, which had a negligible impact on the results. The test results presented for ER-1 reflect the exclusion of the

steam produced by natural gas from the steam produced by refuse.

It was later discovered that the CEMs Trace system was reporting falsely low furnace temperature and was immediately corrected to account for the signal time delay between the plant's DCS and CEMs Trace system.

3.2 Test Procedures

3.2.1 Number of Tests Conducted

The Test Procedures called for a minimum of three 8-Hour Energy Recovery Tests. A total of five 8-Hour tests were conducted. All five test results are presented and discussed herein.

3.2.2 Hopper Level Verification/Spillage

Digital photos of each boiler hopper were taken by Covanta and HDR before and after each 8-Hour energy recovery test. The refuse hopper level was returned to the same starting level at the end of each test.

During ER-1, an additional grapple of 534 kg was charged to Boiler 2's hopper to return the level to its starting position. During ER-3, Boiler 1's hopper level was above the starting point at the end of the test. During ER-5, Boiler 2's hopper level was above the starting point at the end of the test. It was agreed upon by Covanta and HDR that the throughput get prorated by an extra 5 minutes to allow for the hopper level to return to the starting position. The calculations reflect the agreed upon adjustments to the throughput for ER-1, ER-3, and ER-5.

Throughout each 8-Hour test period, there was a negligible amount of refuse spillage. Each refuse crane is equipped with semi-automatic refuse feeding. This feature insures that each grapple load drops into the center of the refuse hopper, significantly reducing spillage outside of the hopper boundary or back into the refuse pit.

3.2.3 Crane Weigh System Drift

The throughput data from each 8-Hour test was adjusted for crane calibration drift. During each 8-Hour test, only the west crane was used to charge each hopper. The crane's weigh system registered on average 0.90% (~35 kg) lower than the span check test block. Although the deviation was within the tolerance allowed by the Test Procedures; the correction was made to increase the overall accuracy of the refuse processed, which in turn increased the accuracy of the energy recovery tests. In addition, each span check read below the reference block weight. This was another reason for the adjustment to the throughput for the weigh system's drift.

This average correction would result in incrementally more waste processed and a lower As-Tested waste HHV. This would have no impact on the amount of kWh/Tonne over the guarantee. But would result in slightly lower gross and net energy recovery.

4 DATA ANALYSIS & CALCULATIONS

Five 8-Hour Energy Recovery Tests were performed to demonstrate the overall efficiency of the Facility. These five tests were conducted concurrently with the five boiler-as-a-calorimeter tests to determine the As-Tested waste HHV. The calculations of each test's HHV and energy recovery were performed in accordance with the sample calculations and descriptions presented in the Test Procedures, which are included in the appendix volume of this report.

An Energy Recovery results summary Table 1 and individual boiler process data Table 2 are included in the appendix. The individual test calculations and Ortech's report are also in the appendix.

4.1.1 Instrument Calibrations

Instrument calibration checks were performed two weeks prior to the Acceptance Test start date. The associated documents were provided to HDR for review prior to the test start. The documentation for these checks is included in the appendix.

4.1.2 Data Collection

Required data per the Project Agreement was recorded in 1-minute intervals using the ABB distributed control system (DCS) or recorded via local data-loggers. All data was provided to HDR prior to the noon deadline on the following day. Table 2 summarizes the key process parameters related to the Energy Recovery Tests.

The Schweitzer Engineering Laboratories (SEL) model 735 watt-hour-meters for gross and net electrical output were the official means to determine each 8-Hour test's electrical output. The gross and net totalizers were calibrated by Eaton Technologies prior to the start of the Acceptance Test. The test start and end MWH reading was taken locally at each meter and was witnessed by HDR.

4.1.3 Flue Gas Measurements

Sampling of the flue gas for O_2, CO_2, and moisture was performed in accordance with EPA Method 3 and 4. The O_2 and CO_2 measurements were logged electronically once per minute. The moisture in the flue gas was measured four times over the 8-Hour test period. Multi-point flue gas flow and temperature traverses were conducted in accordance with EPA Methods 1 and 2. These traverses were performed sixteen times per boiler during each 8-Hour test period.

The sampling plane was located in the straight vertical flue between the economizer outlet and the evaporative cooler inlet. All flue gas testing was performed by the environmental testing company, Ortech.

4.1.4 Heated Combustion Air Temperature

Three thermocouples were temporarily installed (on each boiler) at the outlet duct downstream of the air-preheater just prior to entering the stoker plenum. These data points were recorded via mini data loggers with a sample interval of 1-minute. All calculations were performed using the average of the three test thermocouples.

4.1.5 Ash Discharger Quench Temperature

The quench water temperature was measured via a local thermocouple inserted below the water line of the ash discharger. The ash discharger make-up water temperature, the fuel temperature and the SNCR water temperature are all assumed to be the same, so measurement of the make-up water flow and SNCR water flow are unnecessary. The calculated combined moisture is equal to the difference of the measured total moisture in the flue gas minus the moisture in the air. The total water weight leaving the ash dischargers is calculated by multiplying the overall test bottom ash quantity by the test residue moisture content.

4.1.6 Barometric Pressure and Combustion Air Humidity

A digital psychrometer and barometer were set up on the charging deck to record the combustion air relative humidity, the combustion air inlet dry bulb temperature, and the barometric pressure. All of these measurements were averaged over each 8-Hour test period and utilized in the boiler-as-a-calorimeter calculations for HHV.

4.1.7 Crane Weigh System Drift

The throughput data from each 8-Hour test was adjusted for the crane weigh system's drift. This adjustment was done on an individual test basis. The calculation was performed in accordance with the methodology outlined in the Test Procedures. Table B summarizes the average deviation in crane weight and the corrected fuel flow for each 8-Hour test.

Table B: Crane Weigh System Drift Adjustment to Refuse Processed

Energy Recovery: Crane Calibration Drift Adjustment							
	Start Time	9/27/15 8:00	9/28/15 8:00	9/29/15 9:00	9/30/15 8:00	10/1/15 9:00	
	End Time	9/27/15 16:00	9/28/15 16:00	9/29/15 17:00	9/30/15 16:00	10/1/15 17:00	
	Test	ER 1	ER 2	ER 3	ER 4	ER 5	AvG
Crane Weigh System Drift*	%	-0.37%	-0.22%	-0.33%	-0.40%	-0.44%	**-0.35%**
Uncorrected Fuel Flow	kg/hr	18,277	17,887	17,193	19,115	17,987	**18,092**
Adjusted Fuel Flow	kg/hr	18,345	17,926	17,251	19,191	18,066	**18,156**

*Calculation done in accordance with Test Procedure methodology

4.1.8 Dry Bulb Temperature Correction

The average annual ambient temperature used for correction is 8 degrees C as shown in the weather data tables from the Test Procedures. Each 8-Hour Energy Recovery Test was performed with ambient air conditions greater than the annual average temperature. Table C shows the difference between the test average ambient temperature and the annual average, the correction factor for the test average turbine exhaust pressure, and the correction to turbine electrical output.

Table C: Annual Average Dry Bulb Temperature Correction

Energy Recovery: Dry Bulb Temperature Correction							
	Start Time	9/27/15 8:00	9/28/15 8:00	9/29/15 9:00	9/30/15 8:00	10/1/15 9:00	
	End Time	9/27/15 16:00	9/28/15 16:00	9/29/15 17:00	9/30/15 16:00	10/1/15 17:00	
	Test	ER 1	ER 2	ER 3	ER 4	ER 5	AvG
Average Dry Bulb Temperature	C	19.5	20.3	20.2	15.8	12.5	**17.6**
Difference from Annual Temperature	C	11.5	12.3	12.2	7.8	4.5	**10**
Average Turbine Exhaust Pressure	mbara	107	111	110	91	80	**100**
Turbine Exhaust Pressure Correction	mbara	39	43	42	23	11	**32**
Ambient Temperature Adjustment	%	**2.3%**	**2.5%**	**2.5%**	**1.4%**	**0.7%**	**1.9%**
Turbine Output Correction	kW	**410**	**445**	**434**	**239**	**117**	**329**
Corrected Gross Electrical Output	MW	17.73	17.45	17.27	17.50	17.21	**17.43**
Corrected Net Electrical Output	MW	15.59	15.22	15.04	15.27	15.09	**15.24**

The turbine exhaust pressure curve was developed based on the GE guaranteed and MCR heat balances. The curve-fitted equation was used to calculate the exhaust pressure correction factor of the turbine's electrical output. This resulted in a downward adjustment to the turbine exhaust pressure by an average of 32 millibar-absolute and an average turbine electrical output correction of 1.9%, or 329 kWs.

4.1.9 Energy Recovery

The corrected gross and net electrical outputs are divided by the actual throughput (tonne/hr) to obtain the outputs on a kWh/Tonne basis. The guaranteed gross and net energy recovery values are determined from the As-Tested waste HHV. The results from each test were compared to the linearly adjusted guaranteed values per Item 3 of Exhibit 2, Appendix 19 of the Project Agreement.

The measured average gross energy recovery of **961** kWh/Tonne surpassed the guarantee by **3.5%** (32 kWh/Tonne). The measured average net energy recovery of **840** kWh/Tonne surpassed the guarantee by **2.3%** (19 kWh/Tonne). Furthermore, all five individual energy recovery tests surpassed the gross and net guarantees. The detailed results for the individual tests are shown in Table 1 of the appendix.

4.1.10 Residue Quality

Bottom ash was sampled and combined from both ash dischargers per the Test Procedures. Samples were sent to SGS Laboratories in South Holland, Illinois, for analysis of moisture and unburned combustible using ASTM D 3302-07 and ASTM D 5468-02 respectively. The lab analysis results are included in the appendix.

Moisture results were **19.6%**, **18%**, **17.4%**, **15%**, and **16.5%** respectively for all five energy recovery tests. The average residue moisture content of all five tests was less than the guaranteed value (25%).

Unburned combustible results were all less than the detection limits of the bomb calorimeter method of 100 BTU/lb. The detection limit of 100 BTU/lb (0.83% of 12,000 BTU/lb) was used in all five test calculations. The average of all five tests was less than the guarantee of 3% unburned combustible by dry weight.

5 DISCUSSION

5.1.1 Air Pre-Heater Usage

The air pre-heater was in service on both boilers during all five 8-Hour Energy Recovery Tests. Three different air pre-heater operating modes were utilized: one coil per boiler, three coils per boiler, and five coils per boiler. During each 8-Hour test, the air pre-heater remained in service with the same number of coils for the entire test period. The tests showed that the more air pre-heater coils in service the better the energy recovery was when compared to the guarantee.

5.1.2 Energy Recovery Test Results

The tests were conducted on five consecutive days where the waste quality was relatively consistent, the boiler fouling conditions remained unchanged, and the ambient air conditions for each test were similar. These factors led to four energy recovery test results being very consistent with each other.

Another contributing factor to the consistency of the results is each boiler was designed with an economizer water bypass. This enables the economizer exit flue gas temperature to be controlled to the boiler design point of 165 degrees C.

When the boiler is clean, water is bypass around the economizer directly to the steam drum to help control the economizer exit gas temperature. As the boiler fouls, less water is bypassed and more water is passed through the economizer to help transfer the heat from the flue gas to the water. This design feature eliminates the boiler fouling impact on boiler efficiency and was part of the reason the test results were consistent with each other.

The fifth energy recovery test (ER-5) produced the best result for both the gross and net energy recovery compared to the guarantee points. The reduction in excess air lowered the flue gas flow through the boilers, which resulted in less flue gas moisture losses. The reduction in losses helped to make the boiler more efficient. In addition, both boilers had five out of six steam coils in service on the air pre-heater, which helped increase the overall steam cycle efficiency. This combination resulted in the best gross and net energy recovery as compared to the guarantee.

Table D summarizes the results from the boiler-as-calorimeter HHV calculation for each energy recovery test.

Table D: Boiler-As-Calorimeter HHV Calculation Summary

Energy Recovery: B-A-C HHV Calculation Summary							
	Start Time	9/27/15 8:00	9/28/15 8:00	9/29/15 9:00	9/30/15 8:00	10/1/15 9:00	
	End Time	9/27/15 16:00	9/28/15 16:00	9/29/15 17:00	9/30/15 16:00	10/1/15 17:00	
	Test	ER 1	ER 2	ER 3	ER 4	ER 5	AvG
Fuel Flow	kg/hr	18,345	17,926	17,251	19,191	18,066	**18,156**
Boiler Outlet Oxygen, Dry	%	8.23	8.36	8.20	8.13	7.42	**8.07**
Flue Gas Moisture @ Boiler Outlet	%	16.1	16.3	15.6	15.4	15.2	**15.7**
Excess Air	%	58.2	58.1	52.2	56.1	54.1	**55.7**
Flue Gas Flow	act m^3/h	184,793	191,918	188,357	195,575	174,272	**186,983**
Heated Comb Air Temperature	C	74	75	124	71	144	**98**
Economizer Outlet Temperature	C	166	167	166	167	166	**167**
Heat Input	KJ/kg	14,040	14,322	14,796	13,416	13,945	**14,104**
Heat Losses	KJ/kg	3,225	3,397	3,381	3,198	3,088	**3,258**
Heat Credits	KJ/kg	248	278	539	232	534	**366**
Heat Output	KJ/kg	10,815	10,926	11,414	10,218	10,857	**10,846**
As-Tested Waste HHV	KJ/kg	**13,792**	**14,044**	**14,257**	**13,184**	**13,411**	**13,738**
As-Tested Boiler Efficiency	%	77.0	76.3	77.2	76.2	77.9	**76.9**

6 ACKNOWLEDGEMENTS

The Energy Recovery Tests were conducted by Covanta and witnessed by the Region's Engineer, HDR. The participants and representatives, especially the plant staff, are gratefully acknowledged for their assistance and cooperation throughout the test program.

HDR

Greg Gesell
John Clark
Bruce Howie
Jeff Martirano
Ryan Lichtman
Daniel Domatto

Covanta

Matt Neild
Jigar Vyas
Ken Coatham
Stephen DeDuck
Lambert Xiao
Gregory Rodia
Shelly Seow
Andy Lang
William Marsden
Peter Tinaburri

Table 1

Durham York Energy Recovery: Overall Test Summary							
	Start Time	9/27/15 8:00	9/28/15 8:00	9/29/15 9:00	9/30/15 8:00	10/1/15 9:00	
	End Time	9/27/15 16:00	9/28/15 16:00	9/29/15 17:00	9/30/15 16:00	10/1/15 17:00	
	Test	ER 1	ER 2	ER 3	ER 4	ER 5	AvG
Actual Refuse Processed	tonnes	146	143	138	153	144	**145**
Steam Flow	kg/hr	70,881	69,894	70,206	69,621	69,919	**70,104**
Steam Temperature	C	501	503	500	505	501	**502**
Steam Pressure	bar-g	88.4	88.4	88.4	88.4	88.4	**88.4**
% of MCR Steam Output	%	104%	101%	104%	103%	103%	**103%**
Feedwater Temperature	C	138	138	136	136	136	**137**
Boiler Outlet Oxygen, Dry	%	8.23	8.36	8.20	8.13	7.42	**8.07**
Flue Gas Moisture @ Boiler Outlet	%	16.1	16.3	15.8	15.4	15.6	**15.8**
Excess Air	%	58.2	58.1	52.2	56.1	54.1	**55.7**
Flue Gas Flow	act m^3/h	184,793	191,918	189,480	195,899	174,591	**187,336**
Heated Comb Air Temperature	C	74	75	124	71	144	**98**
Economizer Outlet Temperature	C	166	167	166	167	166	**167**
Heat Input	KJ/kg	14,019	14,301	14,814	13,408	13,948	**14,098**
Heat Losses	KJ/kg	3,204	3,375	3,400	3,189	3,090	**3,252**
Heat Credits	KJ/kg	248	278	539	232	534	**366**
Heat Output	KJ/kg	10,815	10,926	11,414	10,218	10,857	**10,846**
Unburned Combustible	**%**	**0.42**	**0.42**	**0.42**	**0.42**	**0.42**	**0.42**
Residue Moisture Content	**%**	**19.6**	**18.0**	**17.4**	**15.0**	**16.5**	**17.3**
As-Tested Waste HHV	**KJ/kg**	**13,771**	**14,023**	**14,275**	**13,175**	**13,413**	**13,732**
As-Tested Boiler Efficiency	%	77.1	76.4	77.1	76.2	77.8	**76.9**
Average Dry Bulb Temperature	C	19.5	20.3	20.2	15.8	12.5	**17.6**
Difference from Annual Temperature	C	11.5	12.3	12.2	7.8	4.5	**10**
Average Turbine Exhaust Pressure	mbara	107	111	110	91	80	**100**
Turbine Exhaust Pressure Correction	mbara	39	43	42	23	11	**32**
Ambient Temperature Adjustment	**%**	**2.3%**	**2.5%**	**2.5%**	**1.4%**	**0.7%**	**1.9%**
Turbine Output Correction	**kW**	**410**	**445**	**434**	**239**	**117**	**329**
Corrected Gross Electrical Output	MW	17.73	17.45	17.27	17.50	17.21	**17.43**
In-Plant-Power	MW	2.14	2.23	2.23	2.23	2.12	**2.19**
Corrected Net Electrical Output	MW	15.59	15.22	15.04	15.27	15.09	**15.2**
As-Tested Gross Energy Recovery	kWh/Tonne	966	974	1001	912	953	**961**
Gross Guarantee	kWh/Tonne	931	951	971	884	903	**928**
Delta	**kWh/Tonne**	**35**	**22**	**30**	**27**	**50**	**33**
	%	**3.7%**	**2.3%**	**3.1%**	**3.1%**	**5.5%**	**3.5%**
As-Tested Net Energy Recovery	kWh/Tonne	850	849	872	796	835	**840**
Net Guarantee	kWh/Tonne	824	842	860	782	799	**821**
Delta	**kWh/Tonne**	**26**	**7**	**12**	**14**	**37**	**19**
	%	**3.1%**	**0.8%**	**1.4%**	**1.8%**	**4.6%**	**2.3%**

Table 2

Durham York Energy Recovery: Process Data Summary			Date	9/27/2015		9/28/2015		9/29/2015		9/30/2015		10/1/2015	
			Start Time	8:00:00 AM		8:00:00 AM		9:00:00 AM		8:00:00 AM		9:00:00 AM	
			End Time	4:00:00 PM		4:00:00 PM		5:00:00 PM		4:00:00 PM		5:00:00 PM	
			Test	ER 1		ER 2		ER 3		ER 4		ER 5	
Description	**Tag No.**	**Units**		**Boiler 01**	**Boiler 02**	**Boiler 01**	**Boiler 02**	**Boiler 01**	**Boiler 02**	**Boiler 01**	**Boiler 02**	**Boiler 01**	**Boiler 02**
Flows													
Feedwater	FIR-5252-A	kg/hr	**Proj. Agr.**	*35,092*	*35,858*	*34,876*	*34,879*	*35,120*	*34,932*	*34,612*	*34,893*	*35,055*	*34,717*
Steam	FIR-5250	kg/hr	**Proj. Agr.**	*35,172*	*35,908*	*34,914*	*34,980*	*35,160*	*35,046*	*34,681*	*34,940*	*35,080*	*34,839*
Primary Attemperator Flow	calc	kg/hr	Info only	*185*	*163*	*302*	*364*	*200*	*64*	*421*	*478*	*218*	*18*
Secondary Attemperator Flow	calc	kg/hr	Info only	*133*	*67*	*180*	*160*	*142*	*22*	*317*	*380*	*241*	*33*
Continuous Blow Down	isolated	kg/hr	**Proj. Agr.**	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Total Air	FIR-4202	m3/hr	**Proj. Agr.**	*43,037*	*45,180*	*45,398*	*48,014*	*44,559*	*45,883*	*45,376*	*48,025*	*42,917*	*40,572*
Primary Air		m3/hr	Info only	*33,660*	*37,670*	*35,974*	*39,992*	*35,329*	*38,266*	*36,253*	*40,688*	*33,843*	*33,129*
Secondary Air	FIR-4205	m3/hr	**Proj. Agr.**	*7,528*	*5,994*	*7,687*	*6,434*	*7,526*	*6,110*	*7,370*	*5,743*	*7,352*	*5,913*
Seal Air	FIR-4206	m3/hr	**Proj. Agr.**	*1,850*	*1,517*	*1,737*	*1,588*	*1,705*	*1,506*	*1,753*	*1,593*	*1,722*	*1,530*
Tertiary Air	FIR-4208	m3/hr	**Proj. Agr.**	*2,539*	*7,719*	*2,551*	*8,418*	*2,565*	*8,081*	*3,093*	*8,458*	*2,410*	*6,663*
Hydrated Lime	WIC-4873	kg/hr	Info only	*137.35*	*125.83*	*147.72*	*141.99*	*184.25*	*159.73*	*158.49*	*145.83*	*143.67*	*165.00*
Aqueous Ammonia	FIR-3854	l/hr	Info only	*1.08*	*0.91*	*0.86*	*0.70*	*0.84*	*0.73*	*0.79*	*0.93*	*1.14*	*0.82*
Carbon	WIC-4882	kg/hr	Info only	*4.00*	*3.90*	*4.00*	*3.83*	*4.00*	*3.95*	*3.96*	*3.83*	*3.93*	*3.78*
Natural Gas	FIR-3601	m3/min	Info only	*0.0*	*0.32*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Temperatures													
Air & Gas													
Ambient Air	TIR-4218	C	**Proj. Agr.**	*25.6*	*26.5*	*28.2*	*28.5*	*29.3*	*29.1*	*24.4*	*23.6*	*22.9*	*21.8*
Heated Air	TIR-4215	C	**Proj. Agr.**	*75.4*	*71.4*	*75.4*	*71.8*	*123.0*	*120.6*	*72.7*	*68.7*	*141.0*	*141.8*
Tertiary Air	TIR-4216	C	**Proj. Agr.**	*132.1*	*125.7*	*121.6*	*125.3*	*152.4*	*157.7*	*123.7*	*130.0*	*152.6*	*176.6*
Furnace IR Pyrometer	TIR-4303	C	Info only	*1044.6*	*999.7*	*1040.2*	*1046.7*	*1044.0*	*1039.4*	*1055.8*	*1041.5*	*1064.0*	*1027.8*
Roof	TIR-4301	C	Info only	*824.9*	*667.3*	*812.0*	*667.6*	*814.9*	*659.9*	*820.4*	*674.2*	*820.0*	*670.3*
2nd/3rd Pass	TIR-4312	C	Info only	*679.2*	*671.7*	*685.6*	*676.3*	*693.2*	*675.5*	*697.4*	*693.3*	*697.4*	*686.3*
Evaporator Outlet	TIR-4318	C	Info only	*592.6*	*593.0*	*597.0*	*597.5*	*598.6*	*593.5*	*606.1*	*609.3*	*603.4*	*594.7*
Superheater 2/3	TIR-4313	C	Info only	*534.3*	*528.9*	*537.5*	*532.9*	*536.2*	*527.5*	*542.8*	*538.5*	*539.7*	*525.8*
Superheater 2/1.2	TIR-4314	C	Info only	*471.2*	*469.0*	*472.5*	*471.1*	*469.7*	*464.7*	*475.6*	*474.0*	*472.5*	*461.2*
Superheater 1.3/1.2	TIR-4315	C	Info only	*403.5*	*405.1*	*406.0*	*408.5*	*403.4*	*402.3*	*409.0*	*411.1*	*404.7*	*397.6*
Superheater 1.2/1.1	TIR-4316	C	Info only	*360.0*	*358.7*	*361.8*	*361.1*	*360.1*	*356.9*	*363.9*	*362.7*	*360.9*	*353.3*
Econ. Inlet	TIR-4317	C	Info only	*338.4*	*339.2*	*339.8*	*341.0*	*338.6*	*338.0*	*341.3*	*342.1*	*339.2*	*335.1*
Econ. Outlet/Quench Inlet	TI-4748	C	**Proj. Agr.**	*165.1*	*165.8*	*165.4*	*166.9*	*165.0*	*164.9*	*165.7*	*166.6*	*165.3*	*164.6*
Quench Outlet	TI-4761	C	Info only	*144.1*	*142.8*	*144.0*	*144.0*	*144.0*	*143.2*	*144.2*	*144.3*	*144.1*	*143.9*
Reactor Outlet	TI-47691/2/3	C	Info only	*141.3*	*136.1*	*142.5*	*137.3*	*142.9*	*136.9*	*143.1*	*138.2*	*140.7*	*135.7*
Fabric Filter Outlet	TI-4846	C	Info only	*136.7*	*132.9*	*138.1*	*133.8*	*138.8*	*133.6*	*139.0*	*134.8*	*136.1*	*132.2*
Steam & Water													
Feedwater/Econ Inlet	TI-5211	C	**Proj. Agr.**	*138.2*	*137.8*	*138.2*	*137.7*	*136.2*	*135.7*	*136.1*	*135.7*	*136.2*	*135.9*
Econ Outlet	TI-5210	C	Info only	*232.9*	*234.6*	*237.5*	*240.5*	*232.2*	*231.5*	*238.6*	*241.0*	*231.3*	*223.4*
SH 1.3 Outlet	TI-5209-1/2	C	**Proj. Agr.**	*366.1*	*365.3*	*369.0*	*368.5*	*366.5*	*365.0*	*372.2*	*370.1*	*367.3*	*361.5*
SH 4 Inlet	TI-5208-1/2	C	**Proj. Agr.**	*362.4*	*365.8*	*362.9*	*369.4*	*362.5*	*365.6*	*363.3*	*370.5*	*362.9*	*361.7*
SH 2 Outlet	TI-5207	C	**Proj. Agr.**	*465.1*	*462.4*	*463.0*	*462.8*	*460.1*	*456.2*	*465.2*	*464.0*	*464.8*	*455.9*
SH 3 Inlet	TI-5206	C	**Proj. Agr.**	*461.2*	*460.5*	*457.7*	*458.1*	*456.0*	*455.6*	*455.7*	*452.8*	*457.7*	*454.9*
SH3 Outlet	TIR-5223	C	**Proj. Agr.**	*501.5*	*501.2*	*501.6*	*503.8*	*500.9*	*500.1*	*503.4*	*505.8*	*503.1*	*498.6*
Pressures													
Air & Gas													
Primary Air	PIR-4203	mbar	Info only	*40.0*	*40.1*	*40.0*	*40.1*	*40.0*	*39.9*	*39.8*	*39.9*	*39.9*	*40.1*
Secondary Air Front	PIT-4209	mbar	**Proj. Agr.**	*16.1*	*14.9*	*17.1*	*18.0*	*16.1*	*16.4*	*14.5*	*13.2*	*14.5*	*14.1*
Secondary Air Rear	PIT-4210	mbar	**Proj. Agr.**	*22.5*	*20.4*	*23.6*	*23.8*	*22.3*	*21.7*	*21.2*	*19.3*	*21.0*	*20.7*
Tertiary Header	PIT-4204	mbar	**Proj. Agr.**	*59.9*	*40.0*	*61.4*	*43.3*	*53.6*	*48.0*	*61.3*	*48.2*	*61.3*	*48.0*
Tertiary Air Front	PIT-4211	mbar	**Proj. Agr.**	*6.1*	*34.3*	*6.8*	*39.3*	*7.5*	*39.3*	*11.0*	*42.0*	*6.6*	*29.7*
Tertiary Air Rear	PIT-4213	mbar	**Proj. Agr.**	*6.5*	*34.6*	*7.6*	*39.3*	*7.9*	*39.2*	*12.2*	*41.9*	*7.5*	*29.7*
Furnace Pressure	PIR-4302	mbar	Info only	*-0.7*	*-0.7*	*-0.3*	*-0.3*	*-0.3*	*-0.2*	*-0.2*	*-0.2*	*-0.2*	*-0.2*
Evaporator Outlet	PIR-4309	mbar	Info only	*-1.0*	*-0.9*	*-0.6*	*-0.6*	*-0.5*	*-0.5*	*-0.6*	*-0.5*	*-0.5*	*-0.4*
Horizontal SH dP	PDIR-4308	mbar	Info only	*0.3*	*0.3*	*0.4*	*0.3*	*0.3*	*0.3*	*0.4*	*0.3*	*0.3*	*0.2*
Econ. Inlet	PIR-4318	mbar	Info only	*-1.3*	*-1.2*	*-0.9*	*-0.9*	*-0.9*	*-0.7*	*-0.9*	*-0.8*	*-0.8*	*-0.6*
Econ. Outlet	PIR-4747	mbar	Info only	*-4.9*	*-5.1*	*-4.9*	*-5.0*	*-4.6*	*-4.4*	*-4.8*	*-4.9*	*-4.4*	*-3.9*
Econ dP	PDIR-4310	mbar	Info only	*3.7*	*3.8*	*3.9*	*4.1*	*3.7*	*3.7*	*3.9*	*4.1*	*3.6*	*3.3*
Quench dP	PDI-4749	mbar	Info only	*1.4*	*1.6*	*1.4*	*1.6*	*1.4*	*1.5*	*1.5*	*1.6*	*1.5*	*1.4*
Quench Outlet	PI-4764	mbar	Info only	*-9.0*	*-6.7*	*-9.0*	*-6.6*	*-9.0*	*-5.9*	*-9.0*	*-6.6*	*-9.0*	*-5.3*
Reactor dP	PDI-4765	mbar	Info only	*5.2*	*4.6*	*5.6*	*5.0*	*5.5*	*4.8*	*5.8*	*5.5*	*5.7*	*4.5*
Reactor Outlet	PI-4770	mbar	Info only	*-11.6*	*-11.3*	*-11.9*	*-11.6*	*-11.4*	*-10.7*	*-12.1*	*-12.0*	*-11.5*	*-9.8*
Filter dP	PDI-4790	mbar	Info only	*14.9*	*13.8*	*15.7*	*14.9*	*15.2*	*13.8*	*15.1*	*14.7*	*15.1*	*12.0*
Filter Outlet	PI-4846	mbar	Info only	*-26.5*	*-25.1*	*-27.6*	*-26.6*	*-26.6*	*-24.5*	*-27.2*	*-26.7*	*-26.6*	*-21.8*
Steam & Water													
Feedwater	PIR-5242	bar-g	**Proj. Agr.**	*101.3*	*102.5*	*101.4*	*101.8*	*101.3*	*101.6*	*101.2*	*101.6*	*101.2*	*101.0*
Drum	PIT-5007	bar-g	**Proj. Agr.**	*96.5*	*96.8*	*96.4*	*96.3*	*96.5*	*96.3*	*96.2*	*96.2*	*96.5*	*96.2*
FSH Outlet	PIR-5240	bar-g	**Proj. Agr.**	*88.4*	*88.5*	*88.4*	*88.4*	*88.4*	*88.4*	*88.4*	*88.4*	*88.4*	*88.4*
Miscellaneous													
Boiler Drum Level	LT-5001	mm	Info only	*-23.6*	*-23.6*	*-23.6*	*-23.7*	*-23.7*	*-23.5*	*-23.5*	*-23.7*	*-23.6*	*-23.6*
Common													
Turbine Throttle Press	PIR-0216	bar-g	**Proj. Agr.**	*87.5*		*87.4*		*87.5*		*87.5*		*87.5*	
Turbine Throttle Temp	TIR-0215	C	**Proj. Agr.**	*498.7*		*500.0*		*498.0*		*501.6*		*498.0*	
Turbine Throttle Flow	FIR-0201	kg/hr	**Proj. Agr.**	*73,907*		*72,460*		*71,896*		*72,143*		*73,028*	
HP Roof Pressure	C-PIR-0801-SEL	mbar-a	Info only	*103.9*		*111.8*		*116.4*		*94.6*		*68.9*	
LP Roof Pressure	C-PIR-0841-SEL	mbar-a	Info only	*100.7*		*108.9*		*113.1*		*90.8*		*66.0*	
Turbine Exhaust Temp	TI-0802	C	Info only	*47.7*		*47.9*		*47.7*		*44.6*		*41.3*	
Condensate Tank Temp	TI-0849	C	Info only	*46.0*		*46.3*		*46.3*		*42.6*		*38.7*	
Gland Steam Condenser Inlet	TI-0942	C	Info only	*54.0*		*54.0*		*53.4*		*50.2*		*45.2*	
Ambient Air Temp	TI-0803 A/B	C	**Proj. Agr.**	*19.5*		*20.3*		*20.2*		*15.8*		*12.5*	
DA Press	PIR-0406	bar-g	Info only	*2.4*		*2.4*		*2.2*		*2.2*		*2.2*	
DA Storage Tank Temp	TI-0403	C	Info only	*136.1*		*136.1*		*134.1*		*133.7*		*133.8*	
FW Temp	TIR-0440	C	Info only	*138.7*		*138.6*		*136.7*		*136.3*		*136.4*	
FW Press	PIR-0441	bar-g	Info only	*136.6*		*137.2*		*137.3*		*137.5*		*137.3*	
Gross Electrical Output	MFM-G1-SEL	MW	**Proj. Agr.**	17.325		17.020		16.851		17.260		17.094	
Net Electrical Output	MFM-L1-SEL	MW	**Proj. Agr.**	15.190		14.791		14.620		15.033		14.976	

TABLE 1

PERTINENT TEST DATA

Test Name: Energy Recovery 1
Test Date: 9/27/2015 08:00 - 16:00
Test Start: Test End:

	Item		Units	Unit 1	Unit 2		Average or Wtd. Avg. or Total	Measurement Source
1	Test duration		hours	8.0	8.0		8.00	----
2	Refuse feed rate		kg/hr	9,082	9,263		18,345	Crane Weigh Cell + Assump.
3	Total FW/Steam flow		kg/hr	-			-	Station Instrument
4	Main steam flow		kg/hr	35,172	35,709		70,881	Station Instrument - Gas Stm
5	Feedwater flow		kg/hr	35,092	35,660		70,752	Station Instrument
6	Suphtr. stm temperature		°C	501.5	501.2		501.3	Station Instrument
7	Suphtr. stm pressure		barg	88.4	88.5		88.4	Station Instrument
8	Feedwater temperature		°C	138.2	137.8		138.0	Station Instrument
9	Feedwater pressure		barg	101.3	102.5		101.9	Station Instrument
10	Continuous blowdown rate		kg/hr	0	0		0	Verify Valve Closed
11	Boiler drum pressure		barg	96.5	96.8		96.7	Station Instrument
12	Inlet air dry bulb temp.		°C	-	-		22.9	Digital Psychrometer
12A	Relative humidity %		%	-	-		61.4	Digital Psychrometer
13	Inlet air wet bulb temp.		°C	-	-		17.9	Calculated
14	Total air flow - Ref. Cond.		Rm^3/h	43,037	45,180		88,218	Station Instrument
15	Overfire air flow - Ref. Cond.		Rm^3/h	7,528	5,994		13,522	Station Instrument
16	Seal air flow - Ref. Cond.		Rm^3/h	1,850	1,517		3,367	Station Instrument
17	Overfire air pressure		mbar	46.0	46.1		46.0	Station Instrument
18	OFA and Seal air temp after fan		°C	32.4	32.2		32.3	Test T/C, wtd. avg.
19	Heated underfire air temperature		°C	76.5	72.6		74.4	Test T/C Grid wtd avg.
20	Barometric pressure		mbara	- -			1011.7	Barometer
21	Moisture in combustion air		kg/kg dry ai				0.0108	Calculated
22	CO_2 in dry flue gas		% vol	11.069	10.982		11.02	Manually @ Econ. Outlet
23	O_2 in dry flue gas		% vol	7.983	8.471		8.23	Manually @ Econ. Outlet
24	N_2 in dry flue gas		% vol	80.948	80.547		80.74	Calculated
25	H_2O in flue gas		% vol	16.173	16.015		16.09	Manually @ Econ. Outlet
26	Flue gas flow		act m^3/h	90,450	94,343		184,793	Manually @ Econ. Outlet
27	Economizer exit gas temp.		°C	164.8	166.5		165.7	Station Instrument
28	Sampling point gas temp.		°C	167.1	165.3		166.2	Manually @ Econ. Outlet
	Residue:							
	Sample (Bottom Ash)							
29	Fines (-2")		kg				989	Manual Residue Sampling
30	Overs (+2")		kg				45	Manual Residue Sampling
	Total Flow							
31	Grizzly Rejects		kg			0	0	Combined with Ferrous
32	Ferrous		kg			2.547%	3,737	Ratio from 5-Day Test
33	Non-Ferrous		kg			0.362%	532	Ratio from 5-Day Test
34	Bottom Ash		kg			20.892%	30,661	Ratio from 5-Day Test
35	Fly Ash	**10.00%**	kg			2.089%	3,066	Calculated from assumed %
36	Moisture in -2" bottom ash bottom ash		%				19.6	Laboratory Analysis
37	Combustibles in -2" bottom ash		dry %				0.42	Laboratory Analysis
38	Moisture in flyash leaving test boundary		%				0.0	Assumed zero %
39	Combustibles in flyash		dry %				0.42	Assumed same % as BA
40	Ash discharger water bath temp		°C	44.9	44.8		44.8	Test Thermocouples
41	Turbine Gross MW		MWG				17.33	Station Instrument
42	Net MW Exported		MWN				15.19	Station Instrument
43	Turbine Exhaust Pressure		bara				0.108	Station Instrument (Exh. Temp
44	ACC Ambient Air Temperature		°C				19.5	Station Instrument
45	Annual average dry bulb temp.		°C	-			8.0	Historical weather data
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AS TESTED PERFORMANCE PARAMETERS

TABLE 2

RESIDUE ANALYSIS

Sample Weights	Bottom Ash kg	Bottom Ash %
+2" to -8" Material	45	4.4
-2" Material	+ 989	+ 95.6
-8" Material	1,034	100.0

Total Weights			Bottom Ash (kg)	Flyash (kg)
	Bottom & Fly Ash (Excluding +8" Grizzly Material & All Metals)		30,661	3,066
-2" Ash	-2" Wet Bottom Ash @	95.6%	29,312	
	Moisture of wet bottom as	19.6%	5,747.0	
	Dry Aggregate (by difference)		23,565	3,066
	Combustibles of dry aggre	0.42%	98	13
	Dry Ash (by difference)		23,466	3,053
	Total +2" to (-8")	4.4%	1,349	
	+8" Grizzly Material, Ferrous & Non-Ferrous Metals (metals and inerts)		4,269	

Component Weights	Bottom Ash kg	Bottom Ash (1) kg/h	Bottom Ash (2) %	Bottom Ash (3) kg/kg fuel	Fly Ash kg	Fly Ash (1) kg/h	Fly Ash (2) %	Fly Ash (3) kg/kg fuel
Dry Ash + Inerts:								
-2" Ash	23,466	2,933			3,053	382		
+2" to (-8")	1,349	169						
+8" Grizzly, Ferrous & Non-Fe	4,269	534						
Subtotal	29,085	3,636	90.20	0.1982	3,053	382	9.48	0.0208
Unburned Combustible								
-2" Combustible	98	12.3			13	1.6		
+2" to (-8") Combustible	0	0			0	0		
Subtotal	98	12.3	0.31	0.0007	13	1.6	0.04	0.0001
Total Dry Residue :	**29,183**	**3,647.9**	**90.5**	**0.199**	**3,066**	**383**	**9.5**	**0.021**

Notes:
(1) Divisor is 8 hours
(2) % of Total Dry Residue (excluding Carbon Injection)
(3) Divisor is 18,345 kg/hr of refuse

TABLE 3

FLUE GAS FLOW & ANALYSIS
(Based on Average Data for Test Runs @ Econ. Exit)

	% VOL (DRY)	% VOL (WET)	M.W. kg/kg-mol	R.W. (DRY)	R.W. (WET)	% WT (DRY)	% WT (WET)	KG/HR
CO2	11.069	9.279	44.010	4.871	4.084	16.18	14.51	20,929
O2	7.983	6.692	32.000	2.555	2.141	8.49	7.61	10,972
N2	80.948	67.857	28.016	22.678	19.011	75.33	67.54	97,423
H2O		16.173	18.016	0.000	2.914	0.00	10.35	14,933
Totals	100.0	100.00		30.104	28.150	100.0	100.0	144,257

From flue gas report, average flow = 184,793 a m3/hr
Gas temperature @ sampling point = 166.16907 °C

Specific volume = $\frac{8.314 \times (273.15 + 166.16907 \text{ °F})}{28.15 \times (1.013 \text{ bara}) \times (\text{cm2/m2})}$ = 1.281 m3/kg

Wet gas mass flow = 184,793 / 1.281 = 144,256 kg/hr 136.8%

Percent excess air = $\frac{(O2 - CO/2) \times 100}{0.2682 \times N2 - (O2 - CO/2)}$ = 58.16 %

(per ASME PTC 19.10 Flue and Exhaust Gas Analysis, Section 6.03.6.3.1)

		deg C	deg Kelvin	deg F
Enthalpies From PTC-4, 5.19.4 & 5.19.11	Flue Gas Temp @ econ out	165.7	438.8	330.2

	Flue Gas @ Economizer Outlet		
	Enth. (H) (kJ/kg)	R.H. (WET)	R.H. (DRY)
CO2	128.05	18.58	20.72
O2	131.41	10.00	11.15
N2	145.49	98.26	109.60
H2O	266.10	27.55	0.00
Totals		154.38	141.47

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Total Measured Air Flow

Average compensated total wet air flow in Reference m^3/hr (25 °C) is taken from Table 1.

Total Wet Air Flow = 88,218 m^3/hr at 25 °C reference temperature
(Compensated)

$$\text{Specific Volume of Dry Air} = \frac{(25.00 + 273.15) \times 8.314}{1.012 \times 28.97} = 0.8458 \text{ } m^3/kg$$

$$\text{Dry Air Density} = \frac{1}{0.8458} = 1.1823 \text{ } kg/m^3$$

Wet Air Density = 1.0108 kg wet air/kg dry air x 1.1823 kg dry air/m^3 = 1.1951 kg wet air/m^3

Total Measured Wet Air 88,218 m^3/h x 1.1951 kg wet air/m^3

= **105,428** kg/hr

Moisture in Total Measure Air = (0.0108 x 105,428) / (1 + 0.0108) = **1,127.3** kg/hr

Overfire Air and Seal Air Flow

Average compensated wet overfire air flow & seal air flow in Reference m^3/hr (25 °C) is taken from Table 1.

Wet Overfire Air Flow = 13,522 m^3/hr at 25 °C temperature & 1.013 bara
Wet Seal Air Flow = 3,367 m^3/hr at 25 °C temperature & 1.013 bara
Combined OFA & Seal Air Flow = 13,522 + 3,367 = 16,888 Ref. m^3/hr

$$\text{Specific Volume of Dry Air} = \frac{(25.0 + 273.15) \times 8.314}{1.012 \times 28.97} = 0.8458 \text{ } m^3/kg$$

$$\text{Dry Air Density} = \frac{1}{0.8458} = 1.1823 \text{ } kg/m^3$$

Wet Air Density = 1.0108 kg wet air/kg dry air x 1.1823 kg dry air/m^3 = 1.1951 kg wet air/m^3

OFA & Seal Air (Wet) = 16,888 m^3/h x 1.1951 kg wet air/m^3

= **20,183** kg/hr

Moisture in OFA & Seal Air = (0.0108 x 20,183) / (1 + 0.0108) = **215.8** kg/hr

Wet Underfire Air =
Total Wet Air - Wet OFA & Seal Air = 105,428 - 20,183 = **85,245** kg/hr
Moisture in Underfire air =
Total Air H_2O - OF & Seal Air H_2O = 1,127.3 - 215.8 = **911.5** kg/hr

********** ********** ********** ********** ********** 4 ********** ********** ********** **********

(Continued from Page 4)

Assume ref. waste N2 content of test fuel = 0.87 %
Therefore, N2 in flue gas from fuel =

18,345 kg fuel/hr x 0.0087 kg N2/kg fuel = 160 kg/hr

N2 in flue gas = 97,423 kg/hr

Total dry comb. air supplied = $\frac{97{,}423 - 160}{0.7685}$ = **126,563** kg/hr
(Incl. Air Infiltration)

Moisture in air = 0.0108 kg/kg dry air from psychrometric chart for
22.89 °C db / 17.92 °C wb, therefore

Moisture in Calculated Total Air = 0.0108 x 126,563 = **1,367.9** kg/hr

Total Calculated wet air = 126,563 + 1367.9 = **127,931** kg/hr
(Including Air Infiltration & VLN cooling air)

Total Calculated Wet Air (including air infiltration & VLN cooling air) is greater than Total Measured Wet Air
Wet Air Infiltration (incl. VLN cooling air) = Calculated Total Wet Air - Measured Total Wet Air
= 127,931 - 105,428
= 22,503 kg/hr

Wet Un-heated Air = Total Wet Air - Wet UFA
= 127,931 - 85,245
= 42,686 kg/hr

Moisture in Wet Air Infiltration (incl. VLN cooling air) = Total Air Moisture - Moisture in Measured Total Ai
= 1,367.9 - 1,127.3
= 240.6 kg/hr

********** ********** ********** ********** ********** 5 ********** ********** **********

Calculated moisture in Flue Gas from H2 and H2O in fuel and Ash Discharger Quench Water Vapor:

A water balance around the boiler gives:

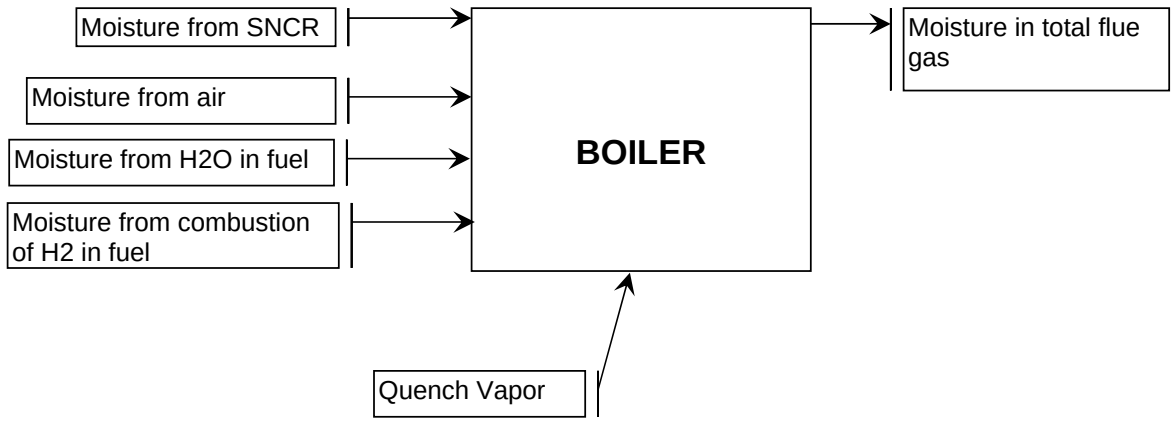
Vapor in flue gas = moisture from H2 and H20 in the fuel + moisture in air + quench vapor + SNCR & carrier water

Therefore:

Moisture from H2 and H2O in fuel + quench vapor + SNCR & carrier water = Vapor in gas - moisture in air

= 14,933 - 1,367.9

= 13,565 kg/hr = 0.739 kg/kg FUEL



DATA FOR HEAT OUTPUT AND LOSS CALCULATIONS

Enthalpy of feedwater @	138.01431	°C,	10291.20	kPa	587.23 kJ/kg
Enthalpy of drum water @ saturated pressure			9768.11	kPa	1397.79 kJ/kg
Enthalpy of steam @	501.31801	°C,	8945.96	kPa	3391.29 kJ/kg
Enthalpy of dry underfire air at 74.4°C comb. temp. referenced to 25°C					49.75 kJ/kg
Enthalpy of dry overfire air at 32.3°C air temp. referenced to 25°C					7.35 kJ/kg
Enthalpy of dry flue gas at 165.7°C econ exit temp. referenced to 25°C					141.47 kJ/kg
Enthalpy of liquid water @ the amb. air temperature of 22.9°C ref. 0°C					95.83 kJ/kg
Enthalpy of water vapor @ UFA temp. of 74.4°C ref. 25°C					92.48 kJ/kg
Enthalpy of water vapor @ the OFA temp. aft. fan of 32.3°C ref. 25°C					13.61 kJ/kg
Enthalpy of steam vapor @ 165.7°C and 1 psia referenced to 0°C					2813.29 kJ/kg
Enthalpy of liquid water @ reference temperature of 25°C ref. 0°C					104.67 kJ/kg
Enthalpy of water vapor @ econ exit temp. of 165.7°C referenced to 25°C					266.1 kJ/kg
Enthalpy of ash discharger water bath @ 44.8°C					187.7 kJ/kg
Enthalpy of dry residue @ air inlet temp of 22.9°C			296.0	°K	-1.594 kJ/kg
Enthalpy of dry residue @ ash discharger temp of 44.8°C or			318.0	°K	15.217 kJ/kg
Enthalpy of dry fly ash @ econ. exit temp. of 165.7°C or			438.8	°K	119.869 kJ/kg
HHV of unburned combustibles					27,913 kJ/kg
Radiation & convection loss per ASME PTC 34, Fig. I-1					
with 99.2 GJ/hr actual average heat output per boiler, 2 boilers =					1.530 GJ/hr
Enthalpy of dry fuel @ ambient temp. of 22.9°C ref. 25°C					-1.582 kJ/kg
Enthalpy of liquid water @ ambient temp. of 22.9°C ref. 25°C					-8.8 kJ/kg

Reference documents:

ASME Performance Test Code for Fired Steam Generators, ASME PTC 4
ASME Performance Test Code for Waste Combustor with Energy Recovery, ASME PTC 34
ASME Steam Tables 1967 Edition

Table 4 - Reference Composition Acceptable Waste

Energy Content 13,000 kJ (HHV) per kilogram

REFERENCE WASTE ULTIMATE ANALYSIS

	%
Moisture	15.16
Total Inert	15.92
Carbon	31.73
Hydrogen	4.56
Oxygen	31.35
Nitrogen	0.87
Sulfur	0.04
Chlorine	0.31
Flourine	0.030
Iron, oxidizable	0.030
	100.00

BOILER EFFICIENCY CALCULATION
AS TESTED CONDITIONS
-HEAT LOSS METHOD-
(ASME PTC 34, SECTION 5.11)

kJoule per kg A.F. Fuel

HEAT OUTPUT due to-

Steam:
(kg/hr of fluid)/(kg/hr fuel) x (h out - h in, kJ/kg)
70,752 / 18,345 x (3,391.29 - 587.23) = 10,814.55

Blowdown:
(kg/hr of fluid)/(kg/hr fuel) x (h out - h in, kJ/kg)
- / 18,345 x (1,397.79 - 587.23) 0.00

Total Heat Output: = 10,814.55

HEAT LOSSES due to-

Dry gas:
(kg/hr dry gas)/(kg/hr fuel) x (flue gas h @ Tgas econ exit ref. 25°C, kJ/kg)
129,324 / 18,345 x (141.47) = 997.32

Moisture from H2 and H2O in fuel, ash discharger quench water vapor and SNCR carrier water:
(kg/hr moisture)/(kg/hr fuel) x (h econ gas exit @ 1 psia - h liquid @ T = 25°C, kJ/kg)
13,565 / 18,345 x (2813.29 - 104.67) = 2002.93

Ash discharger quench water:
Liquid: (kg/hr liquid)/(kg/hr fuel) x (h water @ Tquench - h water @ Tamb air, kJ/kg)
718 / 18,345 x (187.71 - 95.83) = 3.60

Sensible heat in dry bottom residue:
(kg/hr dry residue)/(kg/hr fuel) x (h res @ Tquench - h res @Tamb air, kJ/kg)
3,648 / 18,345 x (15.217 - -1.594) = 3.34

Sensible heat in dry fly ash residue:
(kg/hr dry residue)/(kg/hr fuel) x (h res @ Tecon exit - h res @Tamb air, kJ/kg)
383 / 18,345 x (119.869 - -1.594) = 2.54

Moisture from total air:
(kg/hr air moisture)/(kg/hr fuel) x (h water vap @ Tgas econ exit ref. 25°C, kJ/kg)
1,368 / 18,345 x (266.1) = 19.84

Unburned combustibles:
(lb unburned combustibles/hr)/(kg/hr fuel) x HHV unburned
13.90 / 18,345 x 27,913 = 21.14

Radiation & Convection Loss:
Per ASME PTC 34, Fig. I-1 = 1.530 GJ/hr
1,530,078 / 18,345 = 83.41

Unaccounted for:
0.5 % of heat output and losses (heat input) = 70.09
0.005 x (10,814.6 + 3,204.2)

Total Heat Losses: = 3204.21

HEAT CREDITS due to-

kJoule per kg A.F. Fuel

Dry underfire air sensible heat:
(kg/hr dry air)/(kg/hr fuel) x (h in @ 74.4°C ref. 25°C, kJ/kg)
84,334 / 18,345 x (49.75) = 228.73

Dry overfire air, seal air & air infiltration sensible heat:
(kg/hr dry air)/(kg/hr fuel) x (h in @ 32.3°C ref. 25°C, kJ/kg)
42,230 / 18,345 x (7.35) = 16.92

Moisture in incoming underfire air:
(kg/hr moisture)/(kg/hr fuel) x (h vap in @ 74.4°C ref 25°C, kJ/kg)
911.5 / 18,345 x (92.48) = 4.60

Moisture in incoming overfire, seal air & air infiltration:
(kg/hr moisture)/(kg/hr fuel) x (h vap in @ 32.3°C ref 25°C, kJ/kg)
456.4 / 18,345 x (13.61) = 0.34

Fuel sensible heat:
(dry fuel, lb dry fuel/lb fuel) x (h in @ ambient air temp of 22.9°C ref 25°C, kJ/kg) +
(moisture in fuel, lb H2O/lb fuel) x (h in @ ambient air temp of 22.9°C ref 25°C, kJ/kg)
0.848 x -1.582 + 0.152 x -8.84 = -2.68

Total Heat Credits: 247.90

Gross Heat Input = HHV of Fuel + Heat Credit = Heat Output + Heat Losses

or

HHV of FUEL = Heat Output + Heat Losses - Heat Credit
= 10814.55 + 3204.21 - 247.90
= **13,771** kJ/kg

EFFICIENCY= (1 - (Heat Losses/Heat Input))*100= (1 - 3204.21 / 14,019) x 100 = **77.14** %

Gross Heat Input = 14,019 kJ/kg

HEAT LOSS SUMMARY:

	%
Dry gas:	7.11
Moisture from H2 and H2O in fuel, ash discharger quench water vapor & SNCR:	14.29
Moisture from total air:	0.14
Ash discharger quench water: Liquid:	0.03
Sensible heat in dry bottom residue:	0.02
Sensible heat in dry fly ash:	0.02
Unburned combustibles:	0.15
Radiation/Correction:	0.60
Unaccounted for:	0.50
Total Heat Losses:	22.86

Adjustment For Annual Average Dry Bulb Temperature

Turbine performance is dependent upon exhaust vacuum, which is dependent upon air-cooled condenser (ACC) performance. ACC performance is dependent upon the dry bulb ambient air temperature. An adjustment is made to the as-tested ACC performance for the difference between the average annual dry bulb temperature and the as-tested dry bulb temperature. Per average local weather conditions: (see Procedures page 10)

The average annual dry bulb temperature = 8 °C

Air-Cooled Condenser Performance:

The as-tested ACC ambient dry bulb temperature was: **19.5** °C
Per the ACC performance curve, (see Figures section) the condenser vacuum corresponding to the as-tested dry bulb temperature of 19.5 °C is: 107.1 mbara
Per the ACC performance curve, the condenser vacuum corresponding to the average annual dry bulb temperature of 8 °C is: 68.0 mbara
Therefore, the correction to exhaust pressure for temperature difference is 39.0 mbar

Turbine Performance:

Per the curve defining change in exhaust pressure vs. change in turbine-generator output (see page 12 of procedures), a 39.0 mbar change in exhaust pressure at design throttle flow results in a 2.32% change in turbine heat rate. Therefore, the overall adjusted gross electrical output is :

17.33 * (1 + 0.0232) = 17.73 **MWG**

The MW correction is also added to the as-tested NET electrical exported:

15.19 + 17.73 - 17.33 = 15.59 **MWN**

See SAMPLE CALCULATION CURVES at the end of these procedures.

Adjusted Power Outputs Per Ton:

Gross Electrical Output = 17,726 kW adjusted for annual average dry bulb temperature. / 18.345 Actual TPH = 966 kWh/tonne

Compared to the guarantee of 931 kWh/tonne at the same HHV.

Surpassing the guarantee by: 35 kWh/tonne
or 3.7%

Net Electrical Export = 15,591 kW adjusted for annual average dry bulb temperature. / 18.345 Actual TPH = 850 kWh/tonne

Compared to the guarantee of 824 kWh/tonne at the same HHV.

Surpassing the guarantee by: 26 kWh/tonne
or 3.1%

Crane Calibration Drift Adjustment Calculation Energy Recovery 1

Reference Weight (Reference Block Weight)	**3,926**	kg			
Initial Span Check Reading	3,888.3	@	9/27/2015 7:30		
Final Span Check Reading	3,893.3	@	9/27/2015 17:35		
Average of the Initial and Final Span Checks	**3,891**	kg			
Difference between Average and Reference Weight	**-35**	kg	>	45.4	kg

Adjustment to each grapple feed is warranted.

							Adjustment Factor 1.003711371		
	146,217								146,760
Feed at	Feed Weight Reading (kg)	Ref. Weight (Drifted, by Equation)	Difference (Drift)	% Difference (% Drift)		Feed Weight % of Ref. Drifted Weight	Proportioned Drift (%)	Feed Weight Drifted	Adjusted Feed Weight (kg)
9/27/15 8:02	1,283.0	3,889.3	-36.7	-0.93%		32.99%	-0.31%	-3.95	**1,286.95**
9/27/15 8:12	1,799.0	3,889.6	-36.4	-0.93%		46.25%	-0.43%	-7.71	**1,806.71**
9/27/15 8:18	1,856.0	3,889.8	-36.2	-0.92%		47.71%	-0.44%	-8.16	**1,864.16**
9/27/15 8:20	1,654.0	3,889.9	-36.1	-0.92%		42.52%	-0.39%	-6.47	**1,660.47**
9/27/15 8:29	2,904.0	3,890.2	-35.8	-0.91%		74.65%	-0.68%	-19.78	**2,923.78**
9/27/15 8:34	1,955.0	3,890.3	-35.7	-0.91%		50.25%	-0.46%	-8.92	**1,963.92**
9/27/15 8:41	1,773.0	3,890.5	-35.5	-0.90%		45.57%	-0.41%	-7.30	**1,780.30**
9/27/15 8:47	1,974.0	3,890.7	-35.3	-0.90%		50.74%	-0.46%	-8.99	**1,982.99**
9/27/15 8:51	2,689.0	3,890.9	-35.1	-0.90%		69.11%	-0.62%	-16.64	**2,705.64**
9/27/15 8:54	1,799.0	3,891.0	-35.0	-0.89%		46.24%	-0.41%	-7.42	**1,806.42**
9/27/15 9:08	1,486.0	3,891.4	-34.6	-0.88%		38.19%	-0.34%	-5.00	**1,491.00**
9/27/15 9:12	1,805.0	3,891.5	-34.5	-0.88%		46.38%	-0.41%	-7.35	**1,812.35**
9/27/15 9:17	1,773.0	3,891.7	-34.3	-0.87%		45.56%	-0.40%	-7.06	**1,780.06**
9/27/15 9:21	1,884.0	3,891.8	-34.2	-0.87%		48.41%	-0.42%	-7.94	**1,891.94**
9/27/15 9:32	2,145.0	3,892.1	-33.9	-0.86%		55.11%	-0.48%	-10.19	**2,155.19**
9/27/15 9:37	1,891.0	3,892.3	-33.7	-0.86%		48.58%	-0.42%	-7.89	**1,898.89**
9/27/15 9:41	2,175.0	3,892.4	-33.6	-0.85%		55.88%	-0.48%	-10.39	**2,185.39**
9/27/15 9:47	1,756.0	3,892.6	-33.4	-0.85%		45.11%	-0.38%	-6.74	**1,762.74**
9/27/15 9:52	1,894.0	3,892.8	-33.2	-0.85%		48.65%	-0.41%	-7.79	**1,901.79**
9/27/15 9:55	2,314.0	3,892.9	-33.1	-0.84%		59.44%	-0.50%	-11.61	**2,325.61**
9/27/15 10:02	2,457.0	3,893.1	-32.9	-0.84%		63.11%	-0.53%	-13.00	**2,470.00**
9/27/15 10:06	1,616.0	3,893.2	-32.8	-0.83%		41.51%	-0.35%	-5.60	**1,621.60**
9/27/15 10:18	1,595.0	3,893.6	-32.4	-0.83%		40.96%	-0.34%	-5.39	**1,600.39**
9/27/15 10:22	1,657.0	3,893.7	-32.3	-0.82%		42.56%	-0.35%	-5.79	**1,662.79**
9/27/15 10:33	1,613.0	3,894.1	-31.9	-0.81%		41.42%	-0.34%	-5.43	**1,618.43**
9/27/15 10:37	2,005.0	3,894.2	-31.8	-0.81%		51.49%	-0.42%	-8.36	**2,013.36**
9/27/15 10:46	2,420.0	3,894.5	-31.5	-0.80%		62.14%	-0.50%	-12.07	**2,432.07**
9/27/15 10:49	2,281.0	3,894.6	-31.4	-0.80%		58.57%	-0.47%	-10.69	**2,291.69**
9/27/15 11:01	2,685.0	3,894.9	-31.1	-0.79%		68.94%	-0.55%	-14.64	**2,699.64**
9/27/15 11:04	1,954.0	3,895.0	-31.0	-0.79%		50.17%	-0.40%	-7.73	**1,961.73**
9/27/15 11:17	1,605.0	3,895.5	-30.5	-0.78%		41.20%	-0.32%	-5.14	**1,610.14**
9/27/15 11:25	2,113.0	3,895.7	-30.3	-0.77%		54.24%	-0.42%	-8.84	**2,121.84**
9/27/15 11:29	1,846.0	3,895.8	-30.2	-0.77%		47.38%	-0.36%	-6.72	**1,852.72**
9/27/15 11:39	1,859.0	3,896.1	-29.9	-0.76%		47.71%	-0.36%	-6.75	**1,865.75**
9/27/15 11:42	1,691.0	3,896.2	-29.8	-0.76%		43.40%	-0.33%	-5.56	**1,696.56**
9/27/15 11:51	1,793.0	3,896.5	-29.5	-0.75%		46.02%	-0.35%	-6.19	**1,799.19**
9/27/15 11:55	2,488.0	3,896.6	-29.4	-0.75%		63.85%	-0.48%	-11.88	**2,499.88**
9/27/15 12:03	1,866.0	3,896.9	-29.1	-0.74%		47.88%	-0.35%	-6.62	**1,872.62**
9/27/15 12:08	2,118.0	3,897.1	-28.9	-0.74%		54.35%	-0.40%	-8.48	**2,126.48**
9/27/15 12:13	1,901.0	3,897.2	-28.8	-0.73%		48.78%	-0.36%	-6.80	**1,907.80**
9/27/15 12:25	1,681.0	3,897.6	-28.4	-0.72%		43.13%	-0.31%	-5.24	**1,686.24**
9/27/15 12:28	1,795.0	3,897.7	-28.3	-0.72%		46.05%	-0.33%	-5.96	**1,800.96**
9/27/15 12:33	2,076.0	3,897.9	-28.1	-0.72%		53.26%	-0.38%	-7.92	**2,083.92**
9/27/15 12:43	2,007.0	3,898.2	-27.8	-0.71%		51.49%	-0.36%	-7.32	**2,014.32**
9/27/15 12:52	2,565.0	3,898.5	-27.5	-0.70%		65.80%	-0.46%	-11.84	**2,576.84**
9/27/15 12:56	1,316.0	3,898.6	-27.4	-0.70%		33.76%	-0.24%	-3.10	**1,319.10**
9/27/15 12:58	1,463.0	3,898.6	-27.4	-0.70%		37.53%	-0.26%	-3.83	**1,466.83**
9/27/15 13:04	867.0	3,898.8	-27.2	-0.69%		22.24%	-0.15%	-1.33	**868.33**
9/27/15 13:06	485.0	3,898.9	-27.1	-0.69%		12.44%	-0.09%	-0.42	**485.42**
9/27/15 13:12	756.0	3,899.1	-26.9	-0.69%		19.39%	-0.13%	-1.01	**757.01**
9/27/15 13:18	971.0	3,899.3	-26.7	-0.68%		24.90%	-0.17%	-1.64	**972.64**
9/27/15 13:23	1,898.0	3,899.4	-26.6	-0.68%		48.67%	-0.33%	-6.25	**1,904.25**
9/27/15 13:25	1,070.0	3,899.5	-26.5	-0.67%		27.44%	-0.19%	-1.98	**1,071.98**
9/27/15 13:27	1,047.0	3,899.6	-26.4	-0.67%		26.85%	-0.18%	-1.89	**1,048.89**
9/27/15 13:31	627.0	3,899.7	-26.3	-0.67%		16.08%	-0.11%	-0.68	**627.68**
9/27/15 13:34	1,334.0	3,899.8	-26.2	-0.67%		34.21%	-0.23%	-3.05	**1,337.05**
9/27/15 13:44	1,584.0	3,900.1	-25.9	-0.66%		40.61%	-0.27%	-4.25	**1,588.25**
9/27/15 13:48	1,455.0	3,900.2	-25.8	-0.66%		37.31%	-0.25%	-3.57	**1,458.57**
9/27/15 13:52	1,771.0	3,900.3	-25.7	-0.65%		45.41%	-0.30%	-5.25	**1,776.25**
9/27/15 13:55	1,814.0	3,900.5	-25.5	-0.65%		46.51%	-0.30%	-5.49	**1,819.49**
9/27/15 14:02	1,717.0	3,900.7	-25.3	-0.65%		44.02%	-0.28%	-4.88	**1,721.88**
9/27/15 14:09	1,898.0	3,900.9	-25.1	-0.64%		48.66%	-0.31%	-5.91	**1,903.91**
9/27/15 14:13	2,427.0	3,901.0	-25.0	-0.64%		62.21%	-0.40%	-9.62	**2,436.62**
9/27/15 14:15	894.0	3,901.1	-24.9	-0.63%		22.92%	-0.15%	-1.30	**895.30**
9/27/15 14:18	1,052.0	3,901.2	-24.8	-0.63%		26.97%	-0.17%	-1.80	**1,053.80**
9/27/15 14:20	1,531.0	3,901.2	-24.8	-0.63%		39.24%	-0.25%	-3.79	**1,534.79**
9/27/15 14:24	1,636.0	3,901.4	-24.6	-0.63%		41.93%	-0.26%	-4.31	**1,640.31**
9/27/15 14:32	1,816.0	3,901.6	-24.4	-0.62%		46.55%	-0.29%	-5.25	**1,821.25**
9/27/15 14:36	1,918.0	3,901.7	-24.3	-0.62%		49.16%	-0.30%	-5.83	**1,923.83**
9/27/15 14:38	2,010.0	3,901.8	-24.2	-0.62%		51.51%	-0.32%	-6.38	**2,016.38**
9/27/15 14:43	2,244.0	3,902.0	-24.0	-0.61%		57.51%	-0.35%	-7.90	**2,251.90**
9/27/15 14:45	1,361.0	3,902.0	-24.0	-0.61%		34.88%	-0.21%	-2.90	**1,363.90**
9/27/15 14:57	1,973.0	3,902.4	-23.6	-0.60%		50.56%	-0.30%	-6.00	**1,979.00**
9/27/15 15:04	2,410.0	3,902.6	-23.4	-0.60%		61.75%	-0.37%	-8.87	**2,418.87**
9/27/15 15:06	2,525.0	3,902.7	-23.3	-0.59%		64.70%	-0.38%	-9.70	**2,534.70**
9/27/15 15:23	2,332.0	3,903.2	-22.8	-0.58%		59.75%	-0.35%	-8.08	**2,340.08**
9/27/15 15:26	1,793.0	3,903.3	-22.7	-0.58%		45.94%	-0.27%	-4.76	**1,797.76**
9/27/15 15:44	470.0	3,903.9	-22.1	-0.56%		12.04%	-0.07%	-0.32	**470.32**
9/27/15 15:46	3,051.0	3,903.9	-22.1	-0.56%		78.15%	-0.44%	-13.40	**3,064.40**
9/27/15 15:48	2,557.0	3,904.0	-22.0	-0.56%		65.50%	-0.37%	-9.38	**2,566.38**
9/27/15 15:57	580.0	3,904.3	-21.7	-0.55%		14.86%	-0.08%	-0.48	**580.48**
9/27/15 15:59	534.0	3,904.3	-21.7	-0.55%		13.68%	-0.08%	-0.40	**534.40**

Covanta - Durham York Energy Centre
Boiler No. 1 Scrubber Inlet
Stack Gas Physical Parameters and Volumetric Flowrates
September 27, 2015

Test No.	Test Time	Gas Temp.	Moisture by Volume	Gas Velocity	Static Pressure	Barometric Pressure	Absolute Pressure	Carbon Dioxide by Volume	Oxygen by Volume	Carbon Monoxide By Volume	Actual Flowrate	Dry Reference Flowrate	Wet Reference Flowrate
		°C	%	m/s	kPa	kPa	kPa	% *	% *	ppm*	m^3/s	Rm^3/s **	Rm^3/s**
1	8:15 - 8:19	160	16.7	17.4	-0.65	101.7	101.1	11.4	7.75	26.8	25.7	14.7	17.7
2	8:42 - 8:46	165	16.7	17.5	-0.67	101.7	101.0	11.1	8.14	11.2	25.8	14.6	17.6
3	9:09 - 9:13	166	16.7	16.8	-0.65	101.7	101.1	10.8	8.41	15.0	24.8	14.0	16.8
4	9:35 - 9:39	167	16.7	16.8	-0.62	101.7	101.1	10.8	8.37	22.8	24.8	14.0	16.8
5	10:16 - 10:20	166	16.1	16.2	-0.55	101.7	101.2	11.3	7.72	30.1	23.9	13.6	16.2
6	10:46 - 10:50	167	16.1	16.4	-0.57	101.7	101.1	11.3	7.63	11.1	24.2	13.7	16.4
7	11:16 - 11:20	168	16.1	17.2	-0.65	101.6	101.0	10.1	8.97	28.7	25.3	14.3	17.1
8	11:45 - 11:49	169	16.1	17.2	-0.60	101.6	101.0	10.7	7.85	20.3	25.4	14.4	17.1
9	12:31 - 13:35	169	15.7	17.3	-0.57	101.6	101.0	10.8	8.50	27.0	25.5	14.5	17.2
10	12:59 - 13:03	169	15.7	17.1	-0.60	101.6	101.0	11.0	8.07	29.7	25.3	14.3	17.0
11	13:28 - 13:32	168	15.7	17.3	-0.67	101.5	100.8	11.1	8.04	13.4	25.5	14.5	17.2
12	14:04 - 14:08	168	15.7	17.3	-0.65	101.4	100.8	10.8	8.10	7.8	25.5	14.5	17.2
13	14:44 - 14:48	168	16.3	17.0	-0.55	101.4	100.9	11.7	7.32	7.2	25.1	14.2	16.9
14	15:12 - 15:16	168	16.3	16.7	-0.55	101.3	100.8	11.3	7.74	9.0	24.7	13.9	16.6
15	15:45 - 15:50	167	16.3	17.0	-0.60	101.3	100.7	11.4	7.61	20.5	25.1	14.1	16.9
16	16:13 - 16:19	168	16.3	17.2	-0.65	101.2	100.6	11.5	7.51	20.3	25.4	14.2	17.0
Average		167	16.2	17.0	-0.61	101.5	100.9	11.1	7.98	18.8	25.1	14.2	17.0

* Dry basis

** Reference conditions; 25°C and 1 atm

Covanta - Durham York Energy Centre
Boiler No. 2 Scrubber Inlet
Stack Gas Physical Parameters and Volumetric Flowrates
September 27, 2015

Test No.	Test Time	Gas Temp.	Moisture by Volume	Gas Velocity	Static Pressure	Barometric Pressure	Absolute Pressure	Carbon Dioxide by Volume	Oxygen by Volume	Carbon Monoxide By Volume	Actual Flowrate	Dry Reference Flowrate	Wet Reference Flowrate
		°C	%	m/s	kPa	kPa	kPa	% *	% *	ppm*	m^3/s	Rm^3/s **	Rm^3/s**
1	8:08 - 8:09	153	15.3	19.1	-0.67	101.7	101.0	10.6	8.92	14.2	28.3	16.7	19.8
2	8:34 - 8:38	163	15.3	18.9	-0.70	101.7	101.0	10.5	9.03	27.7	27.9	16.2	19.1
3	9:01 - 9:06	167	15.3	17.7	-0.57	101.7	101.1	10.2	9.49	19.8	26.1	15.0	17.7
4	9:31 - 9:35	167	15.3	18.3	-0.62	101.7	101.1	10.6	8.97	22.6	27.0	15.5	18.3
5	10:11 - 10:15	168	15.9	18.3	-0.60	101.7	101.1	10.3	9.32	18.0	27.0	15.3	18.2
6	10:41 - 10:45	164	15.9	16.6	-0.55	101.7	101.2	11.1	8.42	30.6	24.6	14.1	16.7
7	11:11 - 11:15	164	15.9	17.0	-0.55	101.6	101.1	12.0	7.35	19.7	25.0	14.3	17.1
8	11:40 - 11:44	165	15.9	16.7	-0.60	101.6	101.0	11.0	8.50	16.7	24.7	14.1	16.8
9	12:24 - 12:30	166	16.3	17.2	-0.57	101.6	101.0	10.8	8.66	24.3	25.4	14.4	17.2
10	12:54 - 12.59	167	16.3	17.5	-0.57	101.6	101.0	12.3	6.91	39.7	25.9	14.7	17.5
11	13:24 - 13:27	167	16.3	18.3	-0.65	101.5	100.9	10.9	8.62	19.4	27.1	15.3	18.3
12	13:58 - 14:02	168	16.3	18.4	-0.52	101.4	100.9	2.29	18.7	60.9	27.1	15.3	18.3
13	14:39 - 14:43	167	16.6	18.0	-0.55	101.4	100.9	11.7	7.55	16.2	26.5	15.0	17.9
14	15:07 - 15:10	167	16.6	17.7	-0.62	101.3	100.7	12.0	7.23	16.5	26.2	14.7	17.6
15	15:39 - 15:44	167	16.6	17.6	-0.60	101.3	100.7	9.63	9.98	21.5	26.1	14.7	17.6
16	16:08 - 16:12	165	16.6	16.5	-0.55	101.2	100.7	11.1	8.11	22.6	24.4	13.8	16.5
Average		165	16.0	17.7	-0.59	101.5	101.0	10.4	9.11	24.4	26.2	14.9	17.8

* Dry basis

** Reference conditions; 25°C and 1 atm

SGS

Analysis Report

October 13, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.1 Run 1	Sample ID By:	Covanta
Date Sampled:	Sep 27, 2015	Sample Taken At:	Submitted
Date Received:	Sep 29, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R. 1

SGS Minerals Sample ID: 491-1588227-001

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	19.59	
Sulfur %	ASTM D4239 (A)	0.70	0.87
Gross Calorific Value Btu/lb	ASTM D5865		<100

Vanessa Chambliss
Branch Manager

SGS North America Inc. | Minerals Services Division
16130 Van Drunen Road South Holland IL 60473 t (708) 331-2900 f (708) 333-3060 www.sgs.com/minerals

Member of the SGS Group (Société Générale de Surveillance)

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SGS

Analysis Report

October 13, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.1 Run 2	Sample ID By:	Covanta
Date Sampled:	Sep 27, 2015	Sample Taken At:	Submitted
Date Received:	Sep 29, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R. 1

SGS Minerals Sample ID: 491-1588227-002

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	19.57	
Sulfur %	ASTM D4239 (A)	0.69	0.85
Gross Calorific Value Btu/lb	ASTM D5865		<100

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SGS

Analysis Report

October 13, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.1 Run 3	Sample ID By:	Covanta
Date Sampled:	Sep 27, 2015	Sample Taken At:	Submitted
Date Received:	Sep 29, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R. 1

SGS Minerals Sample ID: 491-1588227-003

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	19.66	
Sulfur %	ASTM D4239 (A)	0.66	0.82
Gross Calorific Value Btu/lb	ASTM D5865		<100

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TABLE 1

PERTINENT TEST DATA

Test Name: Energy Recovery 2
Test Date: 9/28/2015 08:00 - 16:00
Test Start: Test End:

	Item		Units	Unit 1	Unit 2		Average or Wtd. Avg. or Total	Measurement Source
1	Test duration		hours	8.0	8.0		8.00	----
2	Refuse feed rate		kg/hr	9,103	8,823		17,926	Crane Weigh Cell
3	Total FW/Steam flow		kg/hr	-			-	Station Instrument
4	Main steam flow		kg/hr	34,914	34,980		69,894	Station Instrument
5	Feedwater flow		kg/hr	34,876	34,879		69,755	Station Instrument
6	Suphtr. stm temperature		°C	501.6	503.8		502.7	Station Instrument
7	Suphtr. stm pressure		barg	88.4	88.4		88.4	Station Instrument
8	Feedwater temperature		°C	138.2	137.7		138.0	Station Instrument
9	Feedwater pressure		barg	101.4	101.8		101.6	Station Instrument
10	Continuous blowdown rate		kg/hr	0	0		0	Verify Valve Closed
11	Boiler drum pressure		barg	96.4	96.3		96.3	Station Instrument
12	Inlet air dry bulb temp.		°C	-	-		25.1	Digital Psychrometer
12A	Relative humidity %		%	-	-		69.5	Digital Psychrometer
13	Inlet air wet bulb temp.		°C	-	-		21.0	Calculated
14	Total air flow - Ref. Cond.		Rm^3/h	45,398	48,014		93,412	Station Instrument
15	Overfire air flow - Ref. Cond.		Rm^3/h	7,687	6,434		14,121	Station Instrument
16	Seal air flow - Ref. Cond.		Rm^3/h	1,737	1,588		3,324	Station Instrument
17	Overfire air pressure		mbar	46.0	46.1		46.0	Station Instrument
18	OFA and Seal air temp after fan		°C	34.6	34.3		34.5	Test T/C, wtd. avg.
19	Heated underfire air temperature		°C	76.4	73.0		74.6	Test T/C Grid wtd avg.
20	Barometric pressure		mbara	- -			1004.7	Barometer
21	Moisture in combustion air		kg/kg dry ai				0.0141	Calculated
22	CO_2 in dry flue gas		% vol	11.115	10.913		11.01	Manually @ Econ. Outlet
23	O_2 in dry flue gas		% vol	7.974	8.726		8.36	Manually @ Econ. Outlet
24	N_2 in dry flue gas		% vol	80.911	80.362		80.63	Calculated
25	H_2O in flue gas		% vol	16.450	16.100		16.27	Manually @ Econ. Outlet
26	Flue gas flow		act m^3/h	93,528	98,390		191,918	Manually @ Econ. Outlet
27	Economizer exit gas temp.		°C	165.2	167.5		166.4	Station Instrument
28	Sampling point gas temp.		°C	166.4	167.7		167.1	Manually @ Econ. Outlet
	Residue:							
	Sample (Bottom Ash)							
29	Fines (-2")		kg				1,001	Manual Residue Sampling
30	Overs (+2")		kg				34	Manual Residue Sampling
	Total Flow							
31	Grizzly Rejects		kg			0	0	Combined with Ferrous
32	Ferrous		kg			2.547%	3,652	Ratio from 5-Day Test
33	Non-Ferrous		kg			0.362%	520	Ratio from 5-Day Test
34	Bottom Ash		kg			20.892%	29,961	Ratio from 5-Day Test
35	Fly Ash	**10.00%**	kg			2.089%	2,996	Calculated from assumed %
36	Moisture in -2" bottom ash bottom ash		%				18.0	Laboratory Analysis
37	Combustibles in -2" bottom ash		dry %				0.42	Laboratory Analysis
38	Moisture in flyash leaving test boundary		%				0.0	Assumed zero %
39	Combustibles in flyash		dry %				0.42	Assumed same % as BA
40	Ash discharger water bath temp		°C	42.9	47.6		45.3	Test Thermocouples
41	Turbine Gross MW		MWG				17.02	Station Instrument
42	Net MW Exported		MWN				14.79	Station Instrument
43	Turbine Exhaust Pressure		bara				0.109	Station Instrument (Exh. Temp
44	ACC Ambient Air Temperature		°C				20.3	Station Instrument
45	Annual average dry bulb temp.		°C	-			8.0	Historical weather data
****	**********	**********	**********	**********	1	**********	**********	**********

AS TESTED PERFORMANCE PARAMETERS

TABLE 2

RESIDUE ANALYSIS

Sample Weights		Bottom Ash kg		Bottom Ash %
	+2" to -8" Material	34		3.3
	-2" Material	+ 1,001	+	96.7
	-8" Material	1,036		100.0

Total Weights			Bottom Ash (kg)	Flyash (kg)
	Bottom & Fly Ash (Excluding +8" Grizzly Material & All Metals)		29,961	2,996
-2" Ash	-2" Wet Bottom Ash @	96.7%	28,972	
	Moisture of wet bottom as	18.0%	5,220.7	
	Dry Aggregate (by difference)		23,751	2,996
	Combustibles of dry aggre	0.42%	99	12
	Dry Ash (by difference)		23,652	2,984
	Total +2" to (-8")	3.3%	989	
	+8" Grizzly Material, Ferrous & Non-Ferrous Metals (metals and inerts)		4,172	

Component Weights	Bottom Ash kg	Bottom Ash (1) kg/h	Bottom Ash (2) %	Bottom Ash (3) kg/kg fuel	Fly Ash kg	Fly Ash (1) kg/h	Fly Ash (2) %	Fly Ash (3) kg/kg fuel
Dry Ash + Inerts:								
-2" Ash	23,652	2,957			2,984	373		
+2" to (-8")	989	124						
+8" Grizzly, Ferrous & Non-Fe	4,172	521						
Subtotal	28,813	3,602	90.31	0.2009	2,984	373	9.35	0.0208
Unburned Combustible								
-2" Combustible	99	12.4			12	1.6		
+2" to (-8") Combustible	0	0			0	0		
Subtotal	99	12.4	0.31	0.0007	12	1.6	0.04	0.0001
Total Dry Residue :	**28,912**	**3,614.0**	**90.6**	**0.202**	**2,996**	**375**	**9.4**	**0.021**

Notes:
(1) Divisor is 8 hours
(2) % of Total Dry Residue (excluding Carbon Injection)
(3) Divisor is 17,926 kg/hr of refuse

TABLE 3

FLUE GAS FLOW & ANALYSIS
(Based on Average Data for Test Runs @ Econ. Exit)

	% VOL (DRY)	% VOL (WET)	M.W. kg/kg-mol	R.W. (DRY)	R.W. (WET)	% WT (DRY)	% WT (WET)	KG/HR
CO2	11.115	9.287	44.010	4.892	4.087	16.25	14.53	21,705
O2	7.974	6.663	32.000	2.552	2.132	8.48	7.58	11,322
N2	80.911	67.601	28.016	22.668	18.939	75.28	67.35	100,583
H2O		16.450	18.016	0.000	2.964	0.00	10.54	15,742
Totals	100.0	100.00		30.112	28.122	100.0	100.0	149,352

From flue gas report, average flow = 191,918 a m3/hr
Gas temperature @ sampling point = 167.0562 °C

Specific volume = $\frac{8.314 \times (273.15 + 167.0562 \text{ °F})}{28.122 \times (1.013 \text{ bara}) \times (\text{cm2/m2})}$ = 1.285 m3/kg

Wet gas mass flow = 191,918 / 1.285 = 149,352 kg/hr 134.3%

Percent excess air = $\frac{(O2 - CO/2) \times 100}{0.2682 \times N2 - (O2 - CO/2)}$ = 58.10 %

(per ASME PTC 19.10 Flue and Exhaust Gas Analysis, Section 6.03.6.3.1)

		deg C	deg Kelvin	deg F
Enthalpies From PTC-4, 5.19.4 & 5.19.11	Flue Gas Temp @ econ out	166.4	439.5	331.5

	Flue Gas @ Economizer Outlet		
	Enth. (H) (kJ/kg)	R.H. (WET)	R.H. (DRY)
CO2	128.74	18.71	20.92
O2	132.09	10.01	11.19
N2	146.23	98.48	110.08
H2O	267.47	28.19	0.00
Totals		155.39	142.19

********** ********** ********** ********** ********** 3 ********** ********** ********** **********

Total Measured Air Flow

Average compensated total wet air flow in Reference m^3/hr (25 °C) is taken from Table 1.

Total Wet Air Flow = 93,412 m^3/hr at 25 °C reference temperature
(Compensated)

$$\text{Specific Volume of Dry Air} = \frac{(25.00 + 273.15) \times 8.314}{1.005 \times 28.97} = 0.8517 \text{ } m^3/kg$$

$$\text{Dry Air Density} = \frac{1}{0.8517} = 1.1741 \text{ } kg/m^3$$

Wet Air Density = 1.0141 kg wet air/kg dry air x 1.1741 kg dry air/m^3 = 1.1907 kg wet air/m^3

Total Measured Wet Air 93,412 m^3/h x 1.1907 kg wet air/m^3

= **111,224** kg/hr

Moisture in Total Measure Air = (0.0141 x 111,224) / (1 + 0.0141) = **1,546.8** kg/hr

Overfire Air and Seal Air Flow

Average compensated wet overfire air flow & seal air flow in Reference m^3/hr (25 °C) is taken from Table 1.

Wet Overfire Air Flow = 14,121 m^3/hr at 25 °C temperature & 1.013 bara
Wet Seal Air Flow = 3,324 m^3/hr at 25 °C temperature & 1.013 bara
Combined OFA & Seal Air Flow = 14,121 + 3,324 = 17,445 Ref. m^3/hr

$$\text{Specific Volume of Dry Air} = \frac{(25.0 + 273.15) \times 8.314}{1.005 \times 28.97} = 0.8517 \text{ } m^3/kg$$

$$\text{Dry Air Density} = \frac{1}{0.8517} = 1.1741 \text{ } kg/m^3$$

Wet Air Density = 1.0141 kg wet air/kg dry air x 1.1741 kg dry air/m^3 = 1.1907 kg wet air/m^3

OFA & Seal Air (Wet) = 17,445 m^3/h x 1.1907 kg wet air/m^3

= **20,772** kg/hr

Moisture in OFA & Seal Air = (0.0141 x 20,772) / (1 + 0.0141) = **288.9** kg/hr

Wet Underfire Air =
Total Wet Air - Wet OFA & Seal Air = 111,224 - 20,772 = **90,452** kg/hr
Moisture in Underfire air =
Total Air H_2O - OF & Seal Air H_2O = 1,546.8 - 288.9 = **1,257.9** kg/hr

(Continued from Page 4)

Assume ref. waste N2 content of test fuel = 0.87 %
Therefore, N2 in flue gas from fuel =

17,926 kg fuel/hr x 0.0087 kg N2/kg fuel = 156 kg/hr

N2 in flue gas = 100,583 kg/hr

Total dry comb. air supplied = $\frac{100,583 - 156}{0.7685}$ = **130,679** kg/hr
(Incl. Air Infiltration)

Moisture in air = 0.0141 kg/kg dry air from psychrometric chart for
25.08 °C db / 21.03 °C wb, therefore

Moisture in Calculated Total Air = 0.0141 x 130,679 = **1,843.1** kg/hr

Total Calculated wet air = 130,679 + 1843.1 = **132,522** kg/hr
(Including Air Infiltration & VLN cooling air)

Total Calculated Wet Air (including air infiltration & VLN cooling air) is greater than Total Measured Wet Air
Wet Air Infiltration (incl. VLN cooling air) = Calculated Total Wet Air - Measured Total Wet Air
= 132,522 - 111,224
= 21,298 kg/hr

Wet Un-heated Air = Total Wet Air - Wet UFA
= 132,522 - 90,452
= 42,070 kg/hr

Moisture in Wet Air Infiltration (incl. VLN cooling air) = Total Air Moisture - Moisture in Measured Total Ai
= 1,843.1 - 1,546.8
= 296.3 kg/hr

********** ********** ********** ********** ********** 5 ********** ********** **********

Calculated moisture in Flue Gas from H2 and H2O in fuel and Ash Discharger Quench Water Vapor:

A water balance around the boiler gives:

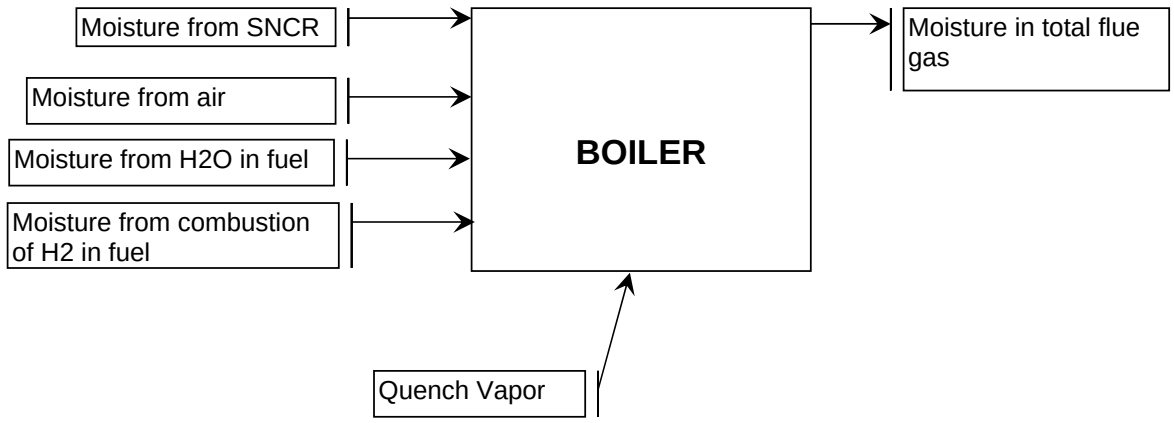
Vapor in flue gas = moisture from H2 and H20 in the fuel + moisture in air + quench vapor + SNCR & carrier water

Therefore:

Moisture from H2 and H2O in fuel + quench vapor + SNCR & carrier water = Vapor in gas - moisture in air

= 15,742 - 1,843.1

= 13,899 kg/hr = 0.775 kg/kg FUEL



DATA FOR HEAT OUTPUT AND LOSS CALCULATIONS

Enthalpy of feedwater @	137.97258	°C,	10259.55	kPa	587.03 kJ/kg
Enthalpy of drum water @ saturated pressure			9734.41	kPa	1396.32 kJ/kg
Enthalpy of steam @	502.69007	°C,	8942.23	kPa	3394.80 kJ/kg
Enthalpy of dry underfire air at 74.6°C comb. temp. referenced to 25°C					49.99 kJ/kg
Enthalpy of dry overfire air at 34.5°C air temp. referenced to 25°C					9.51 kJ/kg
Enthalpy of dry flue gas at 166.4°C econ exit temp. referenced to 25°C					142.19 kJ/kg
Enthalpy of liquid water @ the amb. air temperature of 25.1°C ref. 0°C					105.02 kJ/kg
Enthalpy of water vapor @ UFA temp. of 74.6°C ref. 25°C					92.90 kJ/kg
Enthalpy of water vapor @ the OFA temp. aft. fan of 34.5°C ref. 25°C					17.61 kJ/kg
Enthalpy of steam vapor @ 166.4°C and 1 psia referenced to 0°C					2814.67 kJ/kg
Enthalpy of liquid water @ reference temperature of 25°C ref. 0°C					104.67 kJ/kg
Enthalpy of water vapor @ econ exit temp. of 166.4°C referenced to 25°C					267.5 kJ/kg
Enthalpy of ash discharger water bath @ 45.3°C					189.5 kJ/kg
Enthalpy of dry residue @ air inlet temp of 25.1°C			298.2	°K	0.050 kJ/kg
Enthalpy of dry residue @ ash discharger temp of 45.3°C or			318.4	°K	15.557 kJ/kg
Enthalpy of dry fly ash @ econ. exit temp. of 166.4°C or			439.5	°K	120.532 kJ/kg
HHV of unburned combustibles					27,913 kJ/kg
Radiation & convection loss per ASME PTC 34, Fig. I-1					
with 97.9 GJ/hr actual average heat output per boiler, 2 boilers =					1.517 GJ/hr
Enthalpy of dry fuel @ ambient temp. of 25.1°C ref. 25°C					0.063 kJ/kg
Enthalpy of liquid water @ ambient temp. of 25.1°C ref. 25°C					0.3 kJ/kg

Reference documents:

ASME Performance Test Code for Fired Steam Generators, ASME PTC 4
ASME Performance Test Code for Waste Combustor with Energy Recovery, ASME PTC 34
ASME Steam Tables 1967 Edition

Table 4 - Reference Composition Acceptable Waste

Energy Content 13,000 kJ (HHV) per kilogram

REFERENCE WASTE ULTIMATE ANALYSIS

	%
Moisture	15.16
Total Inert	15.92
Carbon	31.73
Hydrogen	4.56
Oxygen	31.35
Nitrogen	0.87
Sulfur	0.04
Chlorine	0.31
Flourine	0.030
Iron, oxidizable	0.030
	100.00

BOILER EFFICIENCY CALCULATION
AS TESTED CONDITIONS
-HEAT LOSS METHOD-
(ASME PTC 34, SECTION 5.11)

kJoule per kg A.F. Fuel

HEAT OUTPUT due to-

Steam:
(kg/hr of fluid)/(kg/hr fuel) x (h out - h in, kJ/kg)
69,755 / 17,926 x (3,394.80 - 587.03) = 10,925.73

Blowdown:
(kg/hr of fluid)/(kg/hr fuel) x (h out - h in, kJ/kg)
- / 17,926 x (1,396.32 - 587.03) 0.00

Total Heat Output: = 10,925.73

HEAT LOSSES due to-

Dry gas:
(kg/hr dry gas)/(kg/hr fuel) x (flue gas h @ Tgas econ exit ref. 25°C, kJ/kg)
133,610 / 17,926 x (142.19) = 1059.79

Moisture from H2 and H2O in fuel, ash discharger quench water vapor and SNCR carrier water:
(kg/hr moisture)/(kg/hr fuel) x (h econ gas exit @ 1 psia - h liquid @ T = 25°C, kJ/kg)
13,899 / 17,926 x (2814.67 - 104.67) = 2101.13

Ash discharger quench water:
Liquid: (kg/hr liquid)/(kg/hr fuel) x (h water @ Tquench - h water @ Tamb air, kJ/kg)
653 / 17,926 x (189.52 - 105.02) = 3.08

Sensible heat in dry bottom residue:
(kg/hr dry residue)/(kg/hr fuel) x (h res @ Tquench - h res @Tamb air, kJ/kg)
3,614 / 17,926 x (15.557 - 0.050) = 3.13

Sensible heat in dry fly ash residue:
(kg/hr dry residue)/(kg/hr fuel) x (h res @ Tecon exit - h res @Tamb air, kJ/kg)
375 / 17,926 x (120.532 - 0.050) = 2.52

Moisture from total air:
(kg/hr air moisture)/(kg/hr fuel) x (h water vap @ Tgas econ exit ref. 25°C, kJ/kg)
1,843 / 17,926 x (267.5) = 27.50

Unburned combustibles:
(lb unburned combustibles/hr)/(kg/hr fuel) x HHV unburned
13.96 / 17,926 x 27,913 = 21.74

Radiation & Convection Loss:
Per ASME PTC 34, Fig. I-1 = 1.517 GJ/hr
1,516,569 / 17,926 = 84.60

Unaccounted for:
0.5 % of heat output and losses (heat input) = 71.50
0.005 x (10,925.7 + 3,375.0)

Total Heat Losses: = 3374.99

HEAT CREDITS due to-

kJoule per kg A.F. Fuel

Dry underfire air sensible heat:
(kg/hr dry air)/(kg/hr fuel) x (h in @ 74.6°C ref. 25°C, kJ/kg)
89,194 / 17,926 x (49.99) = 248.72

Dry overfire air, seal air & air infiltration sensible heat:
(kg/hr dry air)/(kg/hr fuel) x (h in @ 34.5°C ref. 25°C, kJ/kg)
41,485 / 17,926 x (9.51) = 22.02

Moisture in incoming underfire air:
(kg/hr moisture)/(kg/hr fuel) x (h vap in @ 74.6°C ref 25°C, kJ/kg)
1,257.9 / 17,926 x (92.90) = 6.52

Moisture in incoming overfire, seal air & air infiltration:
(kg/hr moisture)/(kg/hr fuel) x (h vap in @ 34.5°C ref 25°C, kJ/kg)
585.2 / 17,926 x (17.61) = 0.57

Fuel sensible heat:
(dry fuel, lb dry fuel/lb fuel) x (h in @ ambient air temp of 25.1°C ref 25°C, kJ/kg) +
(moisture in fuel, lb H2O/lb fuel) x (h in @ ambient air temp of 25.1°C ref 25°C, kJ/kg)
0.848 x 0.063 + 0.152 x 0.35 = 0.11

Total Heat Credits: 277.94

Gross Heat Input = HHV of Fuel + Heat Credit = Heat Output + Heat Losses

or

HHV of FUEL = Heat Output + Heat Losses - Heat Credit
= 10925.73 + 3374.99 - 277.94
= **14,023** kJ/kg

EFFICIENCY= (1 - (Heat Losses/Heat Input))*100= (1 - 3374.99 / 14,301) x 100 = **76.40** %

Gross Heat Input = 14,301 kJ/kg

HEAT LOSS SUMMARY: %

Dry gas:	7.41
Moisture from H2 and H2O in fuel, ash discharger quench water vapor & SNCR:	14.69
Moisture from total air:	0.19
Ash discharger quench water: Liquid:	0.02
Sensible heat in dry bottom residue:	0.02
Sensible heat in dry fly ash:	0.02
Unburned combustibles:	0.15
Radiation/Correction:	0.59
Unaccounted for:	0.50
Total Heat Losses:	23.60

Adjustment For Annual Average Dry Bulb Temperature

Turbine performance is dependent upon exhaust vacuum, which is dependent upon air-cooled condenser (ACC) performance. ACC performance is dependent upon the dry bulb ambient air temperature. An adjustment is made to the as-tested ACC performance for the difference between the average annual dry bulb temperature and the as-tested dry bulb temperature. Per average local weather conditions: (see Procedures page 10)

The average annual dry bulb temperature = 8 °C

Air-Cooled Condenser Performance:

The as-tested ACC ambient dry bulb temperature was: **20.3** °C
Per the ACC performance curve, (see Figures section) the condenser vacuum corresponding to the as-tested dry bulb temperature of 20.3 °C is: 111.0 mbara
Per the ACC performance curve, the condenser vacuum corresponding to the average annual dry bulb temperature of 8 °C is: 68.0 mbara
Therefore, the correction to exhaust pressure for temperature difference is 43.0 mbar

Turbine Performance:

Per the curve defining change in exhaust pressure vs. change in turbine-generator output (see page 12 of procedures), a 43.0 mbar change in exhaust pressure at design throttle flow results in a 2.55% change in turbine heat rate. Therefore, the overall adjusted gross electrical output is :

17.02 * (1 + 0.0255) = 17.45 **MWG**

The MW correction is also added to the as-tested NET electrical exported:

14.79 + 17.45 - 17.02 = 15.22 **MWN**

See SAMPLE CALCULATION CURVES at the end of these procedures.

Adjusted Power Outputs Per Ton:

Gross Electrical Output = 17,454 kW adjusted for annual average dry bulb temperature. / 17.926 Actual TPH = 974 kWh/tonne

Compared to the guarantee of 951 kWh/tonne at the same HHV.

Surpassing the guarantee by: 22 kWh/tonne
or 2.3%

Net Electrical Export = 15,225 kW adjusted for annual average dry bulb temperature. / 17.926 Actual TPH = 849 kWh/tonne

Compared to the guarantee of 842 kWh/tonne at the same HHV.

Surpassing the guarantee by: 7 kWh/tonne
or 0.8%

Crane Calibration Drift Adjustment Calculation Energy Recovery 2

Reference Weight (Reference Block Weight)	**3,926**	kg			
Initial Span Check Reading	3,900.0	@	9/28/2015 7:32		
Final Span Check Reading	3,901.0	@	9/28/2015 17:25		
Average of the Initial and Final Span Checks	**3,901**	kg			
Difference between Average and Reference Weight	**-26**	kg	>	45.4	kg
Adjustment to each grapple feed is warranted.					

							Adjustment Factor 1.002177722		
	143,097								143,409
Feed at	Feed Weight Reading (kg)	Ref. Weight (Drifted, by Equation)	Difference (Drift)	% Difference (% Drift)		Feed Weight % of Ref. Drifted Weight	Proportioned Drift (%)	Feed Weight Drifted	Adjusted Feed Weight (kg)
9/28/15 8:07	1,845.0	3,901.1	-24.9	-0.63%		47.29%	-0.30%	-5.53	**1,850.53**
9/28/15 8:11	1,833.0	3,901.2	-24.8	-0.63%		46.99%	-0.30%	-5.43	**1,838.43**
9/28/15 8:25	1,660.0	3,901.7	-24.3	-0.62%		42.55%	-0.26%	-4.37	**1,664.37**
9/28/15 8:29	2,020.0	3,901.8	-24.2	-0.62%		51.77%	-0.32%	-6.45	**2,026.45**
9/28/15 8:46	2,456.0	3,902.4	-23.6	-0.60%		62.94%	-0.38%	-9.31	**2,465.31**
9/28/15 8:48	1,990.0	3,902.4	-23.6	-0.60%		50.99%	-0.31%	-6.10	**1,996.10**
9/28/15 8:57	1,970.0	3,902.7	-23.3	-0.59%		50.48%	-0.30%	-5.90	**1,975.90**
9/28/15 9:01	1,632.0	3,902.8	-23.2	-0.59%		41.82%	-0.25%	-4.03	**1,636.03**
9/28/15 9:16	1,425.0	3,903.3	-22.7	-0.58%		36.51%	-0.21%	-3.01	**1,428.01**
9/28/15 9:18	2,054.0	3,903.4	-22.6	-0.58%		52.62%	-0.30%	-6.23	**2,060.23**
9/28/15 9:25	1,768.0	3,903.6	-22.4	-0.57%		45.29%	-0.26%	-4.57	**1,772.57**
9/28/15 9:30	1,714.0	3,903.7	-22.3	-0.57%		43.91%	-0.25%	-4.27	**1,718.27**
9/28/15 9:48	1,838.0	3,904.3	-21.7	-0.55%		47.08%	-0.26%	-4.79	**1,842.79**
9/28/15 9:50	2,090.0	3,904.4	-21.6	-0.55%		53.53%	-0.29%	-6.16	**2,096.16**
9/28/15 9:57	2,133.0	3,904.6	-21.4	-0.55%		54.63%	-0.30%	-6.36	**2,139.36**
9/28/15 9:59	2,162.0	3,904.7	-21.3	-0.54%		55.37%	-0.30%	-6.51	**2,168.51**
9/28/15 10:13	2,747.0	3,905.1	-20.9	-0.53%		70.34%	-0.37%	-10.29	**2,757.29**
9/28/15 10:20	2,220.0	3,905.3	-20.7	-0.53%		56.85%	-0.30%	-6.65	**2,226.65**
9/28/15 10:37	792.0	3,905.8	-20.2	-0.51%		20.28%	-0.10%	-0.82	**792.82**
9/28/15 10:39	676.0	3,905.9	-20.1	-0.51%		17.31%	-0.09%	-0.60	**676.60**
9/28/15 10:47	1,444.0	3,906.2	-19.8	-0.51%		36.97%	-0.19%	-2.70	**1,446.70**
9/28/15 10:49	1,512.0	3,906.2	-19.8	-0.50%		38.71%	-0.20%	-2.95	**1,514.95**
9/28/15 10:51	1,298.0	3,906.3	-19.7	-0.50%		33.23%	-0.17%	-2.17	**1,300.17**
9/28/15 10:53	895.0	3,906.3	-19.7	-0.50%		22.91%	-0.11%	-1.03	**896.03**
9/28/15 10:55	792.0	3,906.4	-19.6	-0.50%		20.27%	-0.10%	-0.80	**792.80**
9/28/15 10:56	1,029.0	3,906.5	-19.5	-0.50%		26.34%	-0.13%	-1.35	**1,030.35**
9/28/15 11:00	1,748.0	3,906.6	-19.4	-0.49%		44.75%	-0.22%	-3.87	**1,751.87**
9/28/15 11:02	2,114.0	3,906.6	-19.4	-0.49%		54.11%	-0.27%	-5.64	**2,119.64**
9/28/15 11:17	1,549.0	3,907.1	-18.9	-0.48%		39.65%	-0.19%	-2.96	**1,551.96**
9/28/15 11:19	1,754.0	3,907.2	-18.8	-0.48%		44.89%	-0.22%	-3.78	**1,757.78**
9/28/15 11:21	1,690.0	3,907.2	-18.8	-0.48%		43.25%	-0.21%	-3.49	**1,693.49**
9/28/15 11:23	1,630.0	3,907.3	-18.7	-0.48%		41.72%	-0.20%	-3.24	**1,633.24**
9/28/15 11:30	745.0	3,907.5	-18.5	-0.47%		19.07%	-0.09%	-0.67	**745.67**
9/28/15 11:35	1,769.0	3,907.7	-18.3	-0.47%		45.27%	-0.21%	-3.74	**1,772.74**
9/28/15 11:37	1,453.0	3,907.7	-18.3	-0.47%		37.18%	-0.17%	-2.51	**1,455.51**
9/28/15 11:43	1,098.0	3,907.9	-18.1	-0.46%		28.10%	-0.13%	-1.42	**1,099.42**
9/28/15 11:47	1,759.0	3,908.0	-18.0	-0.46%		45.01%	-0.21%	-3.62	**1,762.62**
9/28/15 11:52	2,538.0	3,908.2	-17.8	-0.45%		64.94%	-0.29%	-7.47	**2,545.47**
9/28/15 11:55	2,128.0	3,908.3	-17.7	-0.45%		54.45%	-0.25%	-5.23	**2,133.23**
9/28/15 12:03	2,273.0	3,908.5	-17.5	-0.44%		58.15%	-0.26%	-5.88	**2,278.88**
9/28/15 12:04	2,379.0	3,908.6	-17.4	-0.44%		60.87%	-0.27%	-6.42	**2,385.42**
9/28/15 12:18	1,925.0	3,909.0	-17.0	-0.43%		49.25%	-0.21%	-4.10	**1,929.10**
9/28/15 12:20	1,028.0	3,909.1	-16.9	-0.43%		26.30%	-0.11%	-1.17	**1,029.17**
9/28/15 12:28	2,904.0	3,909.3	-16.7	-0.42%		74.28%	-0.32%	-9.15	**2,913.15**
9/28/15 12:30	2,787.0	3,909.4	-16.6	-0.42%		71.29%	-0.30%	-8.40	**2,795.40**
9/28/15 12:38	2,385.0	3,909.7	-16.3	-0.42%		61.00%	-0.25%	-6.05	**2,391.05**
9/28/15 12:42	2,353.0	3,909.8	-16.2	-0.41%		60.18%	-0.25%	-5.85	**2,358.85**
9/28/15 12:58	1,896.0	3,910.3	-15.7	-0.40%		48.49%	-0.19%	-3.68	**1,899.68**
9/28/15 13:00	2,058.0	3,910.3	-15.7	-0.40%		52.63%	-0.21%	-4.32	**2,062.32**
9/28/15 13:13	2,171.0	3,910.7	-15.3	-0.39%		55.51%	-0.22%	-4.68	**2,175.68**
9/28/15 13:22	2,174.0	3,911.1	-14.9	-0.38%		55.59%	-0.21%	-4.60	**2,178.60**
9/28/15 13:28	2,231.0	3,911.2	-14.8	-0.38%		57.04%	-0.21%	-4.79	**2,235.79**
9/28/15 13:33	1,921.0	3,911.4	-14.6	-0.37%		49.11%	-0.18%	-3.51	**1,924.51**
9/28/15 13:39	2,166.0	3,911.6	-14.4	-0.37%		55.37%	-0.20%	-4.41	**2,170.41**
9/28/15 13:42	1,974.0	3,911.7	-14.3	-0.37%		50.46%	-0.18%	-3.64	**1,977.64**
9/28/15 13:57	1,870.0	3,912.1	-13.9	-0.35%		47.80%	-0.17%	-3.15	**1,873.15**
9/28/15 14:00	2,282.0	3,912.2	-13.8	-0.35%		58.33%	-0.20%	-4.67	**2,286.67**
9/28/15 14:07	2,272.0	3,912.4	-13.6	-0.35%		58.07%	-0.20%	-4.55	**2,276.55**
9/28/15 14:11	2,082.0	3,912.6	-13.4	-0.34%		53.21%	-0.18%	-3.79	**2,085.79**
9/28/15 14:23	2,261.0	3,913.0	-13.0	-0.33%		57.78%	-0.19%	-4.34	**2,265.34**
9/28/15 14:25	1,917.0	3,913.0	-13.0	-0.33%		48.99%	-0.16%	-3.10	**1,920.10**
9/28/15 14:35	1,959.0	3,913.4	-12.6	-0.32%		50.06%	-0.16%	-3.16	**1,962.16**
9/28/15 14:40	1,529.0	3,913.5	-12.5	-0.32%		39.07%	-0.12%	-1.90	**1,530.90**
9/28/15 14:45	1,868.0	3,913.6	-12.4	-0.31%		47.73%	-0.15%	-2.80	**1,870.80**
9/28/15 14:53	1,460.0	3,913.9	-12.1	-0.31%		37.30%	-0.11%	-1.68	**1,461.68**
9/28/15 15:02	1,754.0	3,914.2	-11.8	-0.30%		44.81%	-0.13%	-2.36	**1,756.36**
9/28/15 15:07	1,818.0	3,914.3	-11.7	-0.30%		46.44%	-0.14%	-2.51	**1,820.51**
9/28/15 15:14	1,689.0	3,914.6	-11.4	-0.29%		43.15%	-0.13%	-2.12	**1,691.12**
9/28/15 15:17	2,192.0	3,914.6	-11.4	-0.29%		55.99%	-0.16%	-3.55	**2,195.55**
9/28/15 15:24	2,124.0	3,914.9	-11.1	-0.28%		54.25%	-0.15%	-3.27	**2,127.27**
9/28/15 15:31	2,073.0	3,915.1	-10.9	-0.28%		52.95%	-0.15%	-3.05	**2,076.05**
9/28/15 15:33	2,031.0	3,915.2	-10.8	-0.28%		51.88%	-0.14%	-2.91	**2,033.91**
9/28/15 15:41	2,203.0	3,915.4	-10.6	-0.27%		56.26%	-0.15%	-3.34	**2,206.34**
9/28/15 15:43	2,133.0	3,915.5	-10.5	-0.27%		54.48%	-0.15%	-3.11	**2,136.11**
9/28/15 15:49	1,359.0	3,915.7	-10.3	-0.26%		34.71%	-0.09%	-1.24	**1,360.24**
9/28/15 15:51	1,859.0	3,915.7	-10.3	-0.26%		47.48%	-0.12%	-2.31	**1,861.31**
9/28/15 15:55	1,767.0	3,915.9	-10.1	-0.26%		45.12%	-0.12%	-2.06	**1,769.06**

Covanta - Durham York Energy Centre
Boiler No. 1 Scrubber Inlet
Stack Gas Physical Parameters and Volumetric Flowrates
September 28, 2015

Test No.	Test Time	Gas Temp.	Moisture by Volume	Gas Velocity	Static Pressure	Barometric Pressure	Absolute Pressure	Carbon Dioxide by Volume	Oxygen by Volume	Carbon Monoxide By Volume	Actual Flowrate	Dry Reference Flowrate	Wet Reference Flowrate
		°C	%	m/s	kPa	kPa	kPa	% *	% *	ppm*	m^3/s	Rm^3/s **	Rm^3/s**
1	8:27 - 8:31	162	16.4	17.7	-0.65	101.0	100.4	11.2	7.80	8.9	26.1	14.8	17.7
2	8:40 - 8:44	167	16.4	17.4	-0.57	101.0	100.4	10.8	8.43	13.8	25.7	14.5	17.3
3	9:08 - 9:16	168	16.4	17.2	-0.62	101.0	100.4	11.1	8.04	37.0	25.5	14.3	17.1
4	9:38 - 9:42	168	16.4	17.4	-0.57	101.0	100.4	10.4	8.69	49.6	25.7	14.4	17.3
5	10:37 - 10:41	169	16.0	18.7	-0.70	100.9	100.2	10.6	8.63	15.9	27.6	15.5	18.5
6	10:57 - 11:01	167	16.0	16.9	-0.55	100.9	100.4	11.1	7.91	15.3	25.0	14.1	16.8
7	11:26 - 11:30	165	16.0	16.9	-0.55	100.9	100.4	10.8	8.33	25.2	24.9	14.1	16.8
8	11:57 - 12:01	165	16.0	17.6	-0.55	100.9	100.4	11.5	7.45	16.7	26.0	14.7	17.6
9	12:44 - 12:48	168	16.6	18.4	-0.65	100.9	100.3	11.2	7.84	18.0	27.2	15.2	18.2
10	13:15 - 13:19	166	16.6	17.6	-0.65	100.8	100.2	10.4	8.68	21.8	26.1	14.6	17.5
11	13:44 - 13:48	167	16.6	17.4	-0.55	100.8	100.3	11.3	7.77	15.8	25.6	14.4	17.2
12	14:13 - 14:17	165	16.6	16.9	-0.57	100.8	100.2	11.4	7.56	14.4	24.9	14.0	16.8
13	15:03 - 15:11	165	16.8	17.2	-0.55	100.7	100.2	11.4	7.68	13.2	25.5	14.3	17.1
14	15:52 - 15:55	167	16.8	17.1	-0.57	100.7	100.1	11.3	7.79	12.0	25.3	14.1	17.0
15	16:07 - 16:11	167	16.8	17.1	-0.67	100.6	99.9	11.3	7.78	14.3	25.3	14.1	16.9
16	16:26 - 16:30	167	16.8	17.6	-0.60	100.6	100.0	11.9	7.21	19.9	26.0	14.5	17.4
Average		166	16.5	17.5	-0.60	100.8	100.2	11.1	7.97	19.5	25.8	14.5	17.3

* Dry basis

** Reference conditions; 25°C and 1 atm

Covanta - Durham York Energy Centre
Boiler No. 2 Scrubber Inlet
Stack Gas Physical Parameters and Volumetric Flowrates
September 28, 2015

Test No.	Test Time	Gas Temp.	Moisture by Volume	Gas Velocity	Static Pressure	Barometric Pressure	Absolute Pressure	Carbon Dioxide by Volume	Oxygen by Volume	Carbon Monoxide By Volume	Actual Flowrate	Dry Reference Flowrate	Wet Reference Flowrate
		°C	%	m/s	kPa	kPa	kPa	% *	% *	ppm*	m^3/s	Rm^3/s **	Rm^3/s**
1	8:16 - 8:20	165	15.8	17.1	-0.55	101.0	100.5	10.6	8.91	12.9	25.2	14.3	17.0
2	8:34 - 8:38	166	15.8	18.4	-0.60	101.0	100.4	11.4	8.10	9.0	27.2	15.4	18.3
3	9:02 - 9:06	166	15.8	18.1	-0.62	101.0	100.4	10.7	8.86	17.0	26.8	15.2	18.0
4	9:32 - 9:36	166	15.8	18.2	-0.57	101.0	100.4	10.8	8.73	16.9	26.9	15.2	18.1
5	10:24 - 10:29	168	15.6	18.9	-0.60	100.9	100.3	10.5	9.15	40.0	27.9	15.7	18.6
6	10:52 - 10:56	168	15.6	18.4	-0.57	100.9	100.3	10.4	9.37	23.8	27.2	15.4	18.2
7	11:20 - 11:25	170	15.6	19.7	-0.65	100.9	100.3	10.2	9.49	35.0	29.1	16.4	19.4
8	11:52 - 11:56	167	15.6	18.1	-0.62	100.9	100.3	10.8	8.76	23.4	26.7	15.1	17.9
9	12:39 - 13:43	168	16.3	18.6	-0.62	100.9	100.3	11.1	8.49	8.0	27.4	15.3	18.3
10	13:09 - 13:14	168	16.3	19.0	-0.57	100.8	100.2	10.7	9.04	21.9	28.0	15.7	18.8
11	13:38 - 13:42	169	16.3	18.9	-0.60	100.8	100.2	11.1	8.48	5.7	28.0	15.6	18.7
12	14:08 - 14:11	167	16.3	18.2	-0.52	100.8	100.3	10.9	8.58	9.2	26.8	15.0	18.0
13	14:52 - 14:56	168	16.7	18.5	-0.55	100.8	100.3	11.2	8.37	6.2	27.4	15.3	18.3
14	15:48 - 15:51	169	16.7	19.1	-0.57	100.7	100.1	11.4	8.16	3.2	28.1	15.6	18.8
15	16:00 - 16:06	169	16.7	18.8	-0.65	100.6	100.0	10.7	8.97	18.0	27.8	15.4	18.5
16	16:20 - 16:24	168	16.7	19.0	-0.62	100.6	100.0	11.4	8.26	0.0	28.1	15.6	18.7
Average		168	16.1	18.6	-0.59	100.9	100.3	10.9	8.73	15.6	27.4	15.4	18.4

* Dry basis

** Reference conditions; 25°C and 1 atm

SGS

Analysis Report

October 14, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.2 Run 1	Sample ID By:	Covanta
Date Sampled:	Sep 28, 2015	Sample Taken At:	Submitted
Date Received:	Sep 30, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R.2

SGS Minerals Sample ID: 491-1588248-001

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	18.03	
Sulfur %	ASTM D4239 (A)	0.73	0.89
Gross Calorific Value Btu/lb	ASTM D5865		<100

Vanessa Chambliss

Vanessa Chambliss
Branch Manager

SGS North America Inc. | Minerals Services Division
16130 Van Drunen Road South Holland IL 60473 t (708) 331-2900 f (708) 333-3060 www.sgs.com/minerals

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Analysis Report

October 14, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.2 Run 2	Sample ID By:	Covanta
Date Sampled:	Sep 28, 2015	Sample Taken At:	Submitted
Date Received:	Sep 30, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R.2

SGS Minerals Sample ID: 491-1588248-002

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	18.01	
Sulfur %	ASTM D4239 (A)	0.73	0.89
Gross Calorific Value Btu/lb	ASTM D5865		<100

Vanessa Chambliss
Branch Manager

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SGS

Analysis Report

October 14, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.2 Run 3	Sample ID By:	Covanta
Date Sampled:	Sep 28, 2015	Sample Taken At:	Submitted
Date Received:	Sep 30, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R.2

SGS Minerals Sample ID: 491-1588248-003

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	18.02	
Sulfur %	ASTM D4239 (A)	0.72	0.87
Gross Calorific Value Btu/lb	ASTM D5865		<100

Vanessa Chambliss

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Branch Manager

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TABLE 1

PERTINENT TEST DATA

Test Name: Energy Recovery 3

Test Date: 9/29/2015 09:00 - 17:00

Test Start: Test End:

	Item		Units	Unit 1	Unit 2	Average or Wtd. Avg. or Total	Measurement Source
1	Test duration		hours	8.0	8.0	8.00	----
2	Refuse feed rate		kg/hr	8,754	8,496	17,251	Crane Weigh Cell+End Time Adj.
3	Total FW/Steam flow		kg/hr	-		-	Station Instrument
4	Main steam flow		kg/hr	35,160	35,046	70,206	Station Instrument
5	Feedwater flow		kg/hr	35,120	34,932	70,052	Station Instrument
6	Suphtr. stm temperature		°C	500.9	500.1	500.5	Station Instrument
7	Suphtr. stm pressure		barg	88.4	88.4	88.4	Station Instrument
8	Feedwater temperature		°C	136.2	135.7	135.9	Station Instrument
9	Feedwater pressure		barg	101.3	101.6	101.4	Station Instrument
10	Continuous blowdown rate		kg/hr	0	0	0	Verify Valve Closed
11	Boiler drum pressure		barg	96.5	96.3	96.4	Station Instrument
12	Inlet air dry bulb temp.		°C	-	-	25.7	Digital Psychrometer
12A	Relative humidity %		%	-	-	70.5	Digital Psychrometer
13	Inlet air wet bulb temp.		°C	-	-	21.7	Calculated
14	Total air flow - Ref. Cond.		Rm^3/h	44,559	45,883	90,442	Station Instrument
15	Overfire air flow - Ref. Cond.		Rm^3/h	7,526	6,110	13,636	Station Instrument
16	Seal air flow - Ref. Cond.		Rm^3/h	1,705	1,506	3,211	Station Instrument
17	Overfire air pressure		mbar	46.0	45.9	46.0	Station Instrument
18	OFA and Seal air temp after fan		°C	35.9	35.8	35.9	Test T/C, wtd. avg.
19	Heated underfire air temperature		°C	124.8	122.5	123.6	Test T/C Grid wtd avg.
20	Barometric pressure		mbara	- -		999.5	Barometer
21	Moisture in combustion air		kg/kg dry ai			0.0149	Calculated
22	CO_2 in dry flue gas		% vol	11.655	10.648	11.15	Manually @ Econ. Outlet
23	O_2 in dry flue gas		% vol	7.441	8.958	8.20	Manually @ Econ. Outlet
24	N_2 in dry flue gas		% vol	80.904	80.394	80.65	Calculated
25	H_2O in flue gas		% vol	16.115	15.468	15.79	Manually @ Econ. Outlet
26	Flue gas flow		act m^3/h	95,234	94,245	189,480	Manually @ Econ. Outlet
27	Economizer exit gas temp.		°C	164.9	165.5	165.2	Station Instrument
28	Sampling point gas temp.		°C	166.8	165.7	166.3	Manually @ Econ. Outlet
	Residue:						
	Sample (Bottom Ash)						
29	Fines (-2")		kg			943	Manual Residue Sampling
30	Overs (+2")		kg			45	Manual Residue Sampling
	Total Flow						
31	Grizzly Rejects		kg		0	0	Combined with Ferrous
32	Ferrous		kg		2.547%	3,514	Ratio from 5-Day Test
33	Non-Ferrous		kg		0.362%	500	Ratio from 5-Day Test
34	Bottom Ash		kg		20.892%	28,832	Ratio from 5-Day Test
35	Fly Ash	**10.00%**	kg		2.089%	2,883	Calculated from assumed %
36	Moisture in -2" bottom ash bottom ash		%			17.4	Laboratory Analysis
37	Combustibles in -2" bottom ash		dry %			0.42	Laboratory Analysis
38	Moisture in flyash leaving test boundary		%			0.0	Assumed zero %
39	Combustibles in flyash		dry %			0.42	Assumed same % as BA
40	Ash discharger water bath temp		°C	43.1	53.7	48.4	Test Thermocouples
41	Turbine Gross MW		MWG			16.85	Station Instrument
42	Net MW Exported		MWN			14.62	Station Instrument
43	Turbine Exhaust Pressure		bara			0.108	Station Instrument (Exh. Temp)
44	ACC Ambient Air Temperature		°C			20.2	Station Instrument
45	Annual average dry bulb temp.		°C	-		8.0	Historical weather data
****	**********	**********	**********	**********	1	**********	**********

AS TESTED PERFORMANCE PARAMETERS

TABLE 2

RESIDUE ANALYSIS

Sample Weights	Bottom Ash kg	Bottom Ash %
+2" to -8" Material	45	4.5
-2" Material +	943	+ 95.5
-8" Material	988	100.0

Total Weights			Bottom Ash (kg)	Flyash (kg)
	Bottom & Fly Ash (Excluding +8" Grizzly Material & All Metals)		28,832	2,883
-2" Ash	-2" Wet Bottom Ash @	95.5%	27,535	
	Moisture of wet bottom as	17.4%	4,791.0	
	Dry Aggregate (by difference)		22,744	2,883
	Combustibles of dry aggre	0.42%	95	12
	Dry Ash (by difference)		22,649	2,871
	Total +2" to (-8")	4.5%	1,297	
	+8" Grizzly Material, Ferrous & Non-Ferrous Metals (metals and inerts)		4,015	

Component Weights	Bottom Ash kg	Bottom Ash (1) kg/h	Bottom Ash (2) %	Bottom Ash (3) kg/kg fuel	Fly Ash kg	Fly Ash (1) kg/h	Fly Ash (2) %	Fly Ash (3) kg/kg fuel
Dry Ash + Inerts:								
-2" Ash	22,649	2,831			2,871	359		
+2" to (-8")	1,297	162						
+8" Grizzly, Ferrous & Non-Fe	4,015	502						
Subtotal	27,961	3,495	90.37	0.2026	2,871	359	9.28	0.0208
Unburned Combustible								
-2" Combustible	95	11.9			12	1.5		
+2" to (-8") Combustible	0	0			0	0		
Subtotal	95	11.9	0.31	0.0007	12	1.5	0.04	0.0001
Total Dry Residue :	**28,056**	**3,507.0**	**90.7**	**0.203**	**2,883**	**360**	**9.3**	**0.021**

Notes:
(1) Divisor is 8 hours
(2) % of Total Dry Residue (excluding Carbon Injection)
(3) Divisor is 17,251 kg/hr of refuse

TABLE 3

FLUE GAS FLOW & ANALYSIS
(Based on Average Data for Test Runs @ Econ. Exit)

	% VOL (DRY)	% VOL (WET)	M.W. kg/kg-mol	R.W. (DRY)	R.W. (WET)	% WT (DRY)	% WT (WET)	KG/HR
CO2	11.655	9.777	44.010	5.129	4.303	17.00	15.25	22,610
O2	7.441	6.242	32.000	2.381	1.997	7.89	7.08	10,494
N2	80.904	67.866	28.016	22.666	19.013	75.11	67.38	99,906
H2O		16.115	18.016	0.000	2.903	0.00	10.29	15,253
Totals	100.0	100.00		30.176	28.216	100.0	100.0	148,263

From flue gas report, average flow = 189,480 a m3/hr
Gas temperature @ sampling point = 166.27007 °C

Specific volume = $\frac{8.314 \times (273.15 + 166.27007 \text{ °F})}{28.216 \times (1.013 \text{ bara}) \times (\text{cm2/m2})}$ = 1.278 m3/kg

Wet gas mass flow = 189,480 / 1.278 = 148,263 kg/hr 138.3%

Percent excess air = $\frac{(O2 - CO/2) \times 100}{0.2682 \times N2 - (O2 - CO/2)}$ = 52.19 %

(per ASME PTC 19.10 Flue and Exhaust Gas Analysis, Section 6.03.6.3.1)

		deg C	deg Kelvin	deg F
Enthalpies From PTC-4, 5.19.4 & 5.19.11	Flue Gas Temp @ econ out	165.2	438.4	329.4

	Flue Gas @ Economizer Outlet		
	Enth. (H) (kJ/kg)	R.H. (WET)	R.H. (DRY)
CO2	127.60	19.46	21.69
O2	130.97	9.27	10.33
N2	145.01	97.71	108.92
H2O	265.21	27.29	0.00
Totals		153.73	140.94

********** ********** ********** ********** ********** 3 ********** ********** ********** **********

Total Measured Air Flow

Average compensated total wet air flow in Reference m^3/hr (25 °C) is taken from Table 1.

Total Wet Air Flow = 90,442 m^3/hr at 25 °C reference temperature
(Compensated)

$$\text{Specific Volume of Dry Air} = \frac{(25.00 + 273.15) \times 8.314}{1.000 \times 28.97} = 0.8561 \text{ } m^3/kg$$

$$\text{Dry Air Density} = \frac{1}{0.8561} = 1.1681 \text{ } kg/m^3$$

Wet Air Density = 1.0149 kg wet air/kg dry air x 1.1681 kg dry air/m^3 = 1.1855 kg wet air/m^3

Total Measured Wet Air 90,442 m^3/h x 1.1855 kg wet air/m^3

= **107,220** kg/hr

Moisture in Total Measure Air = (0.0149 x 107,220) / (1 + 0.0149) = **1,576.1** kg/hr

Overfire Air and Seal Air Flow

Average compensated wet overfire air flow & seal air flow in Reference m^3/hr (25 °C) is taken from Table 1.

Wet Overfire Air Flow = 13,636 m^3/hr at 25 °C temperature & 1.013 bara
Wet Seal Air Flow = 3,211 m^3/hr at 25 °C temperature & 1.013 bara
Combined OFA & Seal Air Flow = 13,636 + 3,211 = 16,847 Ref. m^3/hr

$$\text{Specific Volume of Dry Air} = \frac{(25.0 + 273.15) \times 8.314}{1.000 \times 28.97} = 0.8561 \text{ } m^3/kg$$

$$\text{Dry Air Density} = \frac{1}{0.8561} = 1.1681 \text{ } kg/m^3$$

Wet Air Density = 1.0149 kg wet air/kg dry air x 1.1681 kg dry air/m^3 = 1.1855 kg wet air/m^3

OFA & Seal Air (Wet) = 16,847 m^3/h x 1.1855 kg wet air/m^3

= **19,972** kg/hr

Moisture in OFA & Seal Air = (0.0149 x 19,972) / (1 + 0.0149) = **293.6** kg/hr

Wet Underfire Air =
Total Wet Air - Wet OFA & Seal Air = 107,220 - 19,972 = **87,248** kg/hr
Moisture in Underfire air =
Total Air H_2O - OF & Seal Air H_2O = 1,576.1 - 293.6 = **1,282.5** kg/hr

(Continued from Page 4)

Assume ref. waste N2 content of test fuel = 0.87 %
Therefore, N2 in flue gas from fuel =

17,251 kg fuel/hr x 0.0087 kg N2/kg fuel = 150 kg/hr

N2 in flue gas = 99,906 kg/hr

Total dry comb. air supplied = $\frac{99{,}906 - 150}{0.7685}$ = **129,806** kg/hr
(Incl. Air Infiltration)

Moisture in air = 0.0149 kg/kg dry air from psychrometric chart for
25.70 °C db / 21.72 °C wb, therefore

Moisture in Calculated Total Air = 0.0149 x 129,806 = **1,936.5** kg/hr

Total Calculated wet air = 129,806 + 1936.5 = **131,743** kg/hr
(Including Air Infiltration & VLN cooling air)

Total Calculated Wet Air (including air infiltration & VLN cooling air) is greater than Total Measured Wet Air
Wet Air Infiltration (incl. VLN cooling air) = Calculated Total Wet Air - Measured Total Wet Air
= 131,743 - 107,220
= 24,523 kg/hr

Wet Un-heated Air = Total Wet Air - Wet UFA
= 131,743 - 87,248
= 44,495 kg/hr

Moisture in Wet Air Infiltration (incl. VLN cooling air) = Total Air Moisture - Moisture in Measured Total Ai
= 1,936.5 - 1,576.1
= 360.4 kg/hr

********** ********** ********** ********** ********** 5 ********** ********** **********

Calculated moisture in Flue Gas from H2 and H2O in fuel and Ash Discharger Quench Water Vapor:

A water balance around the boiler gives:

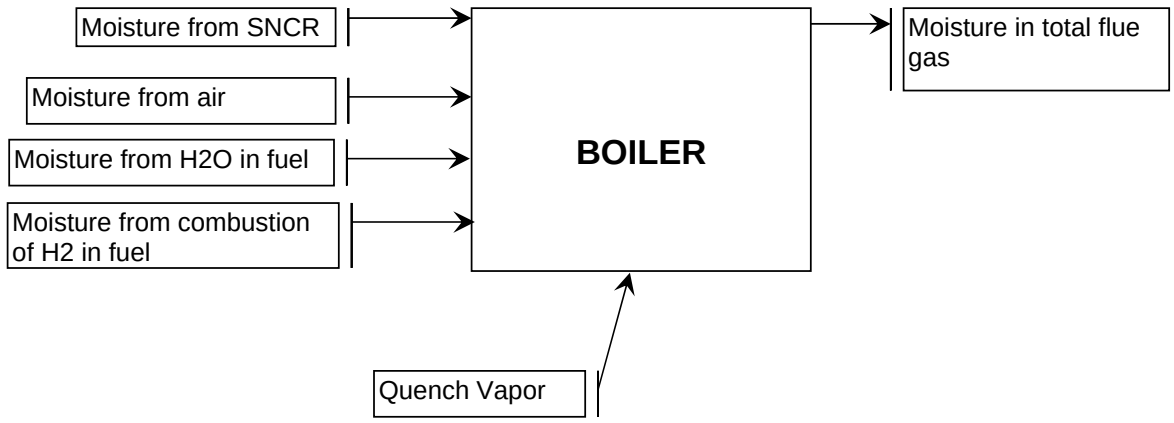
Vapor in flue gas = moisture from H2 and H20 in the fuel + moisture in air + quench vapor + SNCR & carrier water

Therefore:

Moisture from H2 and H2O in fuel + quench vapor + SNCR & carrier water = Vapor in gas - moisture in air

= 15,253 - 1,936.5

= 13,317 kg/hr = 0.772 kg/kg FUEL



DATA FOR HEAT OUTPUT AND LOSS CALCULATIONS

Enthalpy of feedwater @	135.93728	°C,	10245.99	kPa	578.37 kJ/kg
Enthalpy of drum water @ saturated pressure			9742.23	kPa	1396.66 kJ/kg
Enthalpy of steam @	500.48251	°C,	8942.93	kPa	3389.22 kJ/kg
Enthalpy of dry underfire air at 123.6°C comb. temp. referenced to 25°C					99.49 kJ/kg
Enthalpy of dry overfire air at 35.9°C air temp. referenced to 25°C					10.91 kJ/kg
Enthalpy of dry flue gas at 165.2°C econ exit temp. referenced to 25°C					140.94 kJ/kg
Enthalpy of liquid water @ the amb. air temperature of 25.7°C ref. 0°C					107.61 kJ/kg
Enthalpy of water vapor @ UFA temp. of 123.6°C ref. 25°C					185.60 kJ/kg
Enthalpy of water vapor @ the OFA temp. aft. fan of 35.9°C ref. 25°C					20.19 kJ/kg
Enthalpy of steam vapor @ 165.2°C and 1 psia referenced to 0°C					2812.41 kJ/kg
Enthalpy of liquid water @ reference temperature of 25°C ref. 0°C					104.67 kJ/kg
Enthalpy of water vapor @ econ exit temp. of 165.2°C referenced to 25°C					265.2 kJ/kg
Enthalpy of ash discharger water bath @ 48.4°C					202.7 kJ/kg
Enthalpy of dry residue @ air inlet temp of 25.7°C			298.9	°K	0.514 kJ/kg
Enthalpy of dry residue @ ash discharger temp of 48.4°C or			321.6	°K	18.037 kJ/kg
Enthalpy of dry fly ash @ econ. exit temp. of 165.2°C or			438.4	°K	119.437 kJ/kg
HHV of unburned combustibles					27,913 kJ/kg
Radiation & convection loss per ASME PTC 34, Fig. I-1					
with 98.5 GJ/hr actual average heat output per boiler, 2 boilers =					1.522 GJ/hr
Enthalpy of dry fuel @ ambient temp. of 25.7°C ref. 25°C					0.526 kJ/kg
Enthalpy of liquid water @ ambient temp. of 25.7°C ref. 25°C					2.9 kJ/kg

Reference documents:

ASME Performance Test Code for Fired Steam Generators, ASME PTC 4
ASME Performance Test Code for Waste Combustor with Energy Recovery, ASME PTC 34
ASME Steam Tables 1967 Edition

Table 4 - Reference Composition Acceptable Waste

Energy Content 13,000 kJ (HHV) per kilogram

REFERENCE WASTE ULTIMATE ANALYSIS

	%
Moisture	15.16
Total Inert	15.92
Carbon	31.73
Hydrogen	4.56
Oxygen	31.35
Nitrogen	0.87
Sulfur	0.04
Chlorine	0.31
Flourine	0.030
Iron, oxidizable	0.030
	100.00

BOILER EFFICIENCY CALCULATION
AS TESTED CONDITIONS
-HEAT LOSS METHOD-
(ASME PTC 34, SECTION 5.11)

kJoule per kg A.F. Fuel

HEAT OUTPUT due to-

Steam:
(kg/hr of fluid)/(kg/hr fuel) x (h out - h in, kJ/kg)
70,052 / 17,251 x (3,389.22 - 578.37) = 11,414.32

Blowdown:
(kg/hr of fluid)/(kg/hr fuel) x (h out - h in, kJ/kg)
- / 17,251 x (1,396.66 - 578.37) 0.00

Total Heat Output: = 11,414.32

HEAT LOSSES due to-

Dry gas:
(kg/hr dry gas)/(kg/hr fuel) x (flue gas h @ Tgas econ exit ref. 25°C, kJ/kg)
133,010 / 17,251 x (140.94) = 1086.71

Moisture from H2 and H2O in fuel, ash discharger quench water vapor and SNCR carrier water:
(kg/hr moisture)/(kg/hr fuel) x (h econ gas exit @ 1 psia - h liquid @ T = 25°C, kJ/kg)
13,317 / 17,251 x (2812.41 - 104.67) = 2090.24

Ash discharger quench water:
Liquid: (kg/hr liquid)/(kg/hr fuel) x (h water @ Tquench - h water @ Tamb air, kJ/kg)
599 / 17,251 x (202.70 - 107.61) = 3.30

Sensible heat in dry bottom residue:
(kg/hr dry residue)/(kg/hr fuel) x (h res @ Tquench - h res @Tamb air, kJ/kg)
3,507 / 17,251 x (18.037 - 0.514) = 3.56

Sensible heat in dry fly ash residue:
(kg/hr dry residue)/(kg/hr fuel) x (h res @ Tecon exit - h res @Tamb air, kJ/kg)
360 / 17,251 x (119.437 - 0.514) = 2.48

Moisture from total air:
(kg/hr air moisture)/(kg/hr fuel) x (h water vap @ Tgas econ exit ref. 25°C, kJ/kg)
1,937 / 17,251 x (265.2) = 29.77

Unburned combustibles:
(lb unburned combustibles/hr)/(kg/hr fuel) x HHV unburned
13.40 / 17,251 x 27,913 = 21.68

Radiation & Convection Loss:
Per ASME PTC 34, Fig. I-1 = 1.522 GJ/hr
1,522,178 / 17,251 = 88.24

Unaccounted for:
0.5 % of heat output and losses (heat input) = 74.07
0.005 x (11,414.3 + 3,400.1)

Total Heat Losses: = 3400.05

HEAT CREDITS due to-

kJoule per kg A.F. Fuel

Dry underfire air sensible heat:
(kg/hr dry air)/(kg/hr fuel) x (h in @ 123.6°C ref. 25°C, kJ/kg)
85,966 / 17,251 x (99.49) = 495.77

Dry overfire air, seal air & air infiltration sensible heat:
(kg/hr dry air)/(kg/hr fuel) x (h in @ 35.9°C ref. 25°C, kJ/kg)
43,841 / 17,251 x (10.91) = 27.72

Moisture in incoming underfire air:
(kg/hr moisture)/(kg/hr fuel) x (h vap in @ 123.6°C ref 25°C, kJ/kg)
1,282.5 / 17,251 x (185.60) = 13.80

Moisture in incoming overfire, seal air & air infiltration:
(kg/hr moisture)/(kg/hr fuel) x (h vap in @ 35.9°C ref 25°C, kJ/kg)
654.0 / 17,251 x (20.19) = 0.77

Fuel sensible heat:
(dry fuel, lb dry fuel/lb fuel) x (h in @ ambient air temp of 25.7°C ref 25°C, kJ/kg) +
(moisture in fuel, lb H2O/lb fuel) x (h in @ ambient air temp of 25.7°C ref 25°C, kJ/kg)
0.848 x 0.526 + 0.152 x 2.93 = 0.89

Total Heat Credits: 538.95

Gross Heat Input = HHV of Fuel + Heat Credit = Heat Output + Heat Losses

or

HHV of FUEL = Heat Output + Heat Losses - Heat Credit
= 11414.32 + 3400.05 - 538.95
= **14,275** kJ/kg

EFFICIENCY= (1 - (Heat Losses/Heat Input))*100= (1 - 3400.05 / 14,814) x 100 = **77.05** %

Gross Heat Input = 14,814 kJ/kg

HEAT LOSS SUMMARY:

	%
Dry gas:	7.34
Moisture from H2 and H2O in fuel, ash discharger quench water vapor & SNCR:	14.11
Moisture from total air:	0.20
Ash discharger quench water: Liquid:	0.02
Sensible heat in dry bottom residue:	0.02
Sensible heat in dry fly ash:	0.02
Unburned combustibles:	0.15
Radiation/Correction:	0.60
Unaccounted for:	0.50
Total Heat Losses:	22.95

Adjustment For Annual Average Dry Bulb Temperature

Turbine performance is dependent upon exhaust vacuum, which is dependent upon air-cooled condenser (ACC) performance. ACC performance is dependent upon the dry bulb ambient air temperature. An adjustment is made to the as-tested ACC performance for the difference between the average annual dry bulb temperature and the as-tested dry bulb temperature. Per average local weather conditions: (see Procedures page 10)

The average annual dry bulb temperature = 8 °C

Air-Cooled Condenser Performance:

The as-tested ACC ambient dry bulb temperature was: **20.2** °C
Per the ACC performance curve, (see Figures section) the condenser vacuum corresponding to the as-tested dry bulb temperature of 20.2 °C is: 110.3 mbara
Per the ACC performance curve, the condenser vacuum corresponding to the average annual dry bulb temperature of 8 °C is: 68.0 mbara
Therefore, the correction to exhaust pressure for temperature difference is 42.3 mbar

Turbine Performance:

Per the curve defining change in exhaust pressure vs. change in turbine-generator output (see page 12 of procedures), a 42.3 mbar change in exhaust pressure at design throttle flow results in a 2.51% change in turbine heat rate. Therefore, the overall adjusted gross electrical output is :

16.85 * (1 + 0.0251) = 17.27 **MWG**

The MW correction is also added to the as-tested NET electrical exported:

14.62 + 17.27 - 16.85 = 15.04 **MWN**

See SAMPLE CALCULATION CURVES at the end of these procedures.

Adjusted Power Outputs Per Ton:

Gross Electrical Output = 17,274 kW adjusted for annual average dry bulb temperature. / 17.251 Actual TPH = 1001 kWh/tonne

Compared to the guarantee of 971 kWh/tonne at the same HHV.

Surpassing the guarantee by: 30 kWh/tonne
or 3.1%

Net Electrical Export = 15,043 kW adjusted for annual average dry bulb temperature. / 17.251 Actual TPH = 872 kWh/tonne

Compared to the guarantee of 860 kWh/tonne at the same HHV.

Surpassing the guarantee by: 12 kWh/tonne
or 1.4%

Crane Calibration Drift Adjustment Calculation Energy Recovery 3

Reference Weight (Reference Block Weight)	**3,926**	kg			
Initial Span Check Reading	3,886.7	@	9/29/2015 7:27		
Final Span Check Reading	3,905.0	@	9/29/2015 17:31		
Average of the Initial and Final Span Checks	**3,896**	kg			
Difference between Average and Reference Weight	**-30**	kg	>	45.4	kg

Adjustment to each grapple feed is warranted.

	138,260						**Adjustment Factor 1.003333814**		138,721
Feed at	**Feed Weight Reading (kg)**	**Ref. Weight (Drifted, by Equation)**	**Difference (Drift)**	**% Difference (% Drift)**		**Feed Weight % of Ref. Drifted Weight**	**Proportioned Drift (%)**	**Feed Weight Drifted**	**Adjusted Feed Weight (kg)**
9/29/15 9:05	2,177.0	3,889.8	-36.2	-0.92%		55.97%	-0.52%	-11.23	**2,188.23**
9/29/15 9:12	2,812.0	3,890.0	-36.0	-0.92%		72.29%	-0.66%	-18.62	**2,830.62**
9/29/15 9:17	1,926.0	3,890.2	-35.8	-0.91%		49.51%	-0.45%	-8.70	**1,934.70**
9/29/15 9:31	1,840.0	3,890.6	-35.4	-0.90%		47.29%	-0.43%	-7.84	**1,847.84**
9/29/15 9:35	2,722.0	3,890.7	-35.3	-0.90%		69.96%	-0.63%	-17.11	**2,739.11**
9/29/15 9:45	2,254.0	3,891.1	-34.9	-0.89%		57.93%	-0.52%	-11.62	**2,265.62**
9/29/15 9:52	1,292.0	3,891.3	-34.7	-0.88%		33.20%	-0.29%	-3.79	**1,295.79**
9/29/15 10:01	1,883.0	3,891.6	-34.4	-0.88%		48.39%	-0.42%	-7.99	**1,890.99**
9/29/15 10:09	816.0	3,891.8	-34.2	-0.87%		20.97%	-0.18%	-1.49	**817.49**
9/29/15 10:15	446.0	3,892.0	-34.0	-0.87%		11.46%	-0.10%	-0.44	**446.44**
9/29/15 10:18	842.0	3,892.1	-33.9	-0.86%		21.63%	-0.19%	-1.57	**843.57**
9/29/15 10:24	721.0	3,892.3	-33.7	-0.86%		18.52%	-0.16%	-1.15	**722.15**
9/29/15 10:26	899.0	3,892.3	-33.7	-0.86%		23.10%	-0.20%	-1.78	**900.78**
9/29/15 10:28	453.0	3,892.4	-33.6	-0.86%		11.64%	-0.10%	-0.45	**453.45**
9/29/15 10:30	915.0	3,892.5	-33.5	-0.85%		23.51%	-0.20%	-1.84	**916.84**
9/29/15 10:32	725.0	3,892.5	-33.5	-0.85%		18.63%	-0.16%	-1.15	**726.15**
9/29/15 10:36	610.0	3,892.7	-33.3	-0.85%		15.67%	-0.13%	-0.81	**610.81**
9/29/15 10:39	1,777.0	3,892.8	-33.2	-0.85%		45.65%	-0.39%	-6.87	**1,783.87**
9/29/15 10:41	1,311.0	3,892.8	-33.2	-0.84%		33.68%	-0.28%	-3.73	**1,314.73**
9/29/15 10:49	996.0	3,893.1	-32.9	-0.84%		25.58%	-0.21%	-2.14	**998.14**
9/29/15 10:51	1,340.0	3,893.1	-32.9	-0.84%		34.42%	-0.29%	-3.86	**1,343.86**
9/29/15 10:56	1,370.0	3,893.3	-32.7	-0.83%		35.19%	-0.29%	-4.02	**1,374.02**
9/29/15 11:02	1,106.0	3,893.5	-32.5	-0.83%		28.41%	-0.24%	-2.60	**1,108.60**
9/29/15 11:04	2,410.0	3,893.6	-32.4	-0.83%		61.90%	-0.51%	-12.33	**2,422.33**
9/29/15 11:11	1,637.0	3,893.8	-32.2	-0.82%		42.04%	-0.35%	-5.65	**1,642.65**
9/29/15 11:12	1,560.0	3,893.8	-32.2	-0.82%		40.06%	-0.33%	-5.12	**1,565.12**
9/29/15 11:14	1,241.0	3,893.9	-32.1	-0.82%		31.87%	-0.26%	-3.24	**1,244.24**
9/29/15 11:16	1,919.0	3,893.9	-32.1	-0.82%		49.28%	-0.40%	-7.72	**1,926.72**
9/29/15 11:22	1,764.0	3,894.1	-31.9	-0.81%		45.30%	-0.37%	-6.49	**1,770.49**
9/29/15 11:27	516.0	3,894.3	-31.7	-0.81%		13.25%	-0.11%	-0.55	**516.55**
9/29/15 11:30	859.0	3,894.4	-31.6	-0.81%		22.06%	-0.18%	-1.53	**860.53**
9/29/15 11:33	13.0	3,894.5	-31.5	-0.80%		0.33%	0.00%	0.00	**13.00**
9/29/15 11:38	1,027.0	3,894.6	-31.4	-0.80%		26.37%	-0.21%	-2.16	**1,029.16**
9/29/15 11:40	899.0	3,894.7	-31.3	-0.80%		23.08%	-0.18%	-1.66	**900.66**
9/29/15 11:44	1,227.0	3,894.8	-31.2	-0.79%		31.50%	-0.25%	-3.07	**1,230.07**
9/29/15 11:50	750.0	3,895.0	-31.0	-0.79%		19.26%	-0.15%	-1.14	**751.14**
9/29/15 11:52	1,247.0	3,895.1	-30.9	-0.79%		32.01%	-0.25%	-3.15	**1,250.15**
9/29/15 11:54	707.0	3,895.1	-30.9	-0.79%		18.15%	-0.14%	-1.01	**708.01**
9/29/15 11:56	1,390.0	3,895.2	-30.8	-0.78%		35.68%	-0.28%	-3.89	**1,393.89**
9/29/15 11:59	1,070.0	3,895.3	-30.7	-0.78%		27.47%	-0.21%	-2.30	**1,072.30**
9/29/15 12:02	1,481.0	3,895.4	-30.6	-0.78%		38.02%	-0.30%	-4.39	**1,485.39**
9/29/15 12:05	1,656.0	3,895.5	-30.5	-0.78%		42.51%	-0.33%	-5.47	**1,661.47**
9/29/15 12:07	1,423.0	3,895.5	-30.5	-0.78%		36.53%	-0.28%	-4.03	**1,427.03**
9/29/15 12:15	-28.0	3,895.8	-30.2	-0.77%		-0.72%	0.01%	0.00	**-28.00**
9/29/15 12:17	912.0	3,895.8	-30.2	-0.77%		23.41%	-0.18%	-1.64	**913.64**
9/29/15 12:19	1,107.0	3,895.9	-30.1	-0.77%		28.41%	-0.22%	-2.41	**1,109.41**
9/29/15 12:27	1,222.0	3,896.2	-29.8	-0.76%		31.36%	-0.24%	-2.91	**1,224.91**
9/29/15 12:31	1,687.0	3,896.3	-29.7	-0.76%		43.30%	-0.33%	-5.52	**1,692.52**
9/29/15 12:43	883.0	3,896.7	-29.3	-0.75%		22.66%	-0.17%	-1.50	**884.50**
9/29/15 12:46	1,260.0	3,896.8	-29.2	-0.74%		32.33%	-0.24%	-3.03	**1,263.03**
9/29/15 12:49	1,533.0	3,896.9	-29.1	-0.74%		39.34%	-0.29%	-4.48	**1,537.48**
9/29/15 12:51	655.0	3,896.9	-29.1	-0.74%		16.81%	-0.12%	-0.82	**655.82**
9/29/15 12:54	1,229.0	3,897.0	-29.0	-0.74%		31.54%	-0.23%	-2.86	**1,231.86**
9/29/15 12:58	710.0	3,897.1	-28.9	-0.74%		18.22%	-0.13%	-0.95	**710.95**
9/29/15 13:00	1,231.0	3,897.2	-28.8	-0.73%		31.59%	-0.23%	-2.85	**1,233.85**
9/29/15 13:01	1,288.0	3,897.3	-28.7	-0.73%		33.05%	-0.24%	-3.12	**1,291.12**
9/29/15 13:16	2,492.0	3,897.7	-28.3	-0.72%		63.94%	-0.46%	-11.48	**2,503.48**
9/29/15 13:18	2,384.0	3,897.8	-28.2	-0.72%		61.16%	-0.44%	-10.49	**2,394.49**
9/29/15 13:22	2,656.0	3,897.9	-28.1	-0.72%		68.14%	-0.49%	-12.95	**2,668.95**
9/29/15 13:29	2,309.0	3,898.1	-27.9	-0.71%		59.23%	-0.42%	-9.71	**2,318.71**
9/29/15 13:36	1,963.0	3,898.3	-27.7	-0.70%		50.35%	-0.35%	-6.97	**1,969.97**
9/29/15 13:42	2,063.0	3,898.5	-27.5	-0.70%		52.92%	-0.37%	-7.64	**2,070.64**
9/29/15 13:49	2,048.0	3,898.8	-27.2	-0.69%		52.53%	-0.36%	-7.46	**2,055.46**
9/29/15 13:57	2,127.0	3,899.0	-27.0	-0.69%		54.55%	-0.38%	-7.98	**2,134.98**
9/29/15 14:04	1,612.0	3,899.2	-26.8	-0.68%		41.34%	-0.28%	-4.54	**1,616.54**
9/29/15 14:13	1,850.0	3,899.5	-26.5	-0.67%		47.44%	-0.32%	-5.92	**1,855.92**
9/29/15 14:19	1,744.0	3,899.7	-26.3	-0.67%		44.72%	-0.30%	-5.23	**1,749.23**
9/29/15 14:28	2,016.0	3,900.0	-26.0	-0.66%		51.69%	-0.34%	-6.91	**2,022.91**
9/29/15 14:39	1,995.0	3,900.3	-25.7	-0.65%		51.15%	-0.33%	-6.67	**2,001.67**
9/29/15 14:45	2,111.0	3,900.5	-25.5	-0.65%		54.12%	-0.35%	-7.41	**2,118.41**
9/29/15 14:55	1,880.0	3,900.8	-25.2	-0.64%		48.20%	-0.31%	-5.81	**1,885.81**
9/29/15 14:56	1,059.0	3,900.9	-25.1	-0.64%		27.15%	-0.17%	-1.84	**1,060.84**
9/29/15 15:01	1,902.0	3,901.0	-25.0	-0.64%		48.76%	-0.31%	-5.90	**1,907.90**
9/29/15 15:11	2,196.0	3,901.3	-24.7	-0.63%		56.29%	-0.35%	-7.77	**2,203.77**
9/29/15 15:14	2,029.0	3,901.4	-24.6	-0.63%		52.01%	-0.33%	-6.61	**2,035.61**
9/29/15 15:21	2,276.0	3,901.7	-24.3	-0.62%		58.33%	-0.36%	-8.23	**2,284.23**
9/29/15 15:25	2,020.0	3,901.8	-24.2	-0.62%		51.77%	-0.32%	-6.45	**2,026.45**
9/29/15 15:35	2,129.0	3,902.1	-23.9	-0.61%		54.56%	-0.33%	-7.07	**2,136.07**
9/29/15 15:37	1,808.0	3,902.2	-23.8	-0.61%		46.33%	-0.28%	-5.09	**1,813.09**
9/29/15 15:48	2,542.0	3,902.5	-23.5	-0.60%		65.14%	-0.39%	-9.92	**2,551.92**
9/29/15 15:51	2,013.0	3,902.6	-23.4	-0.60%		51.58%	-0.31%	-6.19	**2,019.19**
9/29/15 16:00	2,036.0	3,902.9	-23.1	-0.59%		52.17%	-0.31%	-6.25	**2,042.25**
9/29/15 16:09	2,704.0	3,903.2	-22.8	-0.58%		69.28%	-0.40%	-10.90	**2,714.90**
9/29/15 16:14	2,094.0	3,903.3	-22.7	-0.58%		53.65%	-0.31%	-6.49	**2,100.49**
9/29/15 16:22	1,596.0	3,903.6	-22.4	-0.57%		40.89%	-0.23%	-3.73	**1,599.73**
9/29/15 16:26	2,131.0	3,903.7	-22.3	-0.57%		54.59%	-0.31%	-6.61	**2,137.61**
9/29/15 16:33	2,320.0	3,903.9	-22.1	-0.56%		59.43%	-0.33%	-7.76	**2,327.76**
9/29/15 16:41	1,639.0	3,904.2	-21.8	-0.56%		41.98%	-0.23%	-3.83	**1,642.83**
9/29/15 16:49	1,816.0	3,904.4	-21.6	-0.55%		46.51%	-0.26%	-4.64	**1,820.64**
9/29/15 16:57	484.0	3,904.7	-21.3	-0.54%		12.40%	-0.07%	-0.33	**484.33**
9/29/15 16:59	498.0	3,904.7	-21.3	-0.54%		12.75%	-0.07%	-0.34	**498.34**

Covanta - Durham York Energy Centre
Boiler No. 1 Scrubber Inlet
Stack Gas Physical Parameters and Volumetric Flowrates
September 29, 2015

Test No.	Test Time	Gas Temp.	Moisture by Volume	Gas Velocity	Static Pressure	Barometric Pressure	Absolute Pressure	Carbon Dioxide by Volume	Oxygen by Volume	Carbon Monoxide By Volume	Actual Flowrate	Dry Reference Flowrate	Wet Reference Flowrate
		°C	%	m/s	kPa	kPa	kPa	% *	% *	ppm*	m^3/s	Rm^3/s **	Rm^3/s**
1	9:43 - 9:48	168	17.1	18.9	-0.57	100.4	99.8	11.6	7.55	16.2	28.0	15.4	18.6
2	10:03 - 10:09	167	17.1	19.2	-0.50	100.4	99.9	11.8	7.19	9.7	28.3	15.7	18.9
3	10:33 - 10:40	168	17.1	19.1	-0.55	100.4	99.9	11.8	7.23	15.8	28.2	15.6	18.8
4	11:06 - 11:12	165	17.1	17.9	-0.50	100.4	99.9	11.5	7.80	24.4	26.4	14.7	17.8
5	12:09 - 12:15	168	16.3	18.0	-0.57	100.4	99.8	11.8	7.23	15.1	26.6	14.9	17.7
6	12:25 - 12:30	166	16.3	17.7	-0.60	100.4	99.8	11.4	7.81	19.1	26.2	14.7	17.5
7	12:48 - 12:54	166	16.3	17.9	-0.50	100.4	99.9	11.7	7.57	20.7	26.4	14.8	17.7
8	13:18 - 13:24	166	16.3	17.6	-0.55	100.4	99.9	11.5	7.63	40.4	26.0	14.6	17.4
9	14:07 - 14:13	166	14.5	17.6	-0.57	100.3	99.7	12.4	6.51	29.0	26.0	14.8	17.4
10	14:37 - 14:42	165	14.5	17.6	-0.52	100.3	99.8	11.4	7.77	24.4	26.0	14.9	17.4
11	15:08 - 15:15	166	14.5	16.5	-0.45	100.3	99.9	11.4	7.70	38.4	24.4	14.0	16.4
12	15:40 - 15:46	166	14.5	17.1	-0.52	100.3	99.8	11.7	7.42	30.7	25.3	14.5	16.9
13	16:36 - 16:41	169	16.5	18.2	-0.47	100.4	99.9	12.0	7.06	20.3	26.9	14.9	17.7
14	17:05 - 17:11	168	16.5	17.6	-0.55	100.4	99.9	11.0	8.22	14.2	26.1	14.5	17.4
15	17:33 - 17:38	168	16.5	17.8	-0.47	100.4	99.9	12.0	6.98	39.5	26.2	14.6	17.5
16	18:04 - 18:09	168	16.5	17.8	-0.55	100.4	99.9	11.7	7.39	18.1	26.4	14.7	17.6
Average		167	16.1	17.9	-0.53	100.4	99.8	11.7	7.44	23.5	26.5	14.8	17.7

* Dry basis

** Reference conditions; 25°C and 1 atm

Covanta - Durham York Energy Centre
Boiler No. 2 Scrubber Inlet
Stack Gas Physical Parameters and Volumetric Flowrates
September 29, 2015

Test No.	Test Time	Gas Temp.	Moisture by Volume	Gas Velocity	Static Pressure	Barometric Pressure	Absolute Pressure	Carbon Dioxide by Volume	Oxygen by Volume	Carbon Monoxide By Volume	Actual Flowrate	Dry Reference Flowrate	Wet Reference Flowrate
		°C	%	m/s	kPa	kPa	kPa	% *	% *	ppm*	m^3/s	Rm^3/s **	Rm^3/s**
1	9:14 - 9:33	165	16.2	17.8	-0.47	100.4	99.9	11.1	8.66	28.5	26.3	14.8	17.7
2	9:55 - 10:01	166	16.2	18.1	-0.52	100.4	99.9	11.6	7.93	10.5	26.7	15.0	17.9
3	10:25 - 10:32	164	16.2	18.0	-0.52	100.4	99.9	11.7	7.86	34.3	26.5	15.0	17.9
4	10:57 - 11:04	164	16.2	17.5	-0.52	100.4	99.9	11.6	8.12	26.8	25.8	14.6	17.4
5	11:41 - 11:48	164	15.3	17.5	-0.57	100.4	99.8	11.6	8.10	17.9	25.8	14.7	17.4
6	12:19 - 12:24	167	15.3	17.9	-0.60	100.4	99.8	11.6	7.94	17.4	26.5	15.0	17.7
7	12:41 - 12:47	166	15.3	17.9	-0.60	100.4	99.8	11.6	8.18	25.1	26.5	15.0	17.7
8	13:11 - 13:17	165	15.3	17.3	-0.45	100.4	100.0	11.3	8.18	17.8	25.5	14.5	17.1
9	14:00 - 14:06	165	14.7	17.3	-0.45	100.3	99.9	11.5	8.05	17.8	25.6	14.7	17.2
10	14:29 - 14:35	165	14.7	17.4	-0.50	100.3	99.8	11.7	7.89	16.1	25.7	14.7	17.2
11	15:02 - 15:07	166	14.7	17.4	-0.55	100.3	99.8	10.4	9.15	42.9	25.8	14.7	17.2
12	15:33 - 15:39	166	14.7	17.3	-0.52	100.3	99.8	7.24	12.7	25.9	25.6	14.6	17.1
13	16:28 - 16:35	167	15.7	18.0	-0.50	100.4	99.9	9.42	10.1	40.2	26.6	15.0	17.8
14	16:57 - 17:04	167	15.7	18.2	-0.47	100.4	99.9	9.42	10.1	40.2	26.8	15.1	17.9
15	17:26 - 17:32	167	15.7	17.7	-0.52	100.4	99.9	9.42	10.1	40.2	26.2	14.7	17.5
16	17:56 - 18:03	168	15.7	17.9	-0.50	100.4	99.9	9.42	10.1	40.2	26.5	14.9	17.7
Average		166	15.5	17.7	-0.52	100.4	99.9	10.7	8.95	27.6	26.2	14.8	17.5

* Dry basis

** Reference conditions; 25°C and 1 atm

SGS

Analysis Report

October 14, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.3 Run 1	Sample ID By:	Covanta
Date Sampled:	Sep 29, 2015	Sample Taken At:	Submitted
Date Received:	Oct 1, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R.3

SGS Minerals Sample ID: 491-1588274-001

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	17.41	
Sulfur %	ASTM D4239 (A)	0.77	0.93
Gross Calorific Value Btu/lb	ASTM D5865		<100

Vanessa Chambliss
Branch Manager

SGS North America Inc. | Minerals Services Division
16130 Van Drunen Road South Holland IL 60473 t (708) 331-2900 f (708) 333-3060 www.sgs.com/minerals

Member of the SGS Group (Société Générale de Surveillance)

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Analysis Report

October 14, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.3 Run 2	Sample ID By:	Covanta
Date Sampled:	Sep 29, 2015	Sample Taken At:	Submitted
Date Received:	Oct 1, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R.3

SGS Minerals Sample ID: 491-1588274-002

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	17.38	
Sulfur %	ASTM D4239 (A)	0.75	0.91
Gross Calorific Value Btu/lb	ASTM D5865		<100

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Branch Manager

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Minerals Services Division
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SGS

Analysis Report

October 14, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.3 Run 3	Sample ID By:	Covanta
Date Sampled:	Sep 29, 2015	Sample Taken At:	Submitted
Date Received:	Oct 1, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R.3

SGS Minerals Sample ID: 491-1588274-003

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	17.41	
Sulfur %	ASTM D4239 (A)	0.75	0.90
Gross Calorific Value Btu/lb	ASTM D5865		<100

Vanessa Chambliss
Branch Manager

SGS North America Inc. | Minerals Services Division
16130 Van Drunen Road South Holland IL 60473 t (708) 331-2900 f (708) 333-3060 www.sgs.com/minerals

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TABLE 1

PERTINENT TEST DATA

Test Name: Energy Recovery 4
Test Date: 9/30/2015 08:00 - 16:00
Test Start: Test End:

	Item		Units	Unit 1	Unit 2	Average or Wtd. Avg. or Total	Measurement Source
1	Test duration		hours	8.0	8.0	8.00	----
2	Refuse feed rate		kg/hr	9,505	9,686	19,191	Crane Weigh Cell+End Time Adj.
3	Total FW/Steam flow		kg/hr	-		-	Station Instrument
4	Main steam flow		kg/hr	34,681	34,940	69,621	Station Instrument
5	Feedwater flow		kg/hr	34,612	34,893	69,504	Station Instrument
6	Suphtr. stm temperature		°C	503.4	505.8	504.6	Station Instrument
7	Suphtr. stm pressure		barg	88.4	88.4	88.4	Station Instrument
8	Feedwater temperature		°C	136.1	135.7	135.9	Station Instrument
9	Feedwater pressure		barg	101.2	101.6	101.4	Station Instrument
10	Continuous blowdown rate		kg/hr	0	0	0	Verify Valve Closed
11	Boiler drum pressure		barg	96.2	96.2	96.2	Station Instrument
12	Inlet air dry bulb temp.		°C	-	-	21.8	Digital Psychrometer
12A	Relative humidity %		%	-	-	52.5	Digital Psychrometer
13	Inlet air wet bulb temp.		°C	-	-	15.7	Calculated
14	Total air flow - Ref. Cond.		Rm^3/h	45,376	48,025	93,400	Station Instrument
15	Overfire air flow - Ref. Cond.		Rm^3/h	7,370	5,743	13,113	Station Instrument
16	Seal air flow - Ref. Cond.		Rm^3/h	1,753	1,593	3,346	Station Instrument
17	Overfire air pressure		mbar	45.8	45.9	45.9	Station Instrument
18	OFA and Seal air temp after fan		°C	30.5	30.4	30.5	Test T/C, wtd. avg.
19	Heated underfire air temperature		°C	73.5	69.5	71.4	Test T/C Grid wtd avg.
20	Barometric pressure		mbara	- -		1004.0	Barometer
21	Moisture in combustion air		kg/kg dry ai			0.0087	Calculated
22	CO_2 in dry flue gas		% vol	11.517	11.566	11.54	Manually @ Econ. Outlet
23	O_2 in dry flue gas		% vol	7.781	8.468	8.13	Manually @ Econ. Outlet
24	N_2 in dry flue gas		% vol	80.702	79.967	80.33	Calculated
25	H_2O in flue gas		% vol	15.498	15.400	15.45	Manually @ Econ. Outlet
26	Flue gas flow		act m^3/h	96,285	99,614	195,899	Manually @ Econ. Outlet
27	Economizer exit gas temp.		°C	165.6	167.1	166.4	Station Instrument
28	Sampling point gas temp.		°C	166.7	168.0	167.4	Manually @ Econ. Outlet
	Residue:						
	Sample (Bottom Ash)						
29	Fines (-2")		kg			990	Manual Residue Sampling
30	Overs (+2")		kg			25	Manual Residue Sampling
	Total Flow						
31	Grizzly Rejects		kg		0	0	Combined with Ferrous
32	Ferrous		kg		2.547%	3,910	Ratio from 5-Day Test
33	Non-Ferrous		kg		0.362%	556	Ratio from 5-Day Test
34	Bottom Ash		kg		20.892%	32,074	Ratio from 5-Day Test
35	Fly Ash	**10.00%**	kg		2.089%	3,207	Calculated from assumed %
36	Moisture in -2" bottom ash bottom ash		%			15.0	Laboratory Analysis
37	Combustibles in -2" bottom ash		dry %			0.42	Laboratory Analysis
38	Moisture in flyash leaving test boundary		%			0.0	Assumed zero %
39	Combustibles in flyash		dry %			0.42	Assumed same % as BA
40	Ash discharger water bath temp		°C	46.0	50.9	48.4	Test Thermocouples
41	Turbine Gross MW		MWG			17.26	Station Instrument
42	Net MW Exported		MWN			15.03	Station Instrument
43	Turbine Exhaust Pressure		bara			0.092	Station Instrument (Exh. Temp)
44	ACC Ambient Air Temperature		°C			15.8	Station Instrument
45	Annual average dry bulb temp.		°C	-		8.0	Historical weather data
****	**********	**********	**********	**********	1	**********	**********

AS TESTED PERFORMANCE PARAMETERS

TABLE 2

RESIDUE ANALYSIS

Sample Weights		Bottom Ash kg		Bottom Ash %
	+2" to -8" Material	25		2.5
	-2" Material	+ 990	+	97.5
	-8" Material	1,015		100.0

Total Weights			Bottom Ash (kg)	Flyash (kg)
	Bottom & Fly Ash (Excluding +8" Grizzly Material & All Metals)		32,074	3,207
-2" Ash	-2" Wet Bottom Ash @	97.5%	31,272	
	Moisture of wet bottom as	15.0%	4,701.3	
	Dry Aggregate (by difference)		26,571	3,207
	Combustibles of dry aggre	0.42%	111	13
	Dry Ash (by difference)		26,460	3,194
	Total +2" to (-8")	2.5%	802	
	+8" Grizzly Material, Ferrous & Non-Ferrous Metals (metals and inerts)		4,466	

Component Weights	Bottom Ash kg	Bottom Ash (1) kg/h	Bottom Ash (2) %	Bottom Ash (3) kg/kg fuel	Fly Ash kg	Fly Ash (1) kg/h	Fly Ash (2) %	Fly Ash (3) kg/kg fuel
Dry Ash + Inerts:								
-2" Ash	26,460	3,308			3,194	399		
+2" to (-8")	802	100						
+8" Grizzly, Ferrous & Non-Fe	4,466	558						
Subtotal	31,728	3,966	90.53	0.2067	3,194	399	9.11	0.0208
Unburned Combustible								
-2" Combustible	111	13.8			13	1.7		
+2" to (-8") Combustible	0	0			0	0		
Subtotal	111	13.8	0.32	0.0007	13	1.7	0.04	0.0001
Total Dry Residue :	**31,839**	**3,979.9**	**90.8**	**0.207**	**3,207**	**401**	**9.1**	**0.021**

Notes:
(1) Divisor is 8 hours
(2) % of Total Dry Residue (excluding Carbon Injection)
(3) Divisor is 19,191 kg/hr of refuse

TABLE 3

FLUE GAS FLOW & ANALYSIS
(Based on Average Data for Test Runs @ Econ. Exit)

	% VOL (DRY)	% VOL (WET)	M.W. kg/kg-mol	R.W. (DRY)	R.W. (WET)	% WT (DRY)	% WT (WET)	KG/HR
CO2	11.517	9.732	44.010	5.069	4.283	16.80	15.14	23,211
O2	7.781	6.575	32.000	2.490	2.104	8.25	7.44	11,403
N2	80.702	68.195	28.016	22.609	19.106	74.94	67.55	103,542
H2O		15.498	18.016	0.000	2.792	0.00	9.87	15,131
Totals	100.0	100.00		30.168	28.285	100.0	100.0	153,286

From flue gas report, average flow = 195,899 a m3/hr
Gas temperature @ sampling point = 167.40685 °C

Specific volume = $\frac{8.314 \times (273.15 + 167.40685 \text{ °F})}{28.285 \times (1.013 \text{ bara}) \times (\text{cm2/m2})}$ = 1.278 m3/kg

Wet gas mass flow = 195,899 / 1.278 = 153,286 kg/hr 138.7%

Percent excess air = $\frac{(O2 - CO/2) \times 100}{0.2682 \times N2 - (O2 - CO/2)}$ = 56.13 %

(per ASME PTC 19.10 Flue and Exhaust Gas Analysis, Section 6.03.6.3.1)

		deg C	deg Kelvin	deg F
Enthalpies From PTC-4, 5.19.4 & 5.19.11	Flue Gas Temp @ econ out	166.4	439.5	331.4

	Flue Gas @ Economizer Outlet		
	Enth. (H) (kJ/kg)	R.H. (WET)	R.H. (DRY)
CO2	128.72	19.49	21.63
O2	132.07	9.82	10.90
N2	146.20	98.76	109.57
H2O	267.43	26.40	0.00
Totals		154.47	142.10

********** ********** ********** ********** ********** 3 ********** ********** ********** **********

Total Measured Air Flow

Average compensated total wet air flow in Reference m^3/hr (25 °C) is taken from Table 1.

Total Wet Air Flow = 93,400 m^3/hr at 25 °C reference temperature
(Compensated)

$$\text{Specific Volume of Dry Air} = \frac{(25.00 + 273.15) \times 8.314}{1.004 \times 28.97} = 0.8522 \text{ } m^3/kg$$

$$\text{Dry Air Density} = \frac{1}{0.8522} = 1.1734 \text{ } kg/m^3$$

Wet Air Density = 1.0087 kg wet air/kg dry air x 1.1734 kg dry air/m^3 = 1.1837 kg wet air/m^3

Total Measured Wet Air 93,400 m^3/h x 1.1837 kg wet air/m^3

= **110,554** kg/hr

Moisture in Total Measure Air = (0.0087 x 110,554) / (1 + 0.0087) = **954.8** kg/hr

Overfire Air and Seal Air Flow

Average compensated wet overfire air flow & seal air flow in Reference m^3/hr (25 °C) is taken from Table 1.

Wet Overfire Air Flow = 13,113 m^3/hr at 25 °C temperature & 1.013 bara
Wet Seal Air Flow = 3,346 m^3/hr at 25 °C temperature & 1.013 bara
Combined OFA & Seal Air Flow = 13,113 + 3,346 = 16,460 Ref. m^3/hr

$$\text{Specific Volume of Dry Air} = \frac{(25.0 + 273.15) \times 8.314}{1.004 \times 28.97} = 0.8522 \text{ } m^3/kg$$

$$\text{Dry Air Density} = \frac{1}{0.8522} = 1.1734 \text{ } kg/m^3$$

Wet Air Density = 1.0087 kg wet air/kg dry air x 1.1734 kg dry air/m^3 = 1.1837 kg wet air/m^3

OFA & Seal Air (Wet) = 16,460 m^3/h x 1.1837 kg wet air/m^3

= **19,483** kg/hr

Moisture in OFA & Seal Air = (0.0087 x 19,483) / (1 + 0.0087) = **168.3** kg/hr

Wet Underfire Air =
Total Wet Air - Wet OFA & Seal Air = 110,554 - 19,483 = **91,071** kg/hr
Moisture in Underfire air =
Total Air H_2O - OF & Seal Air H_2O = 954.8 - 168.3 = **786.5** kg/hr

(Continued from Page 4)

Assume ref. waste N2 content of test fuel = 0.87 %
Therefore, N2 in flue gas from fuel =

19,191 kg fuel/hr x 0.0087 kg N2/kg fuel = 167 kg/hr

N2 in flue gas = 103,542 kg/hr

Total dry comb. air supplied = $\frac{103{,}542 - 167}{0.7685}$ = **134,515** kg/hr
(Incl. Air Infiltration)

Moisture in air = 0.0087 kg/kg dry air from psychrometric chart for
21.83 °C db / 15.71 °C wb, therefore

Moisture in Calculated Total Air = 0.0087 x 134,515 = **1,171.8** kg/hr

Total Calculated wet air = 134,515 + 1171.8 = **135,687** kg/hr
(Including Air Infiltration & VLN cooling air)

Total Calculated Wet Air (including air infiltration & VLN cooling air) is greater than Total Measured Wet Air
Wet Air Infiltration (incl. VLN cooling air) = Calculated Total Wet Air - Measured Total Wet Air
= 135,687 - 110,554
= 25,133 kg/hr

Wet Un-heated Air = Total Wet Air - Wet UFA
= 135,687 - 91,071
= 44,616 kg/hr

Moisture in Wet Air Infiltration (incl. VLN cooling air) = Total Air Moisture - Moisture in Measured Total Ai
= 1,171.8 - 954.8
= 217.0 kg/hr

********** ********** ********** ********** ********** 5 ********** ********** **********

Calculated moisture in Flue Gas from H2 and H2O in fuel and Ash Discharger Quench Water Vapor:

A water balance around the boiler gives:

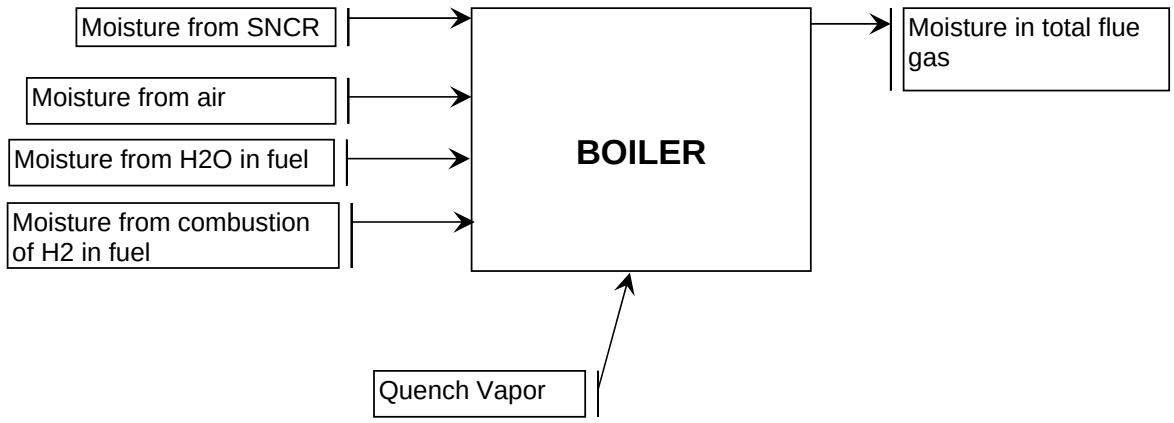
Vapor in flue gas = moisture from H2 and H20 in the fuel + moisture in air + quench vapor + SNCR & carrier water

Therefore:

Moisture from H2 and H2O in fuel + quench vapor + SNCR & carrier water = Vapor in gas - moisture in air

= 15,131 - 1,171.8

= 13,959 kg/hr = 0.727 kg/kg FUEL



DATA FOR HEAT OUTPUT AND LOSS CALCULATIONS

Enthalpy of feedwater @	135.92935	°C,	10238.54	kPa	578.33 kJ/kg
Enthalpy of drum water @ saturated pressure			9721.18	kPa	1395.74 kJ/kg
Enthalpy of steam @	504.62549	°C,	8942.89	kPa	3399.67 kJ/kg
Enthalpy of dry underfire air at 71.4°C comb. temp. referenced to 25°C					46.71 kJ/kg
Enthalpy of dry overfire air at 30.5°C air temp. referenced to 25°C					5.49 kJ/kg
Enthalpy of dry flue gas at 166.4°C econ exit temp. referenced to 25°C					142.10 kJ/kg
Enthalpy of liquid water @ the amb. air temperature of 21.8°C ref. 0°C					91.42 kJ/kg
Enthalpy of water vapor @ UFA temp. of 71.4°C ref. 25°C					86.79 kJ/kg
Enthalpy of water vapor @ the OFA temp. aft. fan of 30.5°C ref. 25°C					10.12 kJ/kg
Enthalpy of steam vapor @ 166.4°C and 1 psia referenced to 0°C					2814.62 kJ/kg
Enthalpy of liquid water @ reference temperature of 25°C ref. 0°C					104.67 kJ/kg
Enthalpy of water vapor @ econ exit temp. of 166.4°C referenced to 25°C					267.4 kJ/kg
Enthalpy of ash discharger water bath @ 48.4°C					202.8 kJ/kg
Enthalpy of dry residue @ air inlet temp of 21.8°C			295.0	°K	-2.379 kJ/kg
Enthalpy of dry residue @ ash discharger temp of 48.4°C or			321.6	°K	18.064 kJ/kg
Enthalpy of dry fly ash @ econ. exit temp. of 166.4°C or			439.5	°K	120.510 kJ/kg
HHV of unburned combustibles					27,913 kJ/kg
Radiation & convection loss per ASME PTC 34, Fig. I-1					
with 98.1 GJ/hr actual average heat output per boiler, 2 boilers =					1.518 GJ/hr
Enthalpy of dry fuel @ ambient temp. of 21.8°C ref. 25°C					-2.366 kJ/kg
Enthalpy of liquid water @ ambient temp. of 21.8°C ref. 25°C					-13.3 kJ/kg

Reference documents:

ASME Performance Test Code for Fired Steam Generators, ASME PTC 4
ASME Performance Test Code for Waste Combustor with Energy Recovery, ASME PTC 34
ASME Steam Tables 1967 Edition

Table 4 - Reference Composition Acceptable Waste

Energy Content 13,000 kJ (HHV) per kilogram

REFERENCE WASTE ULTIMATE ANALYSIS

	%
Moisture	15.16
Total Inert	15.92
Carbon	31.73
Hydrogen	4.56
Oxygen	31.35
Nitrogen	0.87
Sulfur	0.04
Chlorine	0.31
Flourine	0.030
Iron, oxidizable	0.030
	100.00

BOILER EFFICIENCY CALCULATION
AS TESTED CONDITIONS
-HEAT LOSS METHOD-
(ASME PTC 34, SECTION 5.11)

kJoule per kg A.F. Fuel

HEAT OUTPUT due to-

Steam:
(kg/hr of fluid)/(kg/hr fuel) x (h out - h in, kJ/kg)
69,504 / 19,191 x (3,399.67 - 578.33) = 10,218.21

Blowdown:
(kg/hr of fluid)/(kg/hr fuel) x (h out - h in, kJ/kg)
- / 19,191 x (1,395.74 - 578.33) 0.00

Total Heat Output: = 10,218.21

HEAT LOSSES due to-

Dry gas:
(kg/hr dry gas)/(kg/hr fuel) x (flue gas h @ Tgas econ exit ref. 25°C, kJ/kg)
138,155 / 19,191 x (142.10) = 1022.98

Moisture from H2 and H2O in fuel, ash discharger quench water vapor and SNCR carrier water:
(kg/hr moisture)/(kg/hr fuel) x (h econ gas exit @ 1 psia - h liquid @ T = 25°C, kJ/kg)
13,959 / 19,191 x (2814.62 - 104.67) = 1971.17

Ash discharger quench water:
Liquid: (kg/hr liquid)/(kg/hr fuel) x (h water @ Tquench - h water @ Tamb air, kJ/kg)
588 / 19,191 x (202.84 - 91.42) = 3.41

Sensible heat in dry bottom residue:
(kg/hr dry residue)/(kg/hr fuel) x (h res @ Tquench - h res @Tamb air, kJ/kg)
3,980 / 19,191 x (18.064 - -2.379) = 4.24

Sensible heat in dry fly ash residue:
(kg/hr dry residue)/(kg/hr fuel) x (h res @ Tecon exit - h res @Tamb air, kJ/kg)
401 / 19,191 x (120.510 - -2.379) = 2.57

Moisture from total air:
(kg/hr air moisture)/(kg/hr fuel) x (h water vap @ Tgas econ exit ref. 25°C, kJ/kg)
1,172 / 19,191 x (267.4) = 16.33

Unburned combustibles:
(lb unburned combustibles/hr)/(kg/hr fuel) x HHV unburned
15.47 / 19,191 x 27,913 = 22.50

Radiation & Convection Loss:
Per ASME PTC 34, Fig. I-1 = 1.518 GJ/hr
1,517,852 / 19,191 = 79.09

Unaccounted for:
0.5 % of heat output and losses (heat input) = 67.04
0.005 x (10,218.2 + 3,189.3)

Total Heat Losses: = 3189.33

HEAT CREDITS due to-

kJoule per kg A.F. Fuel

Dry underfire air sensible heat:
(kg/hr dry air)/(kg/hr fuel) x (h in @ 71.4°C ref. 25°C, kJ/kg)
90,285 / 19,191 x (46.71) = 219.74

Dry overfire air, seal air & air infiltration sensible heat:
(kg/hr dry air)/(kg/hr fuel) x (h in @ 30.5°C ref. 25°C, kJ/kg)
44,231 / 19,191 x (5.49) = 12.65

Moisture in incoming underfire air:
(kg/hr moisture)/(kg/hr fuel) x (h vap in @ 71.4°C ref 25°C, kJ/kg)
786.5 / 19,191 x (86.79) = 3.56

Moisture in incoming overfire, seal air & air infiltration:
(kg/hr moisture)/(kg/hr fuel) x (h vap in @ 30.5°C ref 25°C, kJ/kg)
385.3 / 19,191 x (10.12) = 0.20

Fuel sensible heat:
(dry fuel, lb dry fuel/lb fuel) x (h in @ ambient air temp of 21.8°C ref 25°C, kJ/kg) +
(moisture in fuel, lb H2O/lb fuel) x (h in @ ambient air temp of 21.8°C ref 25°C, kJ/kg)
0.848 x -2.366 + 0.152 x -13.25 = -4.02

Total Heat Credits: 232.14

Gross Heat Input = HHV of Fuel + Heat Credit = Heat Output + Heat Losses

or

HHV of FUEL = Heat Output + Heat Losses - Heat Credit
= 10218.21 + 3189.33 - 232.14
= **13,175** kJ/kg

EFFICIENCY= (1 - (Heat Losses/Heat Input))*100= (1 - 3189.33 / 13,408) x 100 = **76.21** %

Gross Heat Input = 13,408 kJ/kg

HEAT LOSS SUMMARY:

	%
Dry gas:	7.63
Moisture from H2 and H2O in fuel, ash discharger quench water vapor & SNCR:	14.70
Moisture from total air:	0.12
Ash discharger quench water: Liquid:	0.03
Sensible heat in dry bottom residue:	0.03
Sensible heat in dry fly ash:	0.02
Unburned combustibles:	0.17
Radiation/Correction:	0.59
Unaccounted for:	0.50
Total Heat Losses:	23.79

Adjustment For Annual Average Dry Bulb Temperature

Turbine performance is dependent upon exhaust vacuum, which is dependent upon air-cooled condenser (ACC) performance. ACC performance is dependent upon the dry bulb ambient air temperature. An adjustment is made to the as-tested ACC performance for the difference between the average annual dry bulb temperature and the as-tested dry bulb temperature. Per average local weather conditions: (see Procedures page 10)

The average annual dry bulb temperature = 8 °C

Air-Cooled Condenser Performance:

The as-tested ACC ambient dry bulb temperature was: **15.8** °C
Per the ACC performance curve, (see Figures section) the condenser vacuum corresponding to the as-tested dry bulb temperature of 15.8 °C is: 91.1 mbara
Per the ACC performance curve, the condenser vacuum corresponding to the average annual dry bulb temperature of 8 °C is: 68.0 mbara
Therefore, the correction to exhaust pressure for temperature difference is 23.1 mbar

Turbine Performance:

Per the curve defining change in exhaust pressure vs. change in turbine-generator output (see page 12 of procedures), a 23.1 mbar change in exhaust pressure at design throttle flow results in a 1.37% change in turbine heat rate. Therefore, the overall adjusted gross electrical output is :

17.26 * (1 + 0.0137) = 17.50 **MWG**

The MW correction is also added to the as-tested NET electrical exported:

15.03 + 17.50 - 17.26 = 15.27 **MWN**

See SAMPLE CALCULATION CURVES at the end of these procedures.

Adjusted Power Outputs Per Ton:

Gross Electrical Output = 17,496 kW adjusted for annual average dry bulb temperature. / 19.191 Actual TPH = 912 kWh/tonne

Compared to the guarantee of 884 kWh/tonne at the same HHV.

Surpassing the guarantee by: 27 kWh/tonne
or 3.1%

Net Electrical Export = 15,269 kW adjusted for annual average dry bulb temperature. / 19.191 Actual TPH = 796 kWh/tonne

Compared to the guarantee of 782 kWh/tonne at the same HHV.

Surpassing the guarantee by: 14 kWh/tonne
or 1.8%

Crane Calibration Drift Adjustment Calculation Energy Recovery 4

Reference Weight (Reference Block Weight)	**3,926**	kg			
Initial Span Check Reading	3,881.7	@	9/30/2015 7:25		
Final Span Check Reading	3,895.0	@	9/30/2015 17:26		
Average of the Initial and Final Span Checks	**3,888**	kg			
Difference between Average and Reference Weight	**-38**	kg	>	45.4	kg

Adjustment to each grapple feed is warranted.

							Adjustment Factor 1.003950637		
	154,357								154,967
Feed at	Feed Weight Reading (kg)	Ref. Weight (Drifted, by Equation)	Difference (Drift)	% Difference (% Drift)		Feed Weight % of Ref. Drifted Weight	Proportioned Drift (%)	Feed Weight Drifted	Adjusted Feed Weight (kg)
9/30/15 8:10	1,782.0	3,883.1	-42.9	-1.09%		45.89%	-0.50%	-8.93	**1,790.93**
9/30/15 8:12	1,328.0	3,883.2	-42.8	-1.09%		34.20%	-0.37%	-4.95	**1,332.95**
9/30/15 8:18	2,548.0	3,883.4	-42.6	-1.09%		65.61%	-0.71%	-18.14	**2,566.14**
9/30/15 8:21	2,160.0	3,883.5	-42.5	-1.08%		55.62%	-0.60%	-13.01	**2,173.01**
9/30/15 8:35	1,808.0	3,883.9	-42.1	-1.07%		46.55%	-0.50%	-9.02	**1,817.02**
9/30/15 8:38	1,332.0	3,884.0	-42.0	-1.07%		34.29%	-0.37%	-4.88	**1,336.88**
9/30/15 8:44	1,072.0	3,884.2	-41.8	-1.06%		27.60%	-0.29%	-3.15	**1,075.15**
9/30/15 8:46	1,954.0	3,884.3	-41.7	-1.06%		50.31%	-0.53%	-10.45	**1,964.45**
9/30/15 8:51	1,850.0	3,884.4	-41.6	-1.06%		47.63%	-0.50%	-9.33	**1,859.33**
9/30/15 8:55	1,430.0	3,884.5	-41.5	-1.06%		36.81%	-0.39%	-5.56	**1,435.56**
9/30/15 9:00	1,666.0	3,884.7	-41.3	-1.05%		42.89%	-0.45%	-7.51	**1,673.51**
9/30/15 9:02	1,200.0	3,884.8	-41.2	-1.05%		30.89%	-0.32%	-3.89	**1,203.89**
9/30/15 9:05	723.0	3,884.9	-41.1	-1.05%		18.61%	-0.19%	-1.41	**724.41**
9/30/15 9:10	1,180.0	3,885.0	-41.0	-1.04%		30.37%	-0.32%	-3.74	**1,183.74**
9/30/15 9:13	1,652.0	3,885.1	-40.9	-1.04%		42.52%	-0.44%	-7.31	**1,659.31**
9/30/15 9:21	1,103.0	3,885.4	-40.6	-1.04%		28.39%	-0.29%	-3.24	**1,106.24**
9/30/15 9:22	1,800.0	3,885.4	-40.6	-1.03%		46.33%	-0.48%	-8.62	**1,808.62**
9/30/15 9:27	1,080.0	3,885.6	-40.4	-1.03%		27.80%	-0.29%	-3.09	**1,083.09**
9/30/15 9:29	957.0	3,885.6	-40.4	-1.03%		24.63%	-0.25%	-2.42	**959.42**
9/30/15 9:34	1,139.0	3,885.8	-40.2	-1.02%		29.31%	-0.30%	-3.42	**1,142.42**
9/30/15 9:38	771.0	3,885.9	-40.1	-1.02%		19.84%	-0.20%	-1.56	**772.56**
9/30/15 9:41	841.0	3,886.0	-40.0	-1.02%		21.64%	-0.22%	-1.85	**842.85**
9/30/15 9:46	692.0	3,886.2	-39.8	-1.01%		17.81%	-0.18%	-1.25	**693.25**
9/30/15 9:50	796.0	3,886.3	-39.7	-1.01%		20.48%	-0.21%	-1.65	**797.65**
9/30/15 9:55	1,232.0	3,886.4	-39.6	-1.01%		31.70%	-0.32%	-3.93	**1,235.93**
9/30/15 9:58	1,799.0	3,886.5	-39.5	-1.01%		46.29%	-0.47%	-8.37	**1,807.37**
9/30/15 9:59	2,526.0	3,886.6	-39.4	-1.00%		64.99%	-0.65%	-16.49	**2,542.49**
9/30/15 10:05	2,225.0	3,886.8	-39.2	-1.00%		57.25%	-0.57%	-12.73	**2,237.73**
9/30/15 10:07	560.0	3,886.8	-39.2	-1.00%		14.41%	-0.14%	-0.81	**560.81**
9/30/15 10:15	1,874.0	3,887.1	-38.9	-0.99%		48.21%	-0.48%	-8.96	**1,882.96**
9/30/15 10:17	1,876.0	3,887.1	-38.9	-0.99%		48.26%	-0.48%	-8.96	**1,884.96**
9/30/15 10:24	1,414.0	3,887.4	-38.6	-0.98%		36.37%	-0.36%	-5.06	**1,419.06**
9/30/15 10:26	2,350.0	3,887.4	-38.6	-0.98%		60.45%	-0.59%	-13.96	**2,363.96**
9/30/15 10:37	1,954.0	3,887.8	-38.2	-0.97%		50.26%	-0.49%	-9.56	**1,963.56**
9/30/15 10:41	897.0	3,887.9	-38.1	-0.97%		23.07%	-0.22%	-2.01	**899.01**
9/30/15 10:46	1,321.0	3,888.1	-37.9	-0.97%		33.98%	-0.33%	-4.34	**1,325.34**
9/30/15 10:50	967.0	3,888.2	-37.8	-0.96%		24.87%	-0.24%	-2.32	**969.32**
9/30/15 10:52	1,111.0	3,888.2	-37.8	-0.96%		28.57%	-0.27%	-3.05	**1,114.05**
9/30/15 10:58	1,139.0	3,888.4	-37.6	-0.96%		29.29%	-0.28%	-3.19	**1,142.19**
9/30/15 11:02	2,048.0	3,888.5	-37.5	-0.95%		52.67%	-0.50%	-10.29	**2,058.29**
9/30/15 11:05	1,813.0	3,888.7	-37.3	-0.95%		46.62%	-0.44%	-8.04	**1,821.04**
9/30/15 11:13	928.0	3,888.9	-37.1	-0.95%		23.86%	-0.23%	-2.09	**930.09**
9/30/15 11:23	1,973.0	3,889.2	-36.8	-0.94%		50.73%	-0.48%	-9.38	**1,982.38**
9/30/15 11:25	967.0	3,889.3	-36.7	-0.94%		24.86%	-0.23%	-2.25	**969.25**
9/30/15 11:34	1,682.0	3,889.6	-36.4	-0.93%		43.24%	-0.40%	-6.75	**1,688.75**
9/30/15 11:37	1,694.0	3,889.7	-36.3	-0.93%		43.55%	-0.40%	-6.83	**1,700.83**
9/30/15 11:39	1,426.0	3,889.7	-36.3	-0.92%		36.66%	-0.34%	-4.83	**1,430.83**
9/30/15 11:45	906.0	3,889.9	-36.1	-0.92%		23.29%	-0.21%	-1.94	**907.94**
9/30/15 11:48	1,886.0	3,890.0	-36.0	-0.92%		48.48%	-0.44%	-8.39	**1,894.39**
9/30/15 11:51	480.0	3,890.1	-35.9	-0.91%		12.34%	-0.11%	-0.54	**480.54**
9/30/15 11:56	2,189.0	3,890.3	-35.7	-0.91%		56.27%	-0.51%	-11.21	**2,200.21**
9/30/15 11:59	1,591.0	3,890.4	-35.6	-0.91%		40.90%	-0.37%	-5.91	**1,596.91**
9/30/15 12:09	2,203.0	3,890.7	-35.3	-0.90%		56.62%	-0.51%	-11.23	**2,214.23**
9/30/15 12:12	2,661.0	3,890.8	-35.2	-0.90%		68.39%	-0.61%	-16.34	**2,677.34**
9/30/15 12:18	1,736.0	3,891.0	-35.0	-0.89%		44.62%	-0.40%	-6.91	**1,742.91**
9/30/15 12:22	1,698.0	3,891.1	-34.9	-0.89%		43.64%	-0.39%	-6.59	**1,704.59**
9/30/15 12:28	1,775.0	3,891.3	-34.7	-0.88%		45.61%	-0.40%	-7.16	**1,782.16**
9/30/15 12:30	1,590.0	3,891.3	-34.7	-0.88%		40.86%	-0.36%	-5.74	**1,595.74**
9/30/15 12:44	2,713.0	3,891.8	-34.2	-0.87%		69.71%	-0.61%	-16.49	**2,729.49**
9/30/15 12:47	1,075.0	3,891.9	-34.1	-0.87%		27.62%	-0.24%	-2.58	**1,077.58**
9/30/15 12:53	2,431.0	3,892.0	-34.0	-0.86%		62.46%	-0.54%	-13.13	**2,444.13**
9/30/15 12:59	2,284.0	3,892.2	-33.8	-0.86%		58.68%	-0.50%	-11.52	**2,295.52**
9/30/15 13:06	1,249.0	3,892.5	-33.5	-0.85%		32.09%	-0.27%	-3.42	**1,252.42**
9/30/15 13:12	1,411.0	3,892.6	-33.4	-0.85%		36.25%	-0.31%	-4.35	**1,415.35**
9/30/15 13:15	2,447.0	3,892.8	-33.2	-0.85%		62.86%	-0.53%	-13.03	**2,460.03**
9/30/15 13:20	2,250.0	3,892.9	-33.1	-0.84%		57.80%	-0.49%	-10.97	**2,260.97**
9/30/15 13:27	1,100.0	3,893.1	-32.9	-0.84%		28.26%	-0.24%	-2.60	**1,102.60**
9/30/15 13:32	1,743.0	3,893.3	-32.7	-0.83%		44.77%	-0.37%	-6.51	**1,749.51**
9/30/15 13:39	1,587.0	3,893.5	-32.5	-0.83%		40.76%	-0.34%	-5.36	**1,592.36**
9/30/15 13:44	1,544.0	3,893.7	-32.3	-0.82%		39.65%	-0.33%	-5.04	**1,549.04**
9/30/15 13:46	1,368.0	3,893.7	-32.3	-0.82%		35.13%	-0.29%	-3.95	**1,371.95**
9/30/15 13:57	1,513.0	3,894.1	-31.9	-0.81%		38.85%	-0.32%	-4.78	**1,517.78**
9/30/15 13:59	2,076.0	3,894.1	-31.9	-0.81%		53.31%	-0.43%	-8.99	**2,084.99**
9/30/15 14:01	2,141.0	3,894.2	-31.8	-0.81%		54.98%	-0.45%	-9.54	**2,150.54**
9/30/15 14:13	1,053.0	3,894.6	-31.4	-0.80%		27.04%	-0.22%	-2.28	**1,055.28**
9/30/15 14:17	1,332.0	3,894.7	-31.3	-0.80%		34.20%	-0.27%	-3.63	**1,335.63**
9/30/15 14:19	1,550.0	3,894.8	-31.2	-0.80%		39.80%	-0.32%	-4.91	**1,554.91**
9/30/15 14:25	1,337.0	3,894.9	-31.1	-0.79%		34.33%	-0.27%	-3.63	**1,340.63**
9/30/15 14:30	1,810.0	3,895.1	-30.9	-0.79%		46.47%	-0.37%	-6.62	**1,816.62**
9/30/15 14:34	1,661.0	3,895.2	-30.8	-0.78%		42.64%	-0.33%	-5.55	**1,666.55**
9/30/15 14:38	1,907.0	3,895.4	-30.6	-0.78%		48.96%	-0.38%	-7.28	**1,914.28**
9/30/15 14:43	1,388.0	3,895.5	-30.5	-0.78%		35.63%	-0.28%	-3.84	**1,391.84**
9/30/15 14:52	2,351.0	3,895.8	-30.2	-0.77%		60.35%	-0.46%	-10.92	**2,361.92**
9/30/15 14:54	1,928.0	3,895.9	-30.1	-0.77%		49.49%	-0.38%	-7.33	**1,935.33**
9/30/15 15:02	778.0	3,896.1	-29.9	-0.76%		19.97%	-0.15%	-1.18	**779.18**
9/30/15 15:04	1,411.0	3,896.2	-29.8	-0.76%		36.22%	-0.28%	-3.88	**1,414.88**
9/30/15 15:09	2,215.0	3,896.3	-29.7	-0.76%		56.85%	-0.43%	-9.51	**2,224.51**
9/30/15 15:12	1,311.0	3,896.4	-29.6	-0.75%		33.65%	-0.25%	-3.32	**1,314.32**
9/30/15 15:21	991.0	3,896.7	-29.3	-0.75%		25.43%	-0.19%	-1.88	**992.88**
9/30/15 15:23	764.0	3,896.8	-29.2	-0.74%		19.61%	-0.15%	-1.12	**765.12**
9/30/15 15:25	1,480.0	3,896.8	-29.2	-0.74%		37.98%	-0.28%	-4.17	**1,484.17**
9/30/15 15:29	1,377.0	3,897.0	-29.0	-0.74%		35.34%	-0.26%	-3.60	**1,380.60**
9/30/15 15:32	1,459.0	3,897.0	-29.0	-0.74%		37.44%	-0.28%	-4.03	**1,463.03**
9/30/15 15:36	1,155.0	3,897.2	-28.8	-0.73%		29.64%	-0.22%	-2.51	**1,157.51**
9/30/15 15:40	725.0	3,897.3	-28.7	-0.73%		18.60%	-0.14%	-0.99	**725.99**
9/30/15 15:43	897.0	3,897.4	-28.6	-0.73%		23.02%	-0.17%	-1.50	**898.50**
9/30/15 15:49	1,042.0	3,897.6	-28.4	-0.72%		26.73%	-0.19%	-2.02	**1,044.02**
9/30/15 15:52	1,471.0	3,897.7	-28.3	-0.72%		37.74%	-0.27%	-4.00	**1,475.00**
9/30/15 15:56	2,084.0	3,897.8	-28.2	-0.72%		53.47%	-0.38%	-8.00	**2,092.00**
9/30/15 15:59	1,514.0	3,897.9	-28.1	-0.72%		38.84%	-0.28%	-4.21	**1,518.21**
9/30/15 16:03	583.0	3,898.0	-28.0	-0.71%		14.96%	-0.11%	-0.62	**583.62**
9/30/15 16:05	496.0	3,898.1	-27.9	-0.71%		12.72%	-0.09%	-0.45	**496.45**

Covanta - Durham York Energy Centre
Boiler No. 1 Scrubber Inlet
Stack Gas Physical Parameters and Volumetric Flowrates
September 30, 2015

Test No.	Test Time	Gas Temp.	Moisture by Volume	Gas Velocity	Static Pressure	Barometric Pressure	Absolute Pressure	Carbon Dioxide by Volume	Oxygen by Volume	Carbon Monoxide By Volume	Actual Flowrate	Dry Reference Flowrate	Wet Reference Flowrate
		°C	%	m/s	kPa	kPa	kPa	% *	% *	ppm*	m^3/s	Rm^3/s **	Rm^3/s**
1	8:28 - 8:34	163	15.4	17.6	-0.60	100.8	100.2	11.5	7.90	16.9	26.1	14.9	17.6
2	8:43 - 8:48	166	15.4	17.7	-0.55	100.8	100.3	11.4	8.16	17.4	26.2	14.9	17.6
3	9:11 - 9:17	166	15.4	18.2	-0.55	100.9	100.4	11.7	7.64	12.4	26.9	15.3	18.1
4	9:47 - 9:53	168	15.4	18.6	-0.57	100.9	100.3	11.4	7.93	10.3	27.5	15.6	18.4
5	10:34 - 10:40	167	15.3	18.5	-0.65	100.9	100.3	11.2	8.05	8.5	27.3	15.5	18.3
6	11:04 - 11:10	166	15.3	18.0	-0.47	100.9	100.4	11.1	8.06	20.1	26.6	15.2	18.0
7	11:35 - 11:41	166	15.3	18.2	-0.52	100.9	100.4	11.8	7.50	8.9	26.8	15.3	18.1
8	12:03 - 12:09	166	15.3	18.3	-0.55	100.9	100.4	10.9	8.53	22.8	27.1	15.4	18.2
9	12:52 - 12:59	166	16.0	17.6	-0.47	100.9	100.4	11.6	7.62	21.0	26.0	14.7	17.5
10	13:21 - 13:27	167	16.0	18.0	-0.50	101.0	100.5	12.0	7.23	19.1	26.6	15.0	17.9
11	13:53 - 13:59	166	16.0	17.8	-0.47	101.0	100.5	11.6	7.54	9.4	26.4	14.9	17.7
12	14:25 - 14:31	167	16.0	18.1	-0.50	101.0	100.5	11.8	7.33	11.7	26.7	15.1	18.0
13	15:00 - 15:18	169	15.3	18.3	-0.47	101.0	100.5	11.7	7.52	32.8	27.1	15.4	18.1
14	15:41 - 15:48	169	15.3	18.2	-0.57	101.0	100.4	11.6	7.73	27.0	26.9	15.2	18.0
15	16:15 - 16:22	169	15.3	18.5	-0.55	101.1	100.6	11.5	7.88	31.6	27.4	15.5	18.4
16	16:43 - 16:50	168	15.3	18.3	-0.50	101.1	100.6	11.5	7.89	19.4	27.1	15.4	18.2
Average		167	15.5	18.1	-0.53	100.9	100.4	11.5	7.78	18.1	26.8	15.2	18.0

* Dry basis

** Reference conditions; 25°C and 1 atm

Covanta - Durham York Energy Centre
Boiler No. 2 Scrubber Inlet
Stack Gas Physical Parameters and Volumetric Flowrates
September 30, 2015

Test No.	Test Time	Gas Temp.	Moisture by Volume	Gas Velocity	Static Pressure	Barometric Pressure	Absolute Pressure	Carbon Dioxide by Volume	Oxygen by Volume	Carbon Monoxide By Volume	Actual Flowrate	Dry Reference Flowrate	Wet Reference Flowrate
		°C	%	m/s	kPa	kPa	kPa	% *	% *	ppm*	m^3/s	Rm^3/s **	Rm^3/s**
1	8:11 - 8:18	165	15.8	18.4	-0.50	100.8	100.3	11.3	9.02	7.0	27.2	15.4	18.3
2	8:36 - 8:42	166	15.8	18.4	-0.50	100.8	100.3	11.5	8.89	6.0	27.2	15.4	18.3
3	9:04 - 9:09	168	15.8	19.0	-0.65	100.9	100.3	11.9	7.90	4.5	28.1	15.8	18.8
4	9:37 - 9:44	167	15.8	19.0	-0.67	100.9	100.2	11.4	8.43	7.8	28.1	15.8	18.8
5	10:26 - 10:33	168	15.4	19.1	-0.62	100.9	100.3	11.8	8.09	6.0	28.2	15.9	18.8
6	10:56 - 11:03	167	15.4	18.7	-0.55	100.9	100.4	11.5	8.55	9.8	27.6	15.7	18.5
7	11:27 - 11:33	168	15.4	19.2	-0.62	100.9	100.3	11.4	8.79	7.7	28.4	16.1	19.0
8	11:55 - 12:02	167	15.4	18.5	-0.52	100.9	100.4	11.5	8.70	7.9	27.3	15.5	18.4
9	12:45 - 12:52	168	15.5	18.9	-0.57	100.9	100.3	12.0	7.98	14.8	28.0	15.8	18.7
10	11:13 - 11:20	168	15.5	18.6	-0.65	101.0	100.4	11.2	8.93	11.1	27.5	15.6	18.4
11	13:45 - 13:52	169	15.5	18.8	-0.52	101.0	100.5	11.9	8.10	12.4	27.8	15.8	18.6
12	14:17 - 14:24	169	15.5	18.7	-0.40	101.0	100.6	11.1	9.14	15.4	27.7	15.7	18.5
13	15:03 - 15:11	171	14.9	19.1	-0.60	101.0	100.4	11.5	8.52	8.1	28.3	16.0	18.8
14	15:32 - 15:40	170	14.9	18.4	-0.45	101.0	100.6	12.0	8.20	6.9	27.2	15.5	18.2
15	16:07 - 16:15	169	14.9	18.1	-0.55	101.1	100.6	11.5	8.64	8.0	26.8	15.2	17.9
16	16:32 - 16:40	169	14.9	18.4	-0.55	101.1	100.6	11.8	8.29	8.6	27.2	15.5	18.2
Average		168	15.4	18.7	-0.56	100.9	100.4	11.6	8.51	8.9	27.7	15.7	18.5

* Dry basis

** Reference conditions; 25°C and 1 atm

SGS

Analysis Report

October 14, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.4 Run 1	Sample ID By:	Covanta
Date Sampled:	Sep 30, 2015	Sample Taken At:	Submitted
Date Received:	Oct 2, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R.4

SGS Minerals Sample ID: 491-1588306-001

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	15.06	
Sulfur %	ASTM D4239 (A)	0.99	1.17
Gross Calorific Value Btu/lb	ASTM D5865		<100

Vanessa Chambliss

Vanessa Chambliss
Branch Manager

SGS North America Inc. | Minerals Services Division
16130 Van Drunen Road South Holland IL 60473 t (708) 331-2900 f (708) 333-3060 www.sgs.com/minerals

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SGS

Analysis Report

October 14, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.4 Run 2	Sample ID By:	Covanta
Date Sampled:	Sep 30, 2015	Sample Taken At:	Submitted
Date Received:	Oct 2, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R.4

SGS Minerals Sample ID: 491-1588306-002

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	15.03	
Sulfur %	ASTM D4239 (A)	1.01	1.19
Gross Calorific Value Btu/lb	ASTM D5865		<100

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Branch Manager

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SGS

Analysis Report

October 14, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.4 Run 3	Sample ID By:	Covanta
Date Sampled:	Sep 30, 2015	Sample Taken At:	Submitted
Date Received:	Oct 2, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R.4

SGS Minerals Sample ID: 491-1588306-003

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	15.01	
Sulfur %	ASTM D4239 (A)	0.99	1.17
Gross Calorific Value Btu/lb	ASTM D5865		<100

Vanessa Chambliss
Branch Manager

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TABLE 1

PERTINENT TEST DATA

Test Name: Energy Recovery 5

Test Date: 10/01/2015 09:00 - 17:00

Test Start: Test End:

	Item		Units	Unit 1	Unit 2	Average or Wtd. Avg. or Total	Measurement Source
1	Test duration		hours	8.0	8.0	8.00	----
2	Refuse feed rate		kg/hr	9,186	8,879	18,066	Crane Weigh Cell+End Time Adj.
3	Total FW/Steam flow		kg/hr	-		-	Station Instrument
4	Main steam flow		kg/hr	35,080	34,839	69,919	Station Instrument
5	Feedwater flow		kg/hr	35,055	34,717	69,772	Station Instrument
6	Suphtr. stm temperature		°C	503.1	498.6	500.8	Station Instrument
7	Suphtr. stm pressure		barg	88.4	88.4	88.4	Station Instrument
8	Feedwater temperature		°C	136.2	135.9	136.0	Station Instrument
9	Feedwater pressure		barg	101.2	101.0	101.1	Station Instrument
10	Continuous blowdown rate		kg/hr	0	0	0	Verify Valve Closed
11	Boiler drum pressure		barg	96.5	96.2	96.3	Station Instrument
12	Inlet air dry bulb temp.		°C	-	-	19.4	Digital Psychrometer
12A	Relative humidity %		%	-	-	43.1	Digital Psychrometer
13	Inlet air wet bulb temp.		°C	-	-	12.5	Calculated
14	Total air flow - Ref. Cond.		Rm^3/h	42,917	40,572	83,489	Station Instrument
15	Overfire air flow - Ref. Cond.		Rm^3/h	7,352	5,913	13,265	Station Instrument
16	Seal air flow - Ref. Cond.		Rm^3/h	1,722	1,530	3,252	Station Instrument
17	Overfire air pressure		mbar	45.9	46.1	46.0	Station Instrument
18	OFA and Seal air temp after fan		°C	29.0	29.7	29.3	Test T/C, wtd. avg.
19	Heated underfire air temperature		°C	142.9	144.4	143.6	Test T/C Grid wtd avg.
20	Barometric pressure		mbara	- -		1012.2	Barometer
21	Moisture in combustion air		kg/kg dry ai			0.0062	Calculated
22	CO_2 in dry flue gas		% vol	11.570	11.828	11.70	Manually @ Econ. Outlet
23	O_2 in dry flue gas		% vol	7.611	7.217	7.42	Manually @ Econ. Outlet
24	N_2 in dry flue gas		% vol	80.819	80.956	80.89	Calculated
25	H_2O in flue gas		% vol	15.628	15.493	15.56	Manually @ Econ. Outlet
26	Flue gas flow		act m^3/h	89,630	84,960	174,591	Manually @ Econ. Outlet
27	Economizer exit gas temp.		°C	165.1	165.2	165.2	Station Instrument
28	Sampling point gas temp.		°C	166.8	164.8	165.9	Manually @ Econ. Outlet
	Residue:						
	Sample (Bottom Ash)						
29	Fines (-2")		kg			1,026	Manual Residue Sampling
30	Overs (+2")		kg			39	Manual Residue Sampling
	Total Flow						
31	Grizzly Rejects		kg		0	0	Combined with Ferrous
32	Ferrous		kg		2.547%	3,680	Ratio from 5-Day Test
33	Non-Ferrous		kg		0.362%	524	Ratio from 5-Day Test
34	Bottom Ash		kg		20.892%	30,194	Ratio from 5-Day Test
35	Fly Ash	**10.00%**	kg		2.089%	3,019	Calculated from assumed %
36	Moisture in -2" bottom ash bottom ash		%			16.5	Laboratory Analysis
37	Combustibles in -2" bottom ash		dry %			0.42	Laboratory Analysis
38	Moisture in flyash leaving test boundary		%			0.0	Assumed zero %
39	Combustibles in flyash		dry %			0.42	Assumed same % as BA
40	Ash discharger water bath temp		°C	38.4	51.4	44.9	Test Thermocouples
41	Turbine Gross MW		MWG			17.09	Station Instrument
42	Net MW Exported		MWN			14.98	Station Instrument
43	Turbine Exhaust Pressure		bara			0.076	Station Instrument (Exh. Temp)
44	ACC Ambient Air Temperature		°C			12.5	Station Instrument
45	Annual average dry bulb temp.		°C	-		8.0	Historical weather data
****	**********	**********	**********	**********	1	**********	**********

AS TESTED PERFORMANCE PARAMETERS

TABLE 2

RESIDUE ANALYSIS

Sample Weights		Bottom Ash kg		Bottom Ash %
	+2" to -8" Material	39		3.7
	-2" Material	+ 1,026	+	96.3
	-8" Material	1,065		100.0

Total Weights			Bottom Ash (kg)	Flyash (kg)
	Bottom & Fly Ash (Excluding +8" Grizzly Material & All Metals)		30,194	3,019
-2" Ash	-2" Wet Bottom Ash @	96.3%	29,076	
	Moisture of wet bottom as	16.5%	4,798.6	
	Dry Aggregate (by difference)		24,278	3,019
	Combustibles of dry aggre	0.42%	101	13
	Dry Ash (by difference)		24,177	3,007
	Total +2" to (-8")	3.7%	1,117	
	+8" Grizzly Material, Ferrous & Non-Ferrous Metals (metals and inerts)		4,204	

Component Weights	Bottom Ash kg	Bottom Ash (1) kg/h	Bottom Ash (2) %	Bottom Ash (3) kg/kg fuel	Fly Ash kg	Fly Ash (1) kg/h	Fly Ash (2) %	Fly Ash (3) kg/kg fuel
Dry Ash + Inerts:								
-2" Ash	24,177	3,022			3,007	376		
+2" to (-8")	1,117	140						
+8" Grizzly, Ferrous & Non-Fe	4,204	526						
Subtotal	29,498	3,687	90.43	0.2041	3,007	376	9.22	0.0208
Unburned Combustible								
-2" Combustible	101	12.7			13	1.6		
+2" to (-8") Combustible	0	0			0	0		
Subtotal	101	12.7	0.31	0.0007	13	1.6	0.04	0.0001
Total Dry Residue :	**29,599**	**3,699.9**	**90.7**	**0.205**	**3,019**	**377**	**9.3**	**0.021**

Notes:
(1) Divisor is 8 hours
(2) % of Total Dry Residue (excluding Carbon Injection)
(3) Divisor is 18,066 kg/hr of refuse

TABLE 3

FLUE GAS FLOW & ANALYSIS
(Based on Average Data for Test Runs @ Econ. Exit)

	% VOL (DRY)	% VOL (WET)	M.W. kg/kg-mol	R.W. (DRY)	R.W. (WET)	% WT (DRY)	% WT (WET)	KG/HR
CO2	11.570	9.762	44.010	5.092	4.296	16.88	15.20	20,808
O2	7.611	6.422	32.000	2.436	2.055	8.07	7.27	9,954
N2	80.819	68.189	28.016	22.642	19.104	75.05	67.58	92,536
H2O		15.628	18.016	0.000	2.815	0.00	9.96	13,636
Totals	100.0	100.00		30.170	28.270	100.0	100.0	136,934

From flue gas report, average flow = 174,591 a m3/hr
Gas temperature @ sampling point = 165.85354 °C

Specific volume = $\frac{8.314 \times (273.15 + 165.85354 \text{ °F})}{28.27 \times (1.013 \text{ bara}) \times (\text{cm2/m2})}$ = 1.275 m3/kg

Wet gas mass flow = 174,591 / 1.275 = 136,934 kg/hr 137.8%

Percent excess air = $\frac{(O2 - CO/2) \times 100}{0.2682 \times N2 - (O2 - CO/2)}$ = 54.12 %

(per ASME PTC 19.10 Flue and Exhaust Gas Analysis, Section 6.03.6.3.1)

		deg C	deg Kelvin	deg F
Enthalpies From PTC-4, 5.19.4 & 5.19.11	Flue Gas Temp @ econ out	165.2	438.3	329.3

	Flue Gas @ Economizer Outlet		
	Enth. (H) (kJ/kg)	R.H. (WET)	R.H. (DRY)
CO2	127.56	19.38	21.53
O2	130.93	9.52	10.57
N2	144.96	97.96	108.79
H2O	265.13	26.40	0.00
Totals		153.27	140.89

********** ********** ********** ********** ********** 3 ********** ********** ********** **********

Total Measured Air Flow

Average compensated total wet air flow in Reference m^3/hr (25 °C) is taken from Table 1.

Total Wet Air Flow = 83,489 m^3/hr at 25 °C reference temperature
(Compensated)

$$\text{Specific Volume of Dry Air} = \frac{(25.00 + 273.15) \times 8.314}{1.012 \times 28.97} = 0.8453 \text{ } m^3/kg$$

$$\text{Dry Air Density} = \frac{1}{0.8453} = 1.1830 \text{ } kg/m^3$$

Wet Air Density = 1.0062 kg wet air/kg dry air x 1.1830 kg dry air/m^3 = 1.1904 kg wet air/m^3

Total Measured Wet Air 83,489 m^3/h x 1.1904 kg wet air/m^3

= **99,382** kg/hr

Moisture in Total Measure Air = (0.0062 x 99,382) / (1 + 0.0062) = **613.4** kg/hr

Overfire Air and Seal Air Flow

Average compensated wet overfire air flow & seal air flow in Reference m^3/hr (25 °C) is taken from Table 1.

Wet Overfire Air Flow = 13,265 m^3/hr at 25 °C temperature & 1.013 bara
Wet Seal Air Flow = 3,252 m^3/hr at 25 °C temperature & 1.013 bara
Combined OFA & Seal Air Flow = 13,265 + 3,252 = 16,517 Ref. m^3/hr

$$\text{Specific Volume of Dry Air} = \frac{(25.0 + 273.15) \times 8.314}{1.012 \times 28.97} = 0.8453 \text{ } m^3/kg$$

$$\text{Dry Air Density} = \frac{1}{0.8453} = 1.1830 \text{ } kg/m^3$$

Wet Air Density = 1.0062 kg wet air/kg dry air x 1.1830 kg dry air/m^3 = 1.1904 kg wet air/m^3

OFA & Seal Air (Wet) = 16,517 m^3/h x 1.1904 kg wet air/m^3

= **19,661** kg/hr

Moisture in OFA & Seal Air = (0.0062 x 19,661) / (1 + 0.0062) = **121.3** kg/hr

Wet Underfire Air =
Total Wet Air - Wet OFA & Seal Air = 99,382 - 19,661 = **79,721** kg/hr
Moisture in Underfire air =
Total Air H_2O - OF & Seal Air H_2O = 613.4 - 121.3 = **492.1** kg/hr

********** ********** ********** ********** ********** 4 ********** ********** ********** **********

(Continued from Page 4)

Assume ref. waste N2 content of test fuel = 0.87 %
Therefore, N2 in flue gas from fuel =

18,066 kg fuel/hr x 0.0087 kg N2/kg fuel = 157 kg/hr

N2 in flue gas = 92,536 kg/hr

Total dry comb. air supplied = $\frac{92{,}536 - 157}{0.7685}$ = **120,207** kg/hr
(Incl. Air Infiltration)

Moisture in air = 0.0062 kg/kg dry air from psychrometric chart for
19.35 °C db / 12.50 °C wb, therefore

Moisture in Calculated Total Air = 0.0062 x 120,207 = **746.5** kg/hr

Total Calculated wet air = 120,207 + 746.5 = **120,954** kg/hr
(Including Air Infiltration & VLN cooling air)

Total Calculated Wet Air (including air infiltration & VLN cooling air) is greater than Total Measured Wet Air
Wet Air Infiltration (incl. VLN cooling air) = Calculated Total Wet Air - Measured Total Wet Air
= 120,954 - 99,382
= 21,572 kg/hr

Wet Un-heated Air = Total Wet Air - Wet UFA
= 120,954 - 79,721
= 41,233 kg/hr

Moisture in Wet Air Infiltration (incl. VLN cooling air) = Total Air Moisture - Moisture in Measured Total Ai
= 746.5 - 613.4
= 133.1 kg/hr

********** ********** ********** ********** ********** 5 ********** ********** **********

Calculated moisture in Flue Gas from H2 and H2O in fuel and Ash Discharger Quench Water Vapor:

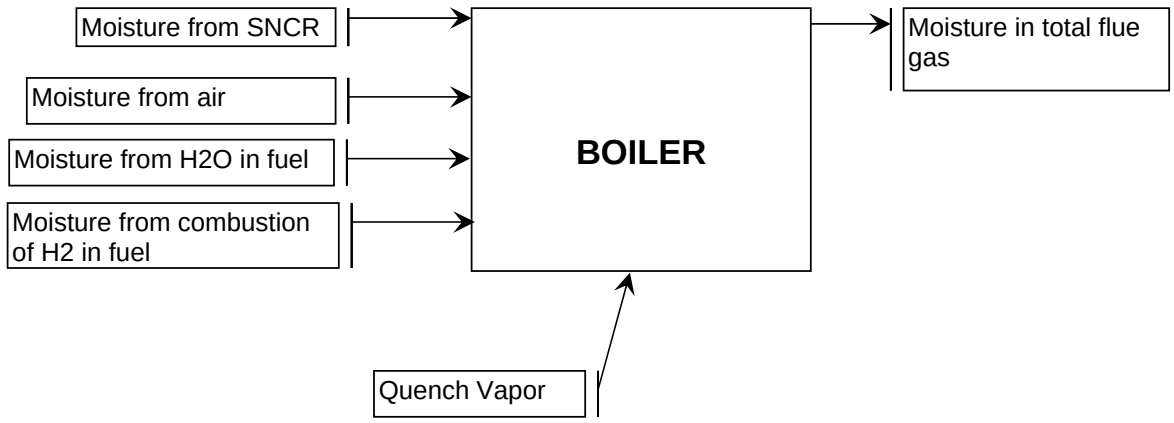
A water balance around the boiler gives:

Vapor in flue gas = moisture from H2 and H20 in the fuel + moisture in air + quench vapor + SNCR & carrier water

Therefore:

Moisture from H2 and H2O in fuel + quench vapor + SNCR & carrier water = Vapor in gas - moisture in air

=	13,636		-	746.5	
=	12,889	kg/hr	=	0.713	kg/kg FUEL



DATA FOR HEAT OUTPUT AND LOSS CALCULATIONS

Enthalpy of feedwater @	136.03887	°C,	10209.13	kPa	578.78 kJ/kg
Enthalpy of drum water @ saturated pressure			9736.23	kPa	1396.40 kJ/kg
Enthalpy of steam @	500.81423	°C,	8945.18	kPa	3390.03 kJ/kg
Enthalpy of dry underfire air at 143.6°C comb. temp. referenced to 25°C					119.82 kJ/kg
Enthalpy of dry overfire air at 29.3°C air temp. referenced to 25°C					4.37 kJ/kg
Enthalpy of dry flue gas at 165.2°C econ exit temp. referenced to 25°C					140.89 kJ/kg
Enthalpy of liquid water @ the amb. air temperature of 19.4°C ref. 0°C					81.04 kJ/kg
Enthalpy of water vapor @ UFA temp. of 143.6°C ref. 25°C					223.84 kJ/kg
Enthalpy of water vapor @ the OFA temp. aft. fan of 29.3°C ref. 25°C					8.05 kJ/kg
Enthalpy of steam vapor @ 165.2°C and 1 psia referenced to 0°C					2812.34 kJ/kg
Enthalpy of liquid water @ reference temperature of 25°C ref. 0°C					104.67 kJ/kg
Enthalpy of water vapor @ econ exit temp. of 165.2°C referenced to 25°C					265.1 kJ/kg
Enthalpy of ash discharger water bath @ 44.9°C					188.0 kJ/kg
Enthalpy of dry residue @ air inlet temp of 19.4°C			292.5	°K	-4.220 kJ/kg
Enthalpy of dry residue @ ash discharger temp of 44.9°C or			318.1	°K	15.277 kJ/kg
Enthalpy of dry fly ash @ econ. exit temp. of 165.2°C or			438.3	°K	119.397 kJ/kg
HHV of unburned combustibles					27,913 kJ/kg
Radiation & convection loss per ASME PTC 34, Fig. I-1					
with	98.1	GJ/hr actual average heat output per boiler, 2 boilers =			1.518 GJ/hr
Enthalpy of dry fuel @ ambient temp. of 19.4°C ref. 25°C					-4.208 kJ/kg
Enthalpy of liquid water @ ambient temp. of 19.4°C ref. 25°C					-23.6 kJ/kg

Reference documents:

ASME Performance Test Code for Fired Steam Generators, ASME PTC 4
ASME Performance Test Code for Waste Combustor with Energy Recovery, ASME PTC 34
ASME Steam Tables 1967 Edition

Table 4 - Reference Composition Acceptable Waste

Energy Content 13,000 kJ (HHV) per kilogram

REFERENCE WASTE ULTIMATE ANALYSIS

	%
Moisture	15.16
Total Inert	15.92
Carbon	31.73
Hydrogen	4.56
Oxygen	31.35
Nitrogen	0.87
Sulfur	0.04
Chlorine	0.31
Flourine	0.030
Iron, oxidizable	0.030
	100.00

BOILER EFFICIENCY CALCULATION
AS TESTED CONDITIONS
-HEAT LOSS METHOD-
(ASME PTC 34, SECTION 5.11)

kJoule per kg A.F. Fuel

HEAT OUTPUT due to-

Steam:
(kg/hr of fluid)/(kg/hr fuel) x (h out - h in, kJ/kg)
69,772 / 18,066 x (3,390.03 - 578.78) = 10,857.47

Blowdown:
(kg/hr of fluid)/(kg/hr fuel) x (h out - h in, kJ/kg)
- / 18,066 x (1,396.40 - 578.78) 0.00

Total Heat Output: = 10,857.47

HEAT LOSSES due to-

Dry gas:
(kg/hr dry gas)/(kg/hr fuel) x (flue gas h @ Tgas econ exit ref. 25°C, kJ/kg)
123,298 / 18,066 x (140.89) = 961.60

Moisture from H2 and H2O in fuel, ash discharger quench water vapor and SNCR carrier water:
(kg/hr moisture)/(kg/hr fuel) x (h econ gas exit @ 1 psia - h liquid @ T = 25°C, kJ/kg)
12,889 / 18,066 x (2812.34 - 104.67) = 1931.86

Ash discharger quench water:
Liquid: (kg/hr liquid)/(kg/hr fuel) x (h water @ Tquench - h water @ Tamb air, kJ/kg)
600 / 18,066 x (188.03 - 81.04) = 3.55

Sensible heat in dry bottom residue:
(kg/hr dry residue)/(kg/hr fuel) x (h res @ Tquench - h res @Tamb air, kJ/kg)
3,700 / 18,066 x (15.277 - -4.220) = 3.99

Sensible heat in dry fly ash residue:
(kg/hr dry residue)/(kg/hr fuel) x (h res @ Tecon exit - h res @Tamb air, kJ/kg)
377 / 18,066 x (119.397 - -4.220) = 2.58

Moisture from total air:
(kg/hr air moisture)/(kg/hr fuel) x (h water vap @ Tgas econ exit ref. 25°C, kJ/kg)
747 / 18,066 x (265.1) = 10.96

Unburned combustibles:
(lb unburned combustibles/hr)/(kg/hr fuel) x HHV unburned
14.27 / 18,066 x 27,913 = 22.05

Radiation & Convection Loss:
Per ASME PTC 34, Fig. I-1 = 1.518 GJ/hr
1,518,119 / 18,066 = 84.03

Unaccounted for:
0.5 % of heat output and losses (heat input) = 69.74
0.005 x (10,857.5 + 3,090.4)

Total Heat Losses: = 3090.36

HEAT CREDITS due to-

kJoule per kg A.F. Fuel

Dry underfire air sensible heat:
(kg/hr dry air)/(kg/hr fuel) x (h in @ 143.6°C ref. 25°C, kJ/kg)
79,229 / 18,066 x (119.82) = 525.47

Dry overfire air, seal air & air infiltration sensible heat:
(kg/hr dry air)/(kg/hr fuel) x (h in @ 29.3°C ref. 25°C, kJ/kg)
40,978 / 18,066 x (4.37) = 9.92

Moisture in incoming underfire air:
(kg/hr moisture)/(kg/hr fuel) x (h vap in @ 143.6°C ref 25°C, kJ/kg)
492.1 / 18,066 x (223.84) = 6.10

Moisture in incoming overfire, seal air & air infiltration:
(kg/hr moisture)/(kg/hr fuel) x (h vap in @ 29.3°C ref 25°C, kJ/kg)
254.4 / 18,066 x (8.05) = 0.11

Fuel sensible heat:
(dry fuel, lb dry fuel/lb fuel) x (h in @ ambient air temp of 19.4°C ref 25°C, kJ/kg) +
(moisture in fuel, lb H2O/lb fuel) x (h in @ ambient air temp of 19.4°C ref 25°C, kJ/kg)
0.848 x -4.208 + 0.152 x -23.64 = -7.15

Total Heat Credits: 534.45

Gross Heat Input = HHV of Fuel + Heat Credit = Heat Output + Heat Losses

or

HHV of FUEL = Heat Output + Heat Losses - Heat Credit
= 10857.47 + 3090.36 - 534.45
= **13,413** kJ/kg

EFFICIENCY= (1 - (Heat Losses/Heat Input))*100= (1 - 3090.36 / 13,948) x 100 = **77.84** %

Gross Heat Input = 13,948 kJ/kg

HEAT LOSS SUMMARY:

	%
Dry gas:	6.89
Moisture from H2 and H2O in fuel, ash discharger quench water vapor & SNCR:	13.85
Moisture from total air:	0.08
Ash discharger quench water: Liquid:	0.03
Sensible heat in dry bottom residue:	0.03
Sensible heat in dry fly ash:	0.02
Unburned combustibles:	0.16
Radiation/Correction:	0.60
Unaccounted for:	0.50
Total Heat Losses:	22.16

Adjustment For Annual Average Dry Bulb Temperature

Turbine performance is dependent upon exhaust vacuum, which is dependent upon air-cooled condenser (ACC) performance. ACC performance is dependent upon the dry bulb ambient air temperature. An adjustment is made to the as-tested ACC performance for the difference between the average annual dry bulb temperature and the as-tested dry bulb temperature. Per average local weather conditions: (see Procedures page 10)

The average annual dry bulb temperature = 8 °C

Air-Cooled Condenser Performance:

The as-tested ACC ambient dry bulb temperature was: **12.5** °C
Per the ACC performance curve, (see Figures section) the condenser vacuum corresponding to the as-tested dry bulb temperature of 12.5 °C is: 79.5 mbara
Per the ACC performance curve, the condenser vacuum corresponding to the average annual dry bulb temperature of 8 °C is: 68.0 mbara
Therefore, the correction to exhaust pressure for temperature difference is 11.5 mbar

Turbine Performance:

Per the curve defining change in exhaust pressure vs. change in turbine-generator output (see page 12 of procedures), a 11.5 mbar change in exhaust pressure at design throttle flow results in a 0.68% change in turbine heat rate. Therefore, the overall adjusted gross electrical output is :

17.09 * (1 + 0.0068) = 17.21 **MWG**

The MW correction is also added to the as-tested NET electrical exported:

14.98 + 17.21 - 17.09 = 15.09 **MWN**

See SAMPLE CALCULATION CURVES at the end of these procedures.

Adjusted Power Outputs Per Ton:

Gross Electrical Output = 17,210 kW adjusted for annual average dry bulb temperature. / 18.066 Actual TPH = 953 kWh/tonne

Compared to the guarantee of 903 kWh/tonne at the same HHV.

Surpassing the guarantee by: 50 kWh/tonne
or 5.5%

Net Electrical Export = 15,093 kW adjusted for annual average dry bulb temperature. / 18.066 Actual TPH = 835 kWh/tonne

Compared to the guarantee of 799 kWh/tonne at the same HHV.

Surpassing the guarantee by: 37 kWh/tonne
or 4.6%

Crane Calibration Drift Adjustment Calculation Energy Recovery 5

Reference Weight (Reference Block Weight)	**3,926**	kg			
Initial Span Check Reading	3,881.7	@	10/1/2015 7:31		
Final Span Check Reading	3,876.7	@	10/1/2015 17:31		
Average of the Initial and Final Span Checks	**3,879**	kg			
Difference between Average and Reference Weight	**-47**	kg	>	45.4	kg
Adjustment to each grapple feed is warranted.					

	144,780						**Adjustment Factor 1.004366454**		145,412
Feed at	**Feed Weight Reading (kg)**	**Ref. Weight (Drifted, by Equation)**	**Difference (Drift)**	**% Difference (% Drift)**		**Feed Weight % of Ref. Drifted Weight**	**Proportioned Drift (%)**	**Feed Weight Drifted**	**Adjusted Feed Weight (kg)**
10/1/15 9:08	2,042.0	3,884.8	-41.2	-1.05%		52.56%	-0.55%	-11.27	**2,053.27**
10/1/15 9:11	1,879.0	3,884.9	-41.1	-1.05%		48.37%	-0.51%	-9.52	**1,888.52**
10/1/15 9:22	2,017.0	3,885.2	-40.8	-1.04%		51.91%	-0.54%	-10.88	**2,027.88**
10/1/15 9:24	2,132.0	3,885.3	-40.7	-1.04%		54.87%	-0.57%	-12.13	**2,144.13**
10/1/15 9:32	2,005.0	3,885.5	-40.5	-1.03%		51.60%	-0.53%	-10.67	**2,015.67**
10/1/15 9:39	2,445.0	3,885.7	-40.3	-1.03%		62.92%	-0.65%	-15.78	**2,460.78**
10/1/15 9:43	2,378.0	3,885.9	-40.1	-1.02%		61.20%	-0.63%	-14.88	**2,392.88**
10/1/15 9:46	1,918.0	3,886.0	-40.0	-1.02%		49.36%	-0.50%	-9.65	**1,927.65**
10/1/15 10:02	1,241.0	3,886.5	-39.5	-1.01%		31.93%	-0.32%	-3.99	**1,244.99**
10/1/15 10:07	1,804.0	3,886.6	-39.4	-1.00%		46.42%	-0.47%	-8.40	**1,812.40**
10/1/15 10:11	1,129.0	3,886.8	-39.2	-1.00%		29.05%	-0.29%	-3.28	**1,132.28**
10/1/15 10:16	1,129.0	3,886.9	-39.1	-1.00%		29.05%	-0.29%	-3.27	**1,132.27**
10/1/15 10:21	1,376.0	3,887.1	-38.9	-0.99%		35.40%	-0.35%	-4.83	**1,380.83**
10/1/15 10:24	2,133.0	3,887.2	-38.8	-0.99%		54.87%	-0.54%	-11.57	**2,144.57**
10/1/15 10:32	1,700.0	3,887.4	-38.6	-0.98%		43.73%	-0.43%	-7.31	**1,707.31**
10/1/15 10:34	780.0	3,887.5	-38.5	-0.98%		20.06%	-0.20%	-1.54	**781.54**
10/1/15 10:36	2,036.0	3,887.6	-38.4	-0.98%		52.37%	-0.51%	-10.44	**2,046.44**
10/1/15 10:42	1,572.0	3,887.7	-38.3	-0.97%		40.43%	-0.39%	-6.19	**1,578.19**
10/1/15 10:46	1,358.0	3,887.8	-38.2	-0.97%		34.93%	-0.34%	-4.61	**1,362.61**
10/1/15 10:51	2,093.0	3,888.0	-38.0	-0.97%		53.83%	-0.52%	-10.90	**2,103.90**
10/1/15 10:59	1,680.0	3,888.3	-37.7	-0.96%		43.21%	-0.42%	-6.98	**1,686.98**
10/1/15 11:07	1,463.0	3,888.5	-37.5	-0.95%		37.62%	-0.36%	-5.25	**1,468.25**
10/1/15 11:12	828.0	3,888.7	-37.3	-0.95%		21.29%	-0.20%	-1.68	**829.68**
10/1/15 11:22	2,101.0	3,889.0	-37.0	-0.94%		54.02%	-0.51%	-10.70	**2,111.70**
10/1/15 11:25	2,309.0	3,889.1	-36.9	-0.94%		59.37%	-0.56%	-12.89	**2,321.89**
10/1/15 11:31	1,474.0	3,889.3	-36.7	-0.94%		37.90%	-0.35%	-5.23	**1,479.23**
10/1/15 11:41	2,454.0	3,889.6	-36.4	-0.93%		63.09%	-0.58%	-14.35	**2,468.35**
10/1/15 11:47	1,821.0	3,889.8	-36.2	-0.92%		46.81%	-0.43%	-7.86	**1,828.86**
10/1/15 11:53	875.0	3,890.0	-36.0	-0.92%		22.49%	-0.21%	-1.81	**876.81**
10/1/15 12:04	1,856.0	3,890.3	-35.7	-0.91%		47.71%	-0.43%	-8.05	**1,864.05**
10/1/15 12:06	1,165.0	3,890.4	-35.6	-0.91%		29.95%	-0.27%	-3.17	**1,168.17**
10/1/15 12:10	2,037.0	3,890.5	-35.5	-0.90%		52.36%	-0.47%	-9.65	**2,046.65**
10/1/15 12:12	1,752.0	3,890.6	-35.4	-0.90%		45.03%	-0.41%	-7.12	**1,759.12**
10/1/15 12:19	1,998.0	3,890.8	-35.2	-0.90%		51.35%	-0.46%	-9.21	**2,007.21**
10/1/15 12:20	1,847.0	3,890.8	-35.2	-0.90%		47.47%	-0.43%	-7.85	**1,854.85**
10/1/15 12:31	2,099.0	3,891.2	-34.8	-0.89%		53.94%	-0.48%	-10.04	**2,109.04**
10/1/15 12:33	1,830.0	3,891.2	-34.8	-0.89%		47.03%	-0.42%	-7.62	**1,837.62**
10/1/15 12:42	1,293.0	3,891.5	-34.5	-0.88%		33.23%	-0.29%	-3.77	**1,296.77**
10/1/15 12:49	1,225.0	3,891.7	-34.3	-0.87%		31.48%	-0.27%	-3.36	**1,228.36**
10/1/15 12:58	2,170.0	3,892.0	-34.0	-0.87%		55.76%	-0.48%	-10.47	**2,180.47**
10/1/15 13:03	2,158.0	3,892.2	-33.8	-0.86%		55.44%	-0.48%	-10.31	**2,168.31**
10/1/15 13:09	2,143.0	3,892.4	-33.6	-0.86%		55.06%	-0.47%	-10.11	**2,153.11**
10/1/15 13:18	2,132.0	3,892.6	-33.4	-0.85%		54.77%	-0.47%	-9.92	**2,141.92**
10/1/15 13:22	2,239.0	3,892.8	-33.2	-0.85%		57.52%	-0.49%	-10.89	**2,249.89**
10/1/15 13:36	2,023.0	3,893.2	-32.8	-0.83%		51.96%	-0.43%	-8.78	**2,031.78**
10/1/15 13:42	2,010.0	3,893.4	-32.6	-0.83%		51.63%	-0.43%	-8.62	**2,018.62**
10/1/15 13:44	2,060.0	3,893.5	-32.5	-0.83%		52.91%	-0.44%	-9.03	**2,069.03**
10/1/15 13:54	2,216.0	3,893.8	-32.2	-0.82%		56.91%	-0.47%	-10.35	**2,226.35**
10/1/15 13:58	1,716.0	3,893.9	-32.1	-0.82%		44.07%	-0.36%	-6.18	**1,722.18**
10/1/15 14:09	1,867.0	3,894.3	-31.7	-0.81%		47.94%	-0.39%	-7.23	**1,874.23**
10/1/15 14:17	1,635.0	3,894.5	-31.5	-0.80%		41.98%	-0.34%	-5.51	**1,640.51**
10/1/15 14:24	1,861.0	3,894.7	-31.3	-0.80%		47.78%	-0.38%	-7.08	**1,868.08**
10/1/15 14:31	1,980.0	3,894.9	-31.1	-0.79%		50.84%	-0.40%	-7.96	**1,987.96**
10/1/15 14:35	2,644.0	3,895.1	-30.9	-0.79%		67.88%	-0.53%	-14.14	**2,658.14**
10/1/15 14:38	2,248.0	3,895.2	-30.8	-0.79%		57.71%	-0.45%	-10.18	**2,258.18**
10/1/15 14:49	1,918.0	3,895.5	-30.5	-0.78%		49.24%	-0.38%	-7.33	**1,925.33**
10/1/15 14:54	2,257.0	3,895.7	-30.3	-0.77%		57.94%	-0.45%	-10.10	**2,267.10**
10/1/15 15:04	2,710.0	3,896.0	-30.0	-0.76%		69.56%	-0.53%	-14.41	**2,724.41**
10/1/15 15:08	2,274.0	3,896.1	-29.9	-0.76%		58.37%	-0.44%	-10.11	**2,284.11**
10/1/15 15:18	2,108.0	3,896.4	-29.6	-0.75%		54.10%	-0.41%	-8.59	**2,116.59**
10/1/15 15:21	2,507.0	3,896.5	-29.5	-0.75%		64.34%	-0.48%	-12.12	**2,519.12**
10/1/15 15:34	1,883.0	3,896.9	-29.1	-0.74%		48.32%	-0.36%	-6.74	**1,889.74**
10/1/15 15:37	2,202.0	3,897.0	-29.0	-0.74%		56.50%	-0.42%	-9.19	**2,211.19**
10/1/15 15:40	2,080.0	3,897.1	-28.9	-0.74%		53.37%	-0.39%	-8.17	**2,088.17**
10/1/15 15:46	2,001.0	3,897.3	-28.7	-0.73%		51.34%	-0.38%	-7.51	**2,008.51**
10/1/15 15:57	2,462.0	3,897.6	-28.4	-0.72%		63.17%	-0.46%	-11.23	**2,473.23**
10/1/15 16:07	2,165.0	3,898.0	-28.0	-0.71%		55.54%	-0.40%	-8.59	**2,173.59**
10/1/15 16:11	1,609.0	3,898.1	-27.9	-0.71%		41.28%	-0.29%	-4.72	**1,613.72**
10/1/15 16:20	1,163.0	3,898.4	-27.6	-0.70%		29.83%	-0.21%	-2.44	**1,165.44**
10/1/15 16:22	1,469.0	3,898.4	-27.6	-0.70%		37.68%	-0.26%	-3.89	**1,472.89**
10/1/15 16:27	2,248.0	3,898.6	-27.4	-0.70%		57.66%	-0.40%	-9.05	**2,257.05**
10/1/15 16:32	2,046.0	3,898.8	-27.2	-0.69%		52.48%	-0.36%	-7.45	**2,053.45**
10/1/15 16:42	1,351.0	3,899.1	-26.9	-0.69%		34.65%	-0.24%	-3.21	**1,354.21**
10/1/15 16:46	2,414.0	3,899.2	-26.8	-0.68%		61.91%	-0.42%	-10.20	**2,424.20**
10/1/15 16:51	2,626.0	3,899.4	-26.6	-0.68%		67.34%	-0.46%	-12.00	**2,638.00**
10/1/15 16:53	2,434.0	3,899.4	-26.6	-0.68%		62.42%	-0.42%	-10.28	**2,444.28**
10/1/15 17:06	477.0	3,899.8	-26.2	-0.67%		12.23%	-0.08%	-0.39	**477.39**

Covanta - Durham York Energy Centre
Boiler No. 1 Scrubber Inlet
Stack Gas Physical Parameters and Volumetric Flowrates
October 1, 2015

Test No.	Test Time	Gas Temp.	Moisture by Volume	Gas Velocity	Static Pressure	Barometric Pressure	Absolute Pressure	Carbon Dioxide by Volume	Oxygen by Volume	Carbon Monoxide By Volume	Actual Flowrate	Dry Reference Flowrate	Wet Reference Flowrate
		°C	%	m/s	kPa	kPa	kPa	% *	% *	ppm*	m^3/s	Rm^3/s **	Rm^3/s**
1	9:08 - 9:16	168	15.9	16.7	-0.50	101.8	101.3	11.7	7.59	15.3	24.7	14.1	16.7
2	9:38 - 9:45	167	15.9	16.5	-0.50	101.8	101.3	11.4	7.94	11.1	24.4	13.9	16.6
3	10:08 - 10:15	166	15.9	16.9	-0.47	101.8	101.3	10.8	8.36	16.7	24.9	14.2	16.9
4	10:38 - 10:46	167	15.9	17.1	-0.47	101.8	101.3	11.7	7.50	17.7	25.2	14.4	17.1
5	11:35 - 11:41	167	15.2	16.0	-0.52	101.8	101.3	10.8	8.45	39.4	23.6	13.6	16.0
6	12:05 - 12:10	166	15.2	15.9	-0.45	101.8	101.4	12.2	7.04	37.4	23.5	13.6	16.0
7	12:35 - 13:41	169	15.2	17.4	-0.55	101.8	101.3	12.3	6.92	17.8	25.8	14.7	17.4
8	13:04 - 13:09	168	15.2	17.3	-0.47	101.7	101.2	11.5	7.88	11.2	25.5	14.6	17.3
9	14:05 - 14:11	166	15.1	16.5	-0.45	101.7	101.3	11.9	7.20	11.2	24.4	14.1	16.6
10	14:37 - 14:42	167	15.1	17.0	-0.45	101.7	101.3	11.9	7.22	12.0	25.1	14.5	17.0
11	15:03 - 15:09	167	15.1	17.2	-0.55	101.7	101.2	11.9	7.25	22.4	25.3	14.6	17.2
12	15:34 - 15:40	167	15.1	17.0	-0.52	101.7	101.2	11.7	7.50	14.1	25.1	14.4	17.0
13	16:28 - 16:34	168	16.3	17.5	-0.50	101.7	101.2	11.0	7.93	12.4	25.9	14.6	17.5
14	16:57 - 17:05	167	16.3	17.1	-0.55	101.7	101.2	10.9	8.21	13.4	25.3	14.3	17.1
15	17:28 - 17:34	166	16.3	16.3	-0.52	101.7	101.2	11.6	7.54	16.0	24.1	13.7	16.4
16	18:00 - 18:06	167	16.3	17.0	-0.47	101.8	101.3	12.0	7.07	10.0	25.1	14.2	17.0
Average		167	15.6	16.8	-0.50	101.8	101.3	11.6	7.60	17.4	24.9	14.2	16.9

* Dry basis

** Reference conditions; 25°C and 1 atm

Covanta - Durham York Energy Centre
Boiler No. 2 Scrubber Inlet
Stack Gas Physical Parameters and Volumetric Flowrates
October 1, 2015

Test No.	Test Time	Gas Temp.	Moisture by Volume	Gas Velocity	Static Pressure	Barometric Pressure	Absolute Pressure	Carbon Dioxide by Volume	Oxygen by Volume	Carbon Monoxide By Volume	Actual Flowrate	Dry Reference Flowrate	Wet Reference Flowrate
		°C	%	m/s	kPa	kPa	kPa	% *	% *	ppm*	m^3/s	Rm^3/s **	Rm^3/s**
1	9:01 - 9:08	165	16.8	17.6	-0.45	101.8	101.4	10.3	9.17	35.7	26.0	14.7	17.7
2	9:30 - 9:37	163	16.8	15.7	-0.45	101.8	101.4	11.8	7.51	40.8	23.1	13.2	15.8
3	10:00 - 10:08	158	16.8	15.7	-0.45	101.8	101.4	11.1	8.25	31.7	23.2	13.4	16.1
4	10:31 - 10:38	164	16.8	15.9	-0.45	101.8	101.4	11.7	7.24	31.6	23.5	13.3	16.0
5	11:28 - 11:34	167	16.7	16.0	-0.42	101.8	101.4	11.8	7.38	34.4	23.6	13.3	16.0
6	11:57 - 12:04	167	16.7	16.0	-0.42	101.8	101.4	11.4	7.82	32.8	23.7	13.4	16.1
7	12:28 - 12:34	168	16.7	16.5	-0.42	101.8	101.4	12.6	6.68	24.1	24.3	13.7	16.5
8	12:57 - 13:03	167	16.7	16.0	-0.45	101.7	101.3	11.5	7.92	28.8	23.7	13.4	16.0
9	13:57 - 14:04	165	16.6	15.8	-0.42	101.7	101.3	12.0	7.00	61.3	23.4	13.3	15.9
10	14:26 - 14:34	164	16.6	15.5	-0.42	101.7	101.3	11.2	7.96	114.2	22.9	13.0	15.6
11	14:57 - 15:03	165	16.6	15.4	-0.42	101.7	101.3	11.9	7.21	16.1	22.8	12.9	15.5
12	15:27 - 15:33	167	16.6	15.9	-0.40	101.7	101.3	12.5	6.69	13.3	23.4	13.2	15.9
13	16:21 - 16:27	168	16.6	16.5	-0.42	101.7	101.3	13.0	5.60	17.0	24.3	13.7	16.4
14	16:50 - 16:57	167	16.6	16.4	-0.42	101.7	101.3	11.5	7.14	16.7	24.3	13.7	16.4
15	17:20 - 17:27	165	16.6	15.2	-0.45	101.7	101.3	11.8	6.73	19.2	22.4	12.7	15.2
16	17:52 - 17:58	164	16.6	15.3	-0.42	101.7	101.3	13.2	5.17	30.3	22.7	12.9	15.4
Average		165	16.7	16.0	-0.43	101.7	101.3	11.8	7.22	34.3	23.6	13.4	16.0

* Dry basis

** Reference conditions; 25°C and 1 atm

SGS

Analysis Report

October 13, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.5 Run 1	Sample ID By:	Covanta
Date Sampled:	Oct 1, 2015	Sample Taken At:	Submitted
Date Received:	Oct 5, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R.5

SGS Minerals Sample ID: 491-1588334-001

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	16.51	
Sulfur %	ASTM D4239 (A)	1.35	1.61
Gross Calorific Value Btu/lb	ASTM D5865		<100

Vanessa Chambliss
Branch Manager

SGS North America Inc. | Minerals Services Division
16130 Van Drunen Road South Holland IL 60473 t (708) 331-2900 f (708) 333-3060 www.sgs.com/minerals

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SGS

Analysis Report

October 13, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.5 Run 2	Sample ID By:	Covanta
Date Sampled:	Oct 1, 2015	Sample Taken At:	Submitted
Date Received:	Oct 5, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R.5

SGS Minerals Sample ID: 491-1588334-002

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	16.50	
Sulfur %	ASTM D4239 (A)	1.33	1.59
Gross Calorific Value Btu/lb	ASTM D5865		<100

Vanessa Chambliss
Branch Manager

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Analysis Report

October 13, 2015

COVANTA ENERGY WBH LLC
445 SOUTH STREET
MORRISTOWN NJ 07960

ATTN: STEVE DEDUCK

Client Sample ID:	8 H.R. E.R.5 Run 3	Sample ID By:	Covanta
Date Sampled:	Oct 1, 2015	Sample Taken At:	Submitted
Date Received:	Oct 5, 2015	Sample Taken By:	Submitted
Product Description:	ASH	Sample ID:	Covanta DYEC 8 H.R. E.R.5

SGS Minerals Sample ID: 491-1588334-003

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	16.50	
Sulfur %	ASTM D4239 (A)	1.32	1.58
Gross Calorific Value Btu/lb	ASTM D5865		<100

Vanessa Chambliss
Branch Manager

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