BTEC Inc.

US Steel No. 1 Baghouse Emissions Test Summary Report

Prepared for:

United States Steel Corporation

Ecorse, Michigan

United States Steel Corporation
Great Lakes Works
No. 1 Quality Drive
Ecorse, Michigan 48229

Project No. 14-4592.00
November 14, 2014

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

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

RENEWABLE OPERATING PERMIT
REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating (RO) Permit program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as described in General Condition No. 22 in the RO Permit and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name: United States Steel Corporation Great Lakes Works — County: Wayne

Source Address: #1 Quality Drive — City: Ecorse

AQD Source ID (SRN): A7809 — RO Permit No.: 199600132d — RO Permit Section No.: 1 & 5

Please check the appropriate box(es):

☐ **Annual Compliance Certification (General Condition No. 28 and No. 29 of the RO Permit)**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the RO Permit.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the RO Permit, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (General Condition No. 23 of the RO Permit)**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From Sept. 23, 2014 To Sept. 24, 2014

Additional monitoring reports or other applicable documents required by the RO Permit are attached as described:

Submittal of BOP No. 1 Baghouse Stack Test results from the September 23-24, 2014 test.

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete.

James R. Gray	General Manager	313-749-2210
Name of Responsible Official (print or type)	Title	Phone Number

Signature of Responsible Official — Date: 17 Nov 14

* Photocopy this form as needed.

EQP 5736 (Rev 9/01)

EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by United States Steel Company (U. S. Steel) to evaluate particulate matter (PM) emission rates from the No. 2 BOP, No. 1 Baghouse (No.1 Baghouse) located at No. 1 Quality Drive in Ecorse, Michigan. The emissions testing program was conducted on September 23-24, 2014. The purpose of this report is to document the results of the test program.

The testing was performed as a compliance demonstration for permit No. 199600132d. The applicable permit particulate emissions limit for the No.1 Baghouse is 0.005 grains/dscf.

The results of the emission test program are summarized by Table I.

Table I
Executive Summary Table PM Emission Rate Summary

Source	Pollutant	Limit	Results
No. 1 Baghouse	PM	0.005 gr/dscf - Permit	0.001 gr/dscf – Train A
			0.001 gr/dscf – Train B
			3.9 lb/hr – Train A
			5.0 lb/hr – Train B
			4.4 lb/hr Average

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1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by United States Steel Company (U. S. Steel) to evaluate particulate matter (PM) emission rates from the No. 2 BOP, No. 1 Baghouse (No.1 Baghouse) located at No. 1 Quality Drive in Ecorse, Michigan. The emissions testing program was conducted on September 23-24, 2014. The purpose of this report is to document the results of the test program.

The testing was performed as a compliance demonstration for permit No. 199600132d. The applicable permit particulate emissions limit for the No.1 Baghouse is 0.005 grains/dscf.

Due to the size of the No.1 Baghouse and the lack of substantial operation US Steel has requested and has previously been granted a testing variance by Mr. Edward Wojcieshowski of the Region 5 EPA. The variance included the overall testing strategy to obtain the particulate samples for this Baghouse. The following is a description of the testing strategy that was utilized for the No.1 Baghouse.

The testing was conducted with two meter consoles, sampling out of two separate test ports simultaneously in each compartment. Each test run sampled 4 of the 12 of the baghouse compartments at a single point. For example, test No. 1 sampled compartments No. 1-4. Test No. 2 sampled compartments No. 5-8 and test No. 3 compartments No. 9-12. Each of the compartments (12) have two test ports installed on the north side of the baghouse directly over each set of baghouse bags. All of the sampling was conducted out of these ports (24) at a single sampling point per port approximately 6 feet in the baghouse directly above a row of baghouse bags with two sampling consoles simultaneously.

The testing for the No.1 baghouse was performed in the following fashion. The test was started as scrap (2 loads) is charged to the vessel and continued as the hot metal is charged or transferred to the vessel and stopped after the first five (5) minutes of the oxygen blow. Then restarted at the beginning of the tapping (draining the steel from the furnace) of the furnace and stopped at the end of the ladle turn up. Each of the 12 baghouse compartments was tested during a minimum of these operations (scrap charge, hot metal charge, first 5 minutes of the blow and tapping \ turn up).

The data from each of the sample trains (2) were combined to yield one complete test run with a combined sample volume of at least 60 dscf. For reporting purposed each of the test runs was also calculated separately and together to determine the actual concentration and emission rate.

The No.1 baghouse is a positive pressure baghouse that has a low velocity pressure reading in each compartment (0.0007 inches of water). It was necessary to perform a complete velocity traverse on the inlet duct leading to the baghouse. This is done to calculate the

flow rate into and subsequently out of each compartment of the baghouse. BTEC performed a complete velocity traverse at the inlet duct prior to each day of testing.

The opacity was determined utilizing US EPA Method 9 and consisted of reading three complete steel production cycles at the No. 2 BOP No. 1 Baghouse. The steel production cycle starts when scrap is charged to the vessel and ends three (3) minutes after slag has been removed from the furnace.

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 program and results in the format suggested by the aforementioned document.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on September 23-24, 2014 at the US Steel facility in Ecorse, Michigan. The test program included evaluation of particulate matter (PM) and opacity from the No. 2 Basic Oxygen Plant (BOP), No. 1 Baghouse (No.1 Baghouse).

1.b Purpose of Testing

The testing was performed as a compliance demonstration for permit No. 199600132d. Table 1 summarizes the limitations included in this permit.

Table 1
AQD Permit No. 199600132d Emission Limitations Summary

Source	Pollutant	Limit
No. 1 Baghouse	PM	0.005 gr/dscf – Permit
		0.01 gr/dscf - MACT

1.c Source Description

U. S. Steel is a fully integrated steel manufacturer producing steel coils and flat rolled sheets. The #2 Basic Oxygen Plant (#2 BOP) is where the liquid iron is processed with other materials to produce liquid steel.

The #2 BOP has two top-blown, steel conversion vessels and two desulfurization/slag skimming stations at the facility. The process steps at the No. 2 BOP Shop Hot Metal Processing stations are as follows:

1. Hot Metal in torpedo cars is delivered from the blast furnaces
2. Scrap is charged into the vessel
3. Hot metal is transferred (poured) from the torpedo car into a charging ladle
4. The charging ladle is moved into position at the desulfurization station. A lance

is lowered in the charging ladle into position

5. A powdered desulfurization agent is blown through the lance using an inert carrier gas and injected by fluid momentum into the hot metal bath. Desulfurization agent is injected for time periods and in amounts calculated to meet the desired sulfur specification.
6. The charging ladle is tilted to the slag skimming position where the slag is skimmed from the surface of the hot metal.
7. After skimming the charging ladle is removed from the desulfurization/slag skimming station for further processing.

The No. #2 BOP No. 1 Baghouse is the emissions control device for the scrap charging, hot metal charging and tapping (draining the steel from the furnace) operations of the steel-making process. Charging consists of loading scrap metal into the BOP vessel and then pouring hot metal into it. Exhaust hoods are located over the vessels to capture the emissions generated by this process. Ductwork transfers the captured emissions to the baghouse.

The No.1 Baghouse is a twelve (12) compartment, shaker type, positive pressure baghouse, which measures 148 feet by 46 feet. During the testing event one of the baghouse compartments was isolated to represent the baghouse operating while maintenance or inspection is conducted on the isolated chamber.

1.d Test Program Contact

The contact for the source and test plan is:

Mr. Todd Wessel
Senior Project Manager
BT Environmental Consulting, Inc.
4949 Fernlee Ave
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 2.

Table 2
Test Personnel

Name and Title	Affiliation	Telephone
Mr. Brad Wargnier Environmental Department	US Steel No. 1 Quality Drive Ecorse, Michigan 48229	(313) 749-2744
Mr. Todd Wessel Senior Project Manager	BTEC 4949 Fernlee Ave Royal Oak, Michigan 48073	(616) 885-4013
Mr. Mathew Young Project Manager	BTEC 4949 Fernlee Ave Royal Oak, Michigan 48073	(248) 548-8070
Mr. Brandon Chase Environmental Engineer	BTEC 4949 Fernlee Ave Royal Oak, Michigan 48073	(248) 548-8070
Mr. Paul Diven Environmental Technician	BTEC 4949 Fernlee Ave Royal Oak, Michigan 48073	(248) 548-8070
Mr. Randy Tysar Senior Environmental Engineer	BTEC 4949 Fernlee Ave Royal Oak, Michigan 48073	(248) 548-8070
Mr. Tom Maza Air Quality Division	Detroit Field Office Cadillac Place 3058 West Grand Blvd Suite 2-300 Detroit, MI 48202	(313) 456-4700

2. Summary of Results

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

2.a Operating Data

Operating data recorded includes, fan amps, hot metal tons, and scrap charge. The operating data is included in Appendix F.

2.b Applicable Permit

Michigan Renewable Operating Permit Number 199600132d.

2.c Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a). Detailed results for each source can be found in tables 4-6.

2.d Emission Regulation Comparison

The results summarized by table 3 (section 5.a) shows that the PM emissions are well below the limits summarized by table 1 (section 1.b).

3. Source Description

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

3.a Process Description

See section 1.c.

3.b Raw and Finished Materials

Approximately 430,000 lbs of molten iron is mixed with 120,000 lbs. of scrap steel.

3.c Process Capacity

The furnaces are rated for 250 tons of steel. Normal operations yield between 242 to 246 tons of finished steel per heat.

3.d Process Instrumentation

The process stack data will consist of documentation from the BOP control room. This includes amount of scrap and iron charged and the timing of each process step.

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

To evaluate PM mass emission rates from the baghouse, BTEC utilized the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations:

- Method 1 - *"Sample and Velocity Traverses for Stationary Sources"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"*

- Method 3 - *"Gas Analysis for the Determination of Dry Molecular Weight" (Fyrite Analysis)*
- Method 4 - *"Determination of Moisture Content in Stack Gases"*
- Method 9 - *"Visual Determination of the Opacity of Emissions from Stationary Sources"*
- Method 17/5D - *"Determination of Particulate Emissions from Stationary Sources"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2. Figures 1 and 2 present the test port and traverse/sampling point locations used at each site. 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.

Due to the majority of positive pressure Baghouses having low velocity pressure readings in each compartment, it is necessary to perform a complete velocity traverse on the inlet duct leading to the Baghouse. This was done to calculate the flow rate into and subsequently out of each compartment of the Baghouse. A complete velocity traverse was performed at the inlet duct prior to each day of testing. Subsequent to the velocity traverse BTEC calculated the average gas velocity at the measurement site (Baghouse compartment) utilizing equation 5D-1 of the 40 CFR Part 60, App. A, Method 5D.

Sixteen traverse points were determined as locations to measure the inlet volumetric flow in accordance with the provisions of the Method. Two (2) sample ports were utilized for the study, resulting in the use of eight (8) traverse points for each port

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 5D/17 sampling trains according to Method 4.

40 CFR 60, Appendix A, Method 5D/17, *"Determination of Particulate Emissions from Stationary Sources"* was used to measure PM concentrations and calculate PM emission rates (see Figure 4 for a schematic of the sampling train). Triplicate approximately 60-minute test runs were conducted with duplicate side-by-side trains on Baghouse No. 1.

BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel nozzle, (2) an in stack stainless-steel filter housing, (3) a steel probe, (4) a set of four Greenburg-Smith (GS) impingers with the first modified and second standard GS impingers each containing 100 ml of deionized water, and with a third dry modified GS impinger and a fourth modified GS impinger containing 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.

After completion of the final leak test for each test run, the filters were recovered, and the nozzle, probe, and the front half of the filter holder assemblies of the Method 5D/17 train were brushed and triple rinsed with acetone. The nozzle and front half of the Method 5D/17 filter housing was brushed and triple rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container. BTEC labeled the containers with the test number, test location, and test date, and marked the level of liquid on the outside of each container. BTEC personnel transported all samples to BTEC's laboratory in Royal Oak, Michigan, for analysis.

The acetone rinses were transferred to clean pre-weighed beakers. The acetone was evaporated at room-temperature. The beakers and filters were then placed in desiccators for 24 hours and weighed to a constant weight.

4.b Recovery and Analytical Procedures

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

4.c Sampling Ports

The No. 1 Baghouse was sampled as described in the introduction.

4.d Traverse Points

The No. 1 Baghouse was sampled as described in the introduction.

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 3.

Table 3
Test Program PM Emission Rate Summary

Source	Pollutant	Limit	Results
No. 1 Baghouse	PM	0.005 gr/dscf - Permit	0.001 gr/dscf – Train A
			0.001 gr/dscf – Train B
			3.9 lb/hr – Train A
			5.0 lb/hr – Train B
			4.4 lb/hr Average

Detailed data for each test run can be found in Tables 4-5. Opacity data is presented in Appendix E.

5.b Discussion of Results

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

5.c Sampling Procedure Variations

Please see introduction for variations in sampling procedures used on the No. 1 Baghouse.

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 for this test program are provided in Appendix D.