BTEC Inc.

US Steel No. 1 Argon Stir Station 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. 14-4626.00
January 26, 2015

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
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 Dec. 9, 2014 To Dec. 9, 2014

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

Submittal of No. 1 Argon Baghouse Stack Test Results from the December 9, 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: 30 JAN 15

* Photocopy this form as needed.

EQP 5736 (Rev 9/01)

EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by United States Steel Corporation (U. S. Steel) to evaluate Particulate Matter (PM) emission rates from the EGARGON-STIR baghouse serving the No. 1 Argon Stir Station operations located at the U. S. Steel Great Lakes Works facility in Ecorse, Michigan. The testing is being performed as a compliance demonstration for permit No. 199600132d. The compliance test program was conducted on December 9, 2014. The purpose of this report is to document the results of the test program.

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

Table I

Executive Summary Table PM Emission Rate Summary

Source	Pollutant	Permit Limit	Result
No. 1 Argon Stir Station	PM	0.02 gr/dscf	0.0069 gr/dscf
		1.4 lb/hr	1.33 lb/hr
		0.543 lb/heat	1.44 lb/heat

Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by United States Steel Corporation (U. S. Steel) to evaluate Particulate Matter (PM) emission rates from the EGARGON-STIR baghouse serving the No. 1 Argon Stir Station operations located at the U. S. Steel Great Lakes Works facility in Ecorse, Michigan. The testing is being performed as a compliance demonstration for permit No. 199600132d. The compliance test program was conducted on December 9, 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 9, 2014 at the U.S. Steel facility in Ecorse, Michigan. The test program included evaluation of particulate matter (PM) from the EGARGON-STIR baghouse serving the No. 1 Argon Stir Station operations.

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	Permit Limit
No. 1 Argon Stir Station	PM	0.02 gr/dscf
		1.4 lb/hr
		3.04 ton/yr
		0.543 lb/heat

1.c Source Description

The No.2 Basic Oxygen Processing (BOP) is a facility that converts liquid iron to liquid steel. The No.2 BOP has two top-blown conversion vessels along with other ancillary equipment. The liquid iron and steel scrap is charged in the vessels and oxygen is blown into the mixture for mixing, removal of carbon and other impurities. The now liquid steel is sometimes further process in the No.2 BOP, which may include argon stirring. After any further process is completed, steel is conveyed to the Casters where the liquid steel is cast into a continuous solid steel slab.

Argon stirring occurs after the conversion process, when it is necessary to distribute heat evenly in the liquid steel or alloy addition to the liquid steel prior to Casting. The argon stirring produces a higher quality liquid steel product. Argon stirring is also necessary when the Caster is not ready to receive liquid steel.

The ladle is placed into the Argon Stirring Station by overhead crane, and an exhaust capture hood is moved into place over the ladle. An argon-stirring lance is then lowered, and argon is injected as required.

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 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 2.

Table 2
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

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 run can be found in table 4.

2.d Emission Regulation Comparison

The results are summarized by Table 3 (section 5.a). Emission limits are summarized by Table 1 (section 1.b) and also in Table 3 (section 5.a).

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

Typical batches consist of 240-250 tons of liquid steel. Additional alloys and flux is added as needed.

3.c Process Capacity

The No.1 Argon Stir Station can process a maximum of 13,505 heats per year of operation.

3.d Process Instrumentation

The process stack data will consist of the sequence number and the timing of process.

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 - *"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 17 - *"Determination of Particulate Emissions from Stationary Sources"*

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. 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.

Cyclonic flow checks were performed at the sampling location. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the angle between the direction of flow and the axis of the stack. If the average of the absolute values of the flow angles is greater than 20 degrees, cyclonic flow exists. The null angle was determined to be less than 10 degrees at each sampling point.

Molecular weight determinations were evaluated according to USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight." The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers. Carbon dioxide and oxygen content were analyzed using the Fyrite® procedure.

Exhaust gas moisture content was evaluated using Method 4. Exhaust gas was extracted as part of the PM sampling train and passed through (i) two impingers, each with 100 ml deionized water, (ii) an empty impinger, and (iii) an impinger filled with silica gel. Exhaust gas moisture content is then determined gravimetrically.

40 CFR 60, Appendix A, Method 17, *"Determination of Particulate Emissions from Stationary Sources"* was used to measure PM concentrations and calculate PM emission

rates (see Figure 2 for a schematic of the sampling train). Triplicate 60-minute test runs were conducted on the No. 1 Argon Stir Station Stack.

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.

A sampling train leak test was conducted before and after each test run. After completion of the final leak test 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 container.

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 carried all samples to BTEC's laboratory (for filter and acetone gravimetric analysis) in Royal Oak, Michigan.

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 No. 1 Argon Stir Station exhaust duct and meet method 1 criteria.

4.d Traverse Points

Sampling port and traverse point locations for the No. 1 Argon Stir Station exhaust stack is illustrated by Figure 1.

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	Permit Limit	Result
No. 1 Argon Stir Station	PM	0.02 gr/dscf	0.0069 gr/dscf
		1.4 lb/hr	1.33 lb/hr
		0.543 lb/heat	1.44 lb/heat

Detailed data for each test run can be found in Table 4.

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

There were no 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 for this test program are provided in Appendix D.

Table 4
No. 1 Argon Stir Station PM Emission Rate Summary

Company	US Steel			
Source Designation	#1 Argon Stir			
Test Date	12/9/2014	12/9/2014	12/9/2014	
Meter/Nozzle Information	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	69.5	70.3	74.5	71.4
Meter Pressure - Pm (in. Hg)	29.6	29.6	29.6	29.6
Measured Sample Volume (Vm)	50.9	53.7	50.6	51.7
Sample Volume (Vm-Std ft3)	50.2	52.8	49.3	50.7
Sample Volume (Vm-Std m3)	1.42	1.49	1.40	1.44
Condensate Volume (Vw-std)	0.519	0.566	0.519	0.534
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)	3.76	3.96	3.70	3.81
Total weight of sampled gas (m g lbs) (dry)	3.74	3.93	3.67	3.78
Nozzle Size - An (sq. ft.)	0.000241	0.000259	0.000241	0.000247
Isokinetic Variation - I	99.9	99.9	100.0	99.9
Total Time Elapsed During Test Period (minutes)[1]	83	85	97	88.3
Production Time During Test Period (minutes)[1]	62	60	62	61.3
Non Production Time During Test Period (minutes)[1]	21	25	35	27.0
Production Data				
Heats / Run[2]	1.266	2.323	1.053	1.547
Stack Data				
Average Stack Temperature - Ts (F)	96.8	124.3	118.1	113.1
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)	0.992	0.992	0.992	0.992
Percent Moisture (Bws)	1.02	1.06	1.04	1.04
Water Vapor Volume (fraction)	0.0102	0.0106	0.0104	0.0104
Pressure - Ps ("Hg)	29.4	29.4	29.5	29.5
Average Stack Velocity -Vs (ft/sec)	62.8	64.3	63.9	63.7
Area of Stack (ft2)	9.6	9.6	9.6	9.6
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	36,220	37,106	36,882	36,736
Flowrate ft^3 (Standard Wet)	33,800	32,998	33,196	33,331
Flowrate ft^3 (Standard Dry)	33,454	32,648	32,850	32,984
Flowrate m^3 (standard dry)	947	924	930	934
Total Particulate Weights (mg)				
Nozzle/Probe/Filter	13.1	26.9	27.8	22.6
Total Particulate Concentration				
lb/1000 lb (wet)	0.008	0.015	0.017	0.013
lb/1000 lb (dry)	0.008	0.015	0.017	0.013
mg/dscm (dry)	9.2	18.0	19.9	15.7
lb/dscf (dry)	5.76E-07	1.12E-06	1.24E-06	9.81E-07
gr/dscf	0.0040	0.0079	0.0087	0.0069
Total Particulate Emission Rate				
lb/ operating hr - during test	1.16	2.21	2.46	1.94
lb/ hr - Overall Including Non-operational Time	0.87	1.56	1.57	1.33
lb/ heat[3]	0.95	0.95	2.41	1.44

1: Test period = Time from initial time stamp to final time stamp and includes both sampling time and non sampling time
2: Please see Production data in Appendix E for a summary of Heats/Run
3: lb/ heat calculated using "lb / operating hr - during test"
(lb/operating hr) * (1 operating hr / 60 minutes) * (Production time during test period) / (Heats/Run) = lb/heat

Figures

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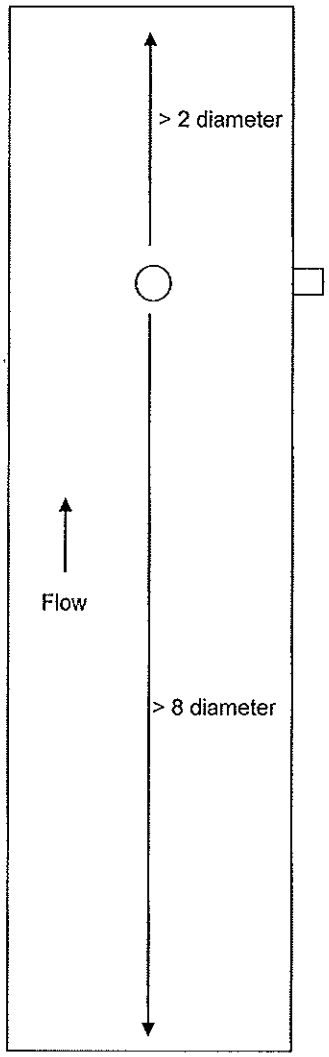
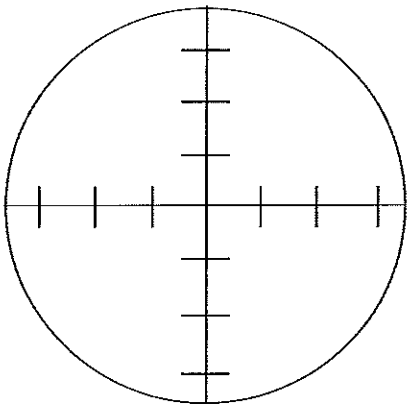
diameter = 42 inches





Not to Scale

Points	Distance "
1	1.8
2	6.1
3	12.4
4	29.6
5	35.9
6	40.2

Figure No. 1

Site: **No. 1 Argon** **US Steel** **Ecorse, Michigan**	**Sampling Date:** **December 9, 2014**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

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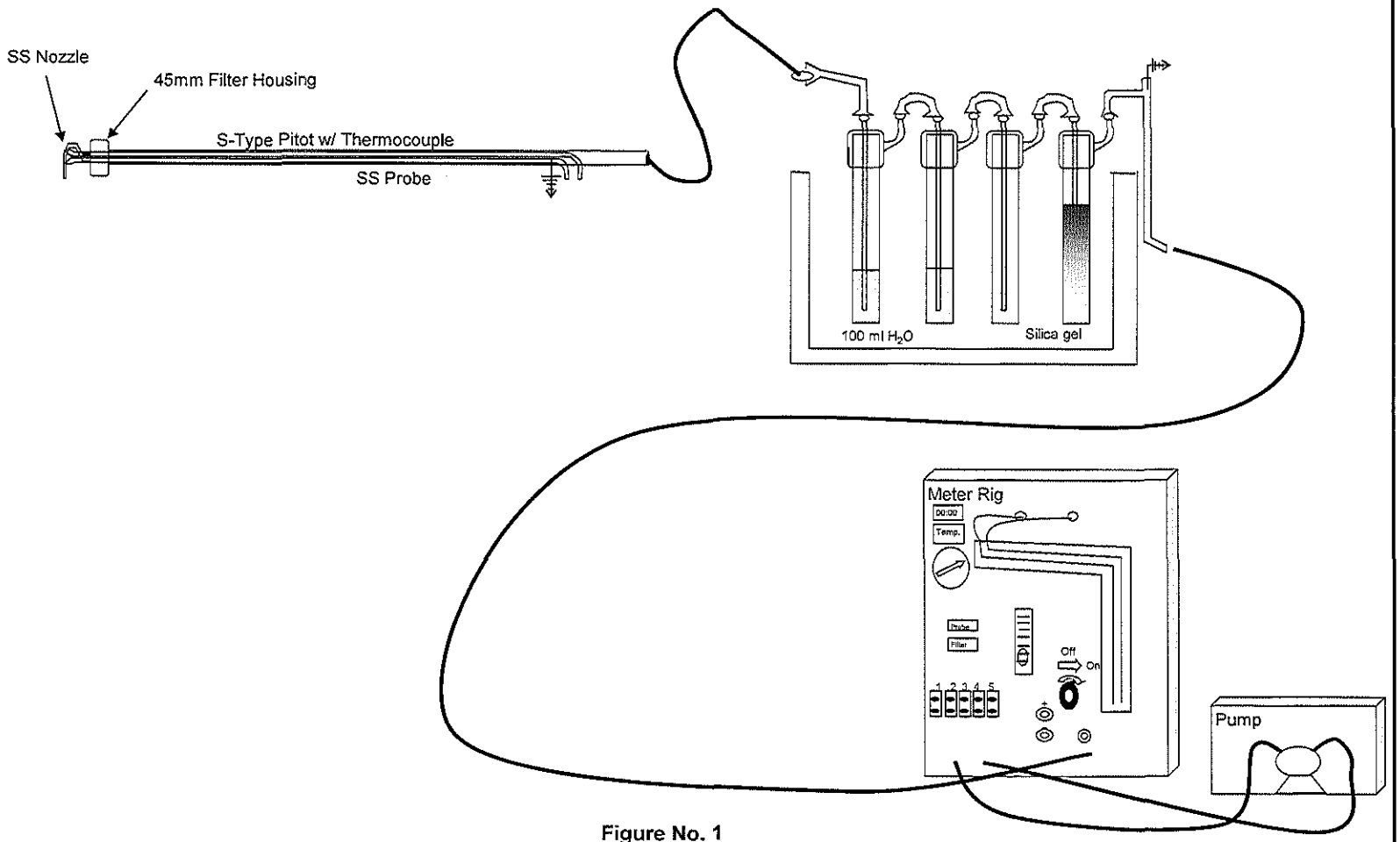

Figure No. 1

Site: **USEPA Method 17** **US Steel** **Ecorse, Michigan**	**Sampling Date:** **December 9, 2014**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**