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PCI Transport
PCI Injection



**Pulverized Coal Transport
Emissions Test Report (Revised)**

Prepared for:

United States Steel Corporation

Ecorse, Michigan

Great Lakes Works
No.1 Quality Drive
Ecorse, Michigan 48229

BTEC Project No. 14-4625.00
February 13, 2015

BT Environmental Consulting, Inc.
4949 Fernlee Ave
Royal Oak, Michigan 48073
(248) 548-8070

EXECUTIVE SUMMARY

REVISED

BT Environmental Consulting, Inc. (BTEC) was retained by United States Steel Corporation, Great Lakes Works (U. S. Steel) to evaluate Particulate Matter (PM) from two exhaust stacks serving the Pulverized Coal Transport (FGPULVCOALTRANSPORT) at the U. S. Steel facility located at No. 1 Quality Drive in Ecorse, Michigan. The testing was performed as a compliance demonstration for permit No. 199600132d. The compliance test program was conducted on December 2-3, 2014.

The testing consisted of triplicate 60-minute test runs at each location. The results of the emission test program are summarized by Table I.

Table I
Executive Summary Table PM Emission Rate Summary

Source	Emission Rate	Permit Limit
PCI North East	0.15 lb/hr	0.26 lb/hr
	12.0 mg/dscm	21.9 mg/dscm
PCI South West	0.002 lb/hr	0.14 lb/hr
	0.7 mg/dscm	21.9 mg/dscm

1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by United States Steel Corporation, Great Lakes Works (U. S. Steel) to evaluate emission rates from two exhaust stacks serving the Pulverized Coal Transport (FGPULVCOALTRANSPORT) at the U. S. Steel facility located at No. 1 Quality Drive in Ecorse, Michigan. The testing was performed as a compliance demonstration for permit No. 199600132d. The compliance test program was conducted on December 2-3, 2014. The purpose of this report is to document the results of the test program.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (December 2013). The following is a summary of the emissions test report in the format suggested by the AQD test plan format guide.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on December 2-3, 2014 at the U. S. Steel facility in Ecorse, Michigan. The test program included evaluation of PM emissions from the north east PCI exhaust stack (PCI NE) and the south west PCI exhaust stack (PCI SW).

1.b Purpose of Testing

Permit No. ROP 199600132d, issued by State of Michigan Division of Environmental Quality, governs this process.

The allowable particulate emission rate for PCI NE by permit is:

- 0.26 pounds per hour
- 1.15 tons per year
- 21.9 mg/dscm

The allowable particulate emission rate for PCI SW by permit is:

- 0.14 pounds per hour
- 0.59 tons per year
- 21.9 mg/dscm

1.c Source Description

A diagram of the exhaust stacks is presented as Figures 1-2.

1.d Test Program Contact

The contacts for the source are:

Mr. Todd Wessel
Senior Project Manager
BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
Phone (616) 885-4013

Mr. Brad Wargnier
U. S. Steel Environmental
United States Steel Corporation
Great Lakes Works
No. 1 Quality Drive
Ecorse, Michigan 48229
(313) 749-2744

1.e Testing Personnel

Names and affiliations for personnel who were present during the testing program are summarized by Table 1.

Table 1
Test Personnel

Name and Title	Affiliation	Telephone
Mr. Brad Wargnier Environmental Department	U.S. Steel No. 1 Quality Drive Ecorse, Michigan 48229	(313) 749-2744
Mr. Paul Draper Environmental Technician	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8072
Mr. Paul Diven Environmental Technician	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8072

2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

2.a Operating Data

Relevant operating data is available in Appendix E.

2.b Applicable Permit

The applicable permit for this emissions test program is ROP No. 199600132d.

2.c Results

The overall results of the emission test program are summarized by Table 2 (see Section 5.a). Detailed results for each run can be found in Tables 3-4.

2.d Emission Regulation Comparison

The results are summarized by table 2 (section 5.a). The emission limits are summarized by section 1.b.

3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.

3.a Process Description

Edison Energy Services grinds coal at the DTE River Rouge power plant which is then transported through a pipeline with air to Zug Island. The air and coal are separated using a dedusting baghouse then the pulverized coal will be conveyed by a rotary valve into a large 1080 ton storage silo.

3.b Process Instrumentation

The process operating parameters relevant to the emissions test program is the amount of coal transferred, and the differential pressure of the baghouse.

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

4.a Sampling Train and Field Procedures

Measurement of exhaust gas velocity, molecular weight, and moisture content was conducted using the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 1 - *"Location of the Sampling Site and Sampling Points"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"*
- Method 3 - *"Determination of Molecular Weight of Dry Stack Gas"*
- Method 4 - *"Determination of Moisture Content in Stack Gases"*
- Method 17 - *"Determination of Particulate Emissions from Stationary Sources (In Stack Filtration)"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2. Figure 1 presents the test port and traverse/sampling point locations used. A cyclonic flow evaluation was conducted at each sampling location. An S-type pitot tube and thermocouple assembly calibrated in accordance with Method 2, Section 4.1.1 was used to measure exhaust gas velocity pressures and temperatures during testing. Because the pitot tube dimensions outlined in Sections 2.6 through 2.8 were within the specified limits, the baseline pitot tube coefficient of 0.84 (dimensionless) was assigned for this testing.

Molecular weight determinations were conducted according to Method 3. The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite[®] combustion gas analyzers. Moisture content was determined from the condensate collected in the Method 17 sampling train according to Method 4.

Method 17 was used to measure particulate concentrations and calculate particulate emission rates from the exhaust stack (see Figure 3 for sampling train schematic diagram)

BTEC's Nutech[®] Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel button-hook nozzle, (2) a stainless steel in stack filter holder with a pre weighed glass fiber filter, (3) a steel sample probe with a tygon tubing transfer line, (4) a modified Greenburg-Smith (GS) impinger with approximately 300 g of silica gel desiccant, (5) a length of sample line, and (6) a Nutech[®] control case equipped with a pump, dry gas meter, and calibrated orifice.

A sampling train and pitot tube leak test was conducted before and after each test run. Upon completion of the final leak check for each test run, the filter was recovered, and the nozzle and the front half of the filter holder assembly were brushed and triple rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample containers.

BTEC labeled each container with the test number, test location, and test date, and marked the level of liquid on the outside of the container. In addition blank samples of the acetone and filter were collected. BTEC personnel transported the filters and acetone fractions to BTEC's laboratory in Royal Oak, Michigan for gravimetric analysis.

4.b Recovery and Analytical Procedures

Recovery and analytical procedures were described in Section 4.a.

4.c Sampling Ports

Sampling ports are located on the stack and meet method 1 criteria.

4.d Traverse Points

Sampling port and traverse point locations for the east PCI transport system exhaust stacks are illustrated by Figures 1-2.

5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

5.a Results Tabulation

The results of the emissions test program are summarized by Table 2.

Table 2
Test Program PM Emission Rates Summary

Source	Emission Rate	Permit Limit
PCI North East	0.15 lb/hr	0.26 lb/hr
	12.0 mg/dscm	21.9 mg/dscm
PCI South West	0.002 lb/hr	0.14 lb/hr
	0.7 mg/dscm	21.9 mg/dscm

Detailed data for each test run can be found in Tables 3-4.

5.b Discussion of Results

Emission limitations for Permit No. 199600132d are summarized by section 1b. The results of the emissions test program are summarized by Table 2 (see section 5.a). Detailed results for each run are summarized by Table 3-4.

5.c Sampling Procedure Variations

There was not any sampling procedure variations used during the emission compliance test program.

5.d Process or Control Device Upsets

No upset conditions occurred during testing.

5.e Control Device Maintenance

No maintenance was performed during the test program.

5.f Audit Sample Analyses

No audit samples were collected as part of the test program.

5.g Calibration Sheets

Relevant equipment calibration documents are provided as Appendix B.

5.h Sample Calculations

Sample calculations are provided in Appendix C.

5.i Field Data Sheets

Field documents relevant to the emissions test program are presented in Appendix A.

5.j Laboratory Data

Laboratory results are presented in Appendix D.

Tables

Table 3
PCI North East Particulate Matter Emission Rates

Company Source Designation Test Date	USS PCI NE (Outlet)			Average
	12/2/2014	12/2/2014	12/3/2014	
Meter/Nozzle Information	P-1	P-2	P-3	
Meter Temperature Tm (F)	44.2	48.0	40.7	44.3
Meter Pressure - Pm (in. Hg)	29.9	29.9	29.5	29.8
Measured Sample Volume (Vm)	49.5	51.5	51.3	50.8
Sample Volume (Vm-Std ft3)	51.7	53.3	53.1	52.7
Sample Volume (Vm-Std m3)	1.46	1.51	1.50	1.49
Condensate Volume (Vw-std)	0.707	0.707	0.660	0.692
Gas Density (Ps(std) lbs/ft3) (wet)	0.0742	0.0742	0.0742	0.0742
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	3.88	4.01	3.99	3.96
Total weight of sampled gas (m g lbs) (dry)	3.85	3.98	3.96	3.93
Nozzle Size - An (sq. ft.)	0.000562	0.000562	0.000562	0.000562
Isokinetic Variation - I	97.0	100.3	100.3	99.2
Stack Data				
Average Stack Temperature - Ts (F)	42.8	44.0	42.5	43.1
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.7	28.7	28.7	28.7
Stack Gas Specific Gravity (Gs)	0.991	0.991	0.991	0.991
Percent Moisture (Bws)	1.35	1.31	1.23	1.30
Water Vapor Volume (fraction)	0.0135	0.0131	0.0123	0.0130
Pressure - Ps ("Hg)	29.7	29.7	29.3	29.6
Average Stack Velocity - Vs (ft/sec)	25.6	25.6	25.8	25.6
Area of Stack (ft2)	2.2	2.2	2.2	2.2
Exhaust Gas Flowrate				
Flowrate ft ³ (Actual)	3,346	3,349	3,371	3,355
Flowrate ft ³ (Standard Wet)	3,489	3,485	3,467	3,480
Flowrate ft ³ (Standard Dry)	3,442	3,439	3,424	3,435
Flowrate m ³ (standard dry)	97	97	97	97
Total Particulate Weights (mg)				
Nozzle/Probe/Filter	16.9	15.7	21.0	17.9
Total Particulate Concentration				
lb/1000 lb (wet)	0.010	0.009	0.012	0.010
lb/1000 lb (dry)	0.010	0.009	0.012	0.010
mg/dscm (dry)	11.6	10.4	14.0	12.0
gr/dscf	0.0050	0.0045	0.0061	0.0052
Total Particulate Emission Rate				
lb/ hr	0.15	0.13	0.18	0.15

Table 4
PCI South West Particulate Matter Emission Rates

Company Source Designation Test Date	USS PCI SW Silo			Average
	12/3/2014	12/3/2014	12/3/2014	
Meter/Nozzle Information	P-1	P-2	P-3	
Meter Temperature Tm (F)	41.1	43.6	47.2	44.0
Meter Pressure - Pm (in. Hg)	29.4	29.4	29.4	29.4
Measured Sample Volume (Vm)	43.1	43.3	43.5	43.3
Sample Volume (Vm-Std ft3)	44.5	44.6	44.4	44.5
Sample Volume (Vm-Std m3)	1.26	1.26	1.26	1.26
Condensate Volume (Vw-std)	0.707	0.566	0.613	0.629
Gas Density (Ps(std) lbs/ft3) (wet)	0.0741	0.0742	0.0741	0.0741
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	3.35	3.35	3.34	3.35
Total weight of sampled gas (m g lbs) (dry)	3.32	3.32	3.31	3.32
Nozzle Size - An (sq. ft.)	0.003092	0.003092	0.003092	0.003092
Isokinetic Variation - I	100.3	100.1	99.9	100.1
Stack Data				
Average Stack Temperature - Ts (F)	40.4	40.4	40.2	40.3
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.7	28.7	28.7	28.7
Stack Gas Specific Gravity (Gs)	0.990	0.991	0.991	0.991
Percent Moisture (Bws)	1.56	1.25	1.36	1.39
Water Vapor Volume (fraction)	0.0156	0.0125	0.0136	0.0139
Pressure - Ps ("Hg)	29.3	29.3	29.3	29.3
Average Stack Velocity - Vs (ft/sec)	3.9	3.9	3.9	3.9
Area of Stack (ft2)	3.1	3.1	3.1	3.1
Exhaust Gas Flowrate				
Flowrate ft ³ (Actual)	738	738	738	738
Flowrate ft ³ (Standard Wet)	763	763	763	763
Flowrate ft ³ (Standard Dry)	751	753	753	752
Flowrate m ³ (standard dry)	21	21	21	21
Total Particulate Weights (mg)				
Nozzle/Probe/Filter	0.5	0.9	1.4	0.9
Total Particulate Concentration				
lb/1000 lb (wet)	0.000	0.001	0.001	0.001
lb/1000 lb (dry)	0.000	0.001	0.001	0.001
mg/dscm (dry)	0.4	0.7	1.1	0.7
gr/dscf	0.0002	0.0003	0.0005	0.0003
Total Particulate Emission Rate				
lb/ hr	0.001	0.002	0.003	0.002