United States Steel Corporation
Mon Valley Works – Edgar Thomson Plant
13th and Braddock Avenues
Braddock, PA 15104

Jon A. Olszewski
Plant Manager, Edgar Thomson Plant

January 16, 2023

EES Case Management Unit
Environmental and Natural Resources Division
U.S. Department of Justice
P.O. Box 7611
Washington, D.C. 20044-7611
Eescdcopy.enrd@usdoj.gov
Re: DJ#90-5-2-12083

Environmental Protection Agency
Region 3
R3_ORC_Mailbox@epa.gov
Augustine.Bruce@epa.gov
Re: U.S. et al. v U. S. Steel Corporation (W.D. Pa.)

Air Quality Program Manager
Allegheny County Health Department
301 Thirty-Ninth Street, Bldg. #7
Pittsburgh, PA 15201
AQReports@AlleghenyCounty.us

SUBJECT: *United States, et al v. United States Steel Corporation (W.D.Pa.)*
Case No. 2:22-cv-0079
U. S. Steel Edgar Thomson Plant – Casthouse Baghouse System Study

Per the requirements of Paragraph V.A.17 of the above referenced Consent Decree, U. S. Steel is submitting for EPA and ACHD approval (pursuant to Paragraph V.57) the plan to conduct the Casthouse Baghouse System Study.

If you have any questions, please contact Coleen Davis at cdavis@uss.com or 412-273-4730.

Sincerely,

Jon A. Olszewski
Plant Manager, Edgar Thomson Plant

Attachment

Blast Furnace Casthouse Emissions Control System Evaluation

Study Plan

GCT Report: T8630-PR-REP-001 Rev 0

January 16, 2023

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Disclaimer

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T8630-PR-REP-001 - BLAST FURNACE CASTHOUSE EMISSIONS CONTROL SYSTEM EVALUATION STUDY PLAN

REV	DESCRIPTION	ORIG	REVIEW	GCT APPROVAL	DATE	CLIENT APPROVAL	DATE
0	Issue for Use	B.Randhawa	M.Russell	P.Safe	01/16/2023		

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1. INTRODUCTION

U.S. Steel (USS) operates the Edgar Thomson Steel Works in Braddock, PA. The plant operates blast furnaces and basic oxygen process (BOP) furnaces to produce up to approximately 3.5 MTPY of steel.

USS has entered into a consent decree with the United States Department of Justice, Environmental Protection Agency, and Allegheny County Health Department for which USS has agreed to conduct a study to evaluate the capacity of the Casthouse Baghouse System to capture and control air emissions from the Blast Furnace Casthouses. The goal of the study is to ensure that the Casthouse Baghouse System has sufficient capacity to maintain compliance with all applicable regulations, including ACHD Rules and Regulations Article XXI § 2104.01.

The study results will include:

- A description of the methodology, observations, data, and other information reviewed
- The study's findings, including an evaluation of potential improvements of the capture and control systems and Blast Furnace operating procedures to ensure compliance with applicable opacity standards.
- An order-of-magnitude capital cost estimate.
- A preliminary staged implementation schedule.

To this end, USS has reached out to Gas Cleaning Technologies, LLC, (GCT) to assist them with the Blast Furnace Casthouse System Study. GCT has established a multi-step approach to evaluation of air emissions control systems that combines standard design equations, field measurements, benchmarking, and process modelling. This approach accounts for the well understood design parameters as well as the less obvious factors affecting the performance of an air emissions control system.

This document is intended to establish a protocol for the testing, inspection and evaluation of the existing emissions control system for the casthouse emissions control system and summarizes the following:

1. Procedure for measurement of air flow, temperature and pressure in the ductwork,
2. Procedure for opacity measurements,
3. Additional data collection requirements,
4. Methods for establishing emissions generated during casthouse operation, and
5. Analytical assessment of the data to establish system capacity and capture efficiency.

This report outlies the protocol that will allow GCT and USS to establish the existing system performance and identify any potential improvements.

2. GENERAL TESTING REQUIREMENTS

GCT will conduct a minimum 5-day measurement campaign while Blast Furnace No. 1 and Blast Furnace No. 3 are at a production rate of 7,400 net tons of hot metal (nthm) per 24 hours for at least four of the five days to establish the current operating conditions of the emissions control system under various Blast Furnace operating conditions. If the production rate is not met for four of the five days, the study shall include a minimum of two additional consecutive days while at a production rate of at least 7,400 nthm.

Visual emissions observations (VEO) as well as system flow rates, pressure and temperature measurements will be collected during the following operating conditions:

- 1 furnace casting, all baghouse modules online
- 1 furnace casting, 2 baghouse modules offline
- One furnace casting, one furnace opening and closing the taphole, all baghouse modules online
- One furnace casting, one furnace opening and closing the taphole, 2 baghouse modules offline:

The testing will be conducted for 6-8 hours each day.

GCT will utilize the following US EPA test methods for during the measurement campaign:

- (40 CFR Part 60, Appendix A) Method 1: Sample and Velocity Traverses for Stationary Sources
- (40 CFR Part 60, Appendix A) Method 2: Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
- (40 CFR Part 60, Appendix A) Method 9: Visual Determination of the Opacity of Emissions from Stationary Sources

Due to access and safety related restrictions of the sampling points as well as the frequency of discrete traverse measurements, as outlined in subsequent sections, a traverse in only one direction will be conducted. This is the only deviation from the EPA Methods.

This testing is not intended for compliance reporting, it is solely for engineering purposes.

GCT will also conduct an inspection of the overall emissions control system, including operation and maintenance practices and any relevant historical Baghouse system studies.

NOTE: Blast Furnace No. 3 has been offline since September 1, 2022 because of business conditions. A definitive date to put Blast Furnace No. 3 online has not been confirmed. The portions of the study that require both blast furnaces at the production rate of 7,400 nthm will be completed within 120 days of study approval or 120 days following a return to full production whichever is later.

3. DUCTWORK MEASUREMENTS

The existing casthouse baghouse systems are positive pressure and discharge directly to atmosphere from the top side of the baghouse compartments. It is not possible to obtain an accurate measurement of the flow rate at this location. In addition, the baghouse system provides de-dusting for both casthouse 1 and casthouse 3. Therefore, in order to collect representative gas flow rate measurements for each casthouse, the measurement locations need to be in the main ducts upstream of the baghouse and fans from each casthouse leading up to the baghouse system.

3.1 Testing Locations

Based on the information provided by USS, and previous experience at USS ET, GCT has established the following testing locations for the ductwork testing:

- Main duct from casthouse 1
- Main duct from casthouse 3

Both of the sampling locations meet the eight- and two-diameter criteria set forth in EPA Method 1.

However, a traverse in only one direction is possible. A second traverse perpendicular to the accessible location is not possible for casthouse 1 as the aerial work platform required to reach the topside of the duct would interfere with the ground operations, hindering the normal operation of casthouse 1.

GCT believes that representative measurements can be taken at the proposed locations with one directional traverse as both locations provide sufficient distance from upstream and downstream flow disturbances that may impact the uniformity of the flow in the duct.

The locations are shown in Figure 3.1 and Figure 3.2.

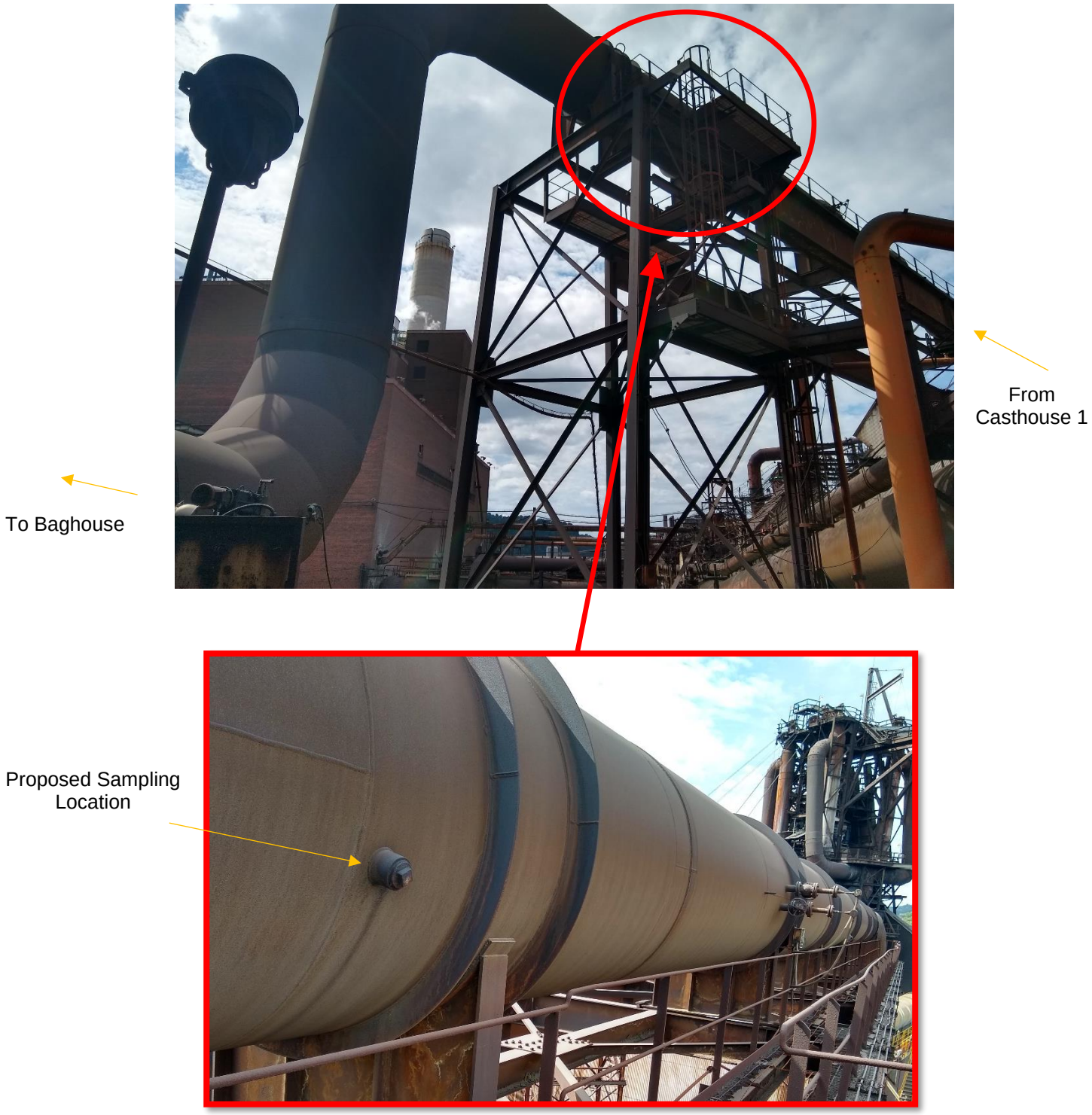

Figure 3.1
Casthouse 1 Testing Location

Figure 3.2
Casthouse 3 Testing Location

3.2 Testing Equipment

Volumetric flow rate within the ductwork will be established using US EPA Method 2. The following equipment will be utilized:

- Velocity pressure and static pressure measured using a 6 ft S-type pitot tube with 0.84 k Factor (Dwyer model 160S-72),
- Digital manometer (Dwyer model 475 or similar) with a range of ± 20.000 in.w.g. and accuracy to within 0.5%, and
- K-type thermocouple with digital thermometer (Dwyer model 472 or similar) with a range of -418 to 2,500 °F and accuracy to within 0.1%.

Deviations from EPA Method 2 include the following:

- Use of digital manometer in lieu of an inclined u-tube manometer. The proposed instrument, Dwyer model 475 has the following advantages:
    - A resolution to 1/1000 of an inch is more precise than a typical 1/100 low range of an inclined u-tube manometer,
    - With a measurement rate of 0.5 seconds, this can provide for rapid averaging of multiple measurements at single traverse point, and
    - The resolution and data averaging would allow for more reliable and accurate data, especially necessary when using a single traverse.

3.3 Testing Procedures

Both of the locations, from casthouse 1 and casthouse 3, will be tested simultaneously. A full traverse to record velocity pressure will be conducted every 5 minutes for 6 to 8 hours per day. A static pressure reading will be taken after each velocity pressure traverse and temperature will be recorded.

The sampling team will be in radio communication with USS personnel in the control room for casthouse 1 and 3. USS personnel will provide routine feedback to sampling team in regard to the casthouse process operations as well as the main duct damper movements. This data, along with additional operating data for the fans and baghouse system will also be collected electronically from USS data historian for subsequent analysis.

4. VISUAL EMISSIONS OBSERVATIONS

Opacity measurements will be performed by trained and qualified personnel throughout the duration of the ductwork testing. Any exceedances of an applicable standard will be investigated, and the root cause will be included in the report.

4.1 Observation Point

The observer will be positioned at a suitable location from where they can monitor the roofline of the casthouse. As there is no suitable location to observe both casthouse 1 and 2 from a common location, two observers will be employed, one dedicated to each casthouse.

The observation points will be chosen each day of the study to satisfy the requirements of Method 9 to the best extent possible. The observer may be required to adjust locations if conditions change such as sun position and interferences that may arise. Any deviations to Method 9 requirements will be noted on each observation record and included in the final report. However, every effort will be made to maintain suitable observation point throughout the day.

4.2 Observation Procedures

Visual emissions observations will be conducted continuously for 6-8 hours each day during the minimum 5-day testing period.

During any event that leads to a visible plume from the casthouse, the observer will make the readings at the point of greatest opacity and record the observed opacity to nearest 5% at 15-second intervals.

In addition to the opacity readings, the observer will record the start and end time of the emissions event and the ambient conditions during the set of readings.

The observer will be in radio communication with USS personnel in the control room for casthouse 1 and 3. USS personnel will provide routine feedback to observer in regard to the casthouse process operations. This data, along with additional operating data will also be collected electronically from USS data historian for subsequent analysis.

In addition to physical observations, GCT may to employ a digital camera to capture and analyze photos of the fugitive emission plume from the casthouse.

5. ADDITIONAL DATA COLLECTION REQUIREMENTS

During the site visit, GCT personnel will also perform other data collection and inspection tasks to fully understand the operating conditions of the existing emissions control system. GCT will also review any relevant past reports of the Casthouse Baghouse System.

5.1 Meetings

GCT will meet with environmental personnel to review air emissions compliance history.

GCT will meet with maintenance personnel to understand existing inspection and maintenance practices, and any known perceived shortcomings of the emissions control system.

GCT will meet with operations personnel to understand any operational consideration or limitations on hood/ventilation design.

5.2 Inspections

In addition to the meetings with maintenance personnel as indicated above, the following tasks will be completed during the site visit to assist with the maintenance audit:

- Conduct a visual / walkthrough inspection of each aspect of the casthouse emissions control system, including hoods, ductwork, dampers, expansion joints, baghouse, I.D. fans and dust handling system,
- Review maintenance and inspection log sheets, and
- Obtain operation & maintenance plans for the emissions control system,
- Inspect and evaluate the capture effectiveness between the furnace shells and casthouse structures (including sheeting) at the hoods,
- Evaluate the overall capture for both furnaces together and individually, including field measurements of system flows, pressures, and temperatures.

The information collected will be used in subsequent analysis of USS's maintenance practices for the casthouse emissions control system.

5.3 Process Data Collection

In addition to the ductwork measurements and opacity readings identified in Sections 3 & 4, additional measurements and observations will be conducted during the site visit period, including:

- Static pressure measurement before and after each I.D. fan; the available measurement locations before and after each fan are not suitable for velocity measurements, and
- Videography of the tap hole opening process, trough and skimmer area emissions, iron runner emissions, and ladle car transfer area emissions.

The following information will be collected for further review and analysis:

- Casthouse operation log sheets
- Blast Furnace production and applicable operating data

- Damper control logic with design setpoints
- Logged electronic data including gas temperature and static pressure within the system, damper setpoint and positioning, baghouse operating and cleaning parameters including sequencing, fan operating parameters including fan motor ramp ups and downs and fan amps.

The information collected will be used in subsequent analysis and design improvements of the emissions control system.

5.4 System Design Documentation

The following information will be collected for review, analysis and design improvements of the emissions control system:

- Emissions control system general arrangement drawings
- Casthouse 1 and 3 general arrangement drawings
- Casting floor area drawings
- Baghouse design parameters and drawings
- I.D. fan design parameters and drawings
- Ductwork and hood design drawings
- Process flow diagrams
- Piping and instrumentation diagrams
- Operating and maintenance manuals

6. ANALYSIS APPROACH

The data collected during the site visit will be used to establish the following:

- Existing ventilation rate of baghouse system under various operating scenarios,
- Estimate of emissions capture efficiency of existing hoods,
- Identification of processes that lead to excessive fugitive emissions, and
- Deficiencies in the design, capacity, operation and maintenance of the existing emissions control system.

A complete understanding of the above will allow GCT to develop recommendations to improve the existing system performance, and to establish the requirement for further upgrades to the emissions control system to meet environmental goals.

6.1 Ventilation System Capacity

The total ventilation rate to each casthouse under varying modes of operation will be calculated from the ductwork measurements of velocity pressure, static pressure and temperature based on the calculation methodology outlined in US EPA Method 2.

The performance of each I.D. fan, and flow rate through individual baghouse compartments, will be established using the I.D. fan performance curve of pressure rise (outlet pressure minus inlet pressure) vs flow rate. Other I.D. fan operating data, including power, will also be used to validate the flow rate estimated from the performance curve.

In order to understand the impact of damper logic, ductwork sizing and arrangement, and system static pressure profile, a model of the casthouse emissions control system will be developed using modeling software such as Applied Flow Technology's Fathom software. Fathom uses the Newton-Raphson method to solve the fundamental equations of pipe flow that govern mass and momentum balance. Fathom is able to model the entire fume collection system, including performance of the flow dampers, I.D. Fans, and the baghouse. The model will be calibrated against the ductwork and I.D. fan measurements. Once calibrated, the system pressure profile will allow for the identification of potential ductwork design or damper control shortcomings.

6.2 Hood Performance

The existing issues with emissions capture, if any, and required ventilation rates will be developed using a multitude of process inputs, including the video plume photography and hood exhaust rate design calculations. These methods will be used to:

- Evaluate the performance characteristics of the existing hoods,
- Evaluate hood design and exhaust rate modifications to improve existing hoods, and
- Establish the hood design and exhaust rate requirements for emissions not currently controlled

Plume analysis

Plume analysis is a method of estimating the emissions generated during the tapping and iron transfer operations. The plume diameter and velocity is tracked frame by frame. The velocity of the plume is measured by selecting a specific plume characteristic and measuring the time and distance for upward drift of that plume characteristic. The diameter of the plume is estimated by measuring the width of the plume in the video against the length of a known object in the video frame.

The plume volume estimated with this technique can then be combined with other engineering methods, such as the ventilation rate calculations promulgated by the US EPA and industrial ventilation design guidebooks, to establish the required ventilation rate.

Other Exhaust Rate Calculations

Additional ventilation design calculation will also be considered to estimate the hood exhaust requirements for the various operations inside the casthouse. This would include calculations developed in EPA publication EPA/600/7-86/016 – Technical Manual: Hood System Capture of Process Fugitive Particulate Emissions, Kashdan et al. as well as other methods illustrated in the ACGIH manual of recommended practice.

7. TENTATIVE SCHEDULE

The testing and inspection scope presented in this protocol will require a 9-day site visit.

Day 1:	Morning	Safety training
		Kick-off meeting
	Afternoon	Walkthrough of casthouse 1 and 3 emissions control system
		Review safe access to testing locations and opacity observation point
Days 2-6:	08:00	Daily pre-task risk assessment
	08:30 – 12:00	Ductwork measurements simultaneously at casthouse 1 and 3 main duct
		Visual emissions observations
	12:00 – 13:00	Lunch
	13:00 – 17:30	Ductwork measurements simultaneously at casthouse 1 and 3 main duct
		Visual emissions observations
	17:30 – 18:00	Daily review of preliminary observations and findings
	All Day	Intermittent measurements at I.D. fan inlet and outlet
		Intermittent videography of casthouse operations
		Collection of drawings, design manuals, O&M plans, etc
Day 7	09:00 – 11:00	Meeting with USS maintenance
	11:00 – 12:00	Walkthrough of emissions control system with maintenance team
	13:00 – 15:00	Meeting with USS operations and environmental
	15:00 – 16:00	Wrap-up meeting

8. REPORT

The report will include the following:

- Methodology
- Observations in including root causes of any applicable standard exceedance
- Data and other information reviewed
- Study findings
- Certification by U. S. Steel and GCT that the study was performed on accordance with the provisions of the Consent Decree.
- Potential improvements to the capture and control systems and Blast Furnace operating procedures