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CLEVELAND CLIFFS

DEARBORN, MICHIGAN

QUARTER 2 (Q2) 2023 SOURCE TESTING REPORT: BASIC OXYGEN FURNACE (EUBOF) AND BASIC OXYGEN FURNACE SHOP OPERATIONS (FGBOFSHOP)

RWDI #2303982

July 10, 2023

SUBMITTED TO

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**QUARTER 2 (Q2) SOURCE TESTING REPORT:
 BASIC OXYGEN FURNACE (EUBOF) AND BASIC OXYGEN FURNACE SHOP OPERATIONS (FGBOFSHOP)
 CLEVELAND CLIFFS - DEARBORN WORKS**



RWDI#2303982
 July 10, 2023

EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) was retained by Cleveland-Cliffs Dearborn Works (CCDW) to complete the Quarter 2 (Q2) 2023 emission sampling program at their facility located at 4001 Miller Road, Dearborn, Michigan. The purpose of the emissions test program was to verify emissions required by Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit MI-ROP-A8640-2016a, and to comply with the testing requirements specified within the current draft First Material Modification to the consent decree, Civil Action No. 15-cv-11804, DJ # 90-5-2-1-10702. The test program consisted of testing for particulate matter, particulate matter less than 10 microns (PM₁₀), particulate matter less than 2.5 microns (PM_{2.5}), lead (Pb), manganese (Mn), and visible emissions (VE) from the Electrostatic Precipitator (ESP) (SVBOFESP) and Pb and Mn from the Secondary Emission Control (SEC) Baghouse (SVBOFBH). In addition, visible emission observations were conducted on the BOF Roof Monitor at the request of EGLE. Pb and Mn testing was performed simultaneously on the ESP and the SEC Baghouse. Condensable Particulate Emissions (CPM) was measured from the ESP along with the FPM testing and PM_{2.5} and PM₁₀ emissions are reported as the sum of FPM and CPM.

Executive Table i: Test Results

| Source | Parameter | Concentration | |
|---------------------------------|---|--|--|
| | | Average Emission Rate | Emission Limit |
| BOF ESP | PM (Filterable only) | 0.0030 gr/dscf | 0.0152 gr/dscf |
| | | 10.9 lb/hr | 62.6 lb/hr |
| | PM ₁₀ (Filterable + Condensable) | 15.4 lb/hr | 47.5 lb/hr |
| | PM _{2.5} (Filterable + Condensable) | 15.43 lb/hr | 46.85 lb/hr |
| | Lead | 0.014 lb/hr | -- |
| | Manganese | 0.049 lb/hr | -- |
| | Visible Emissions | 3%, 6-minute average ⁽¹⁾⁽²⁾ | 20%, 6-minute average ⁽¹⁾ |
| BOF SEC Baghouse | Lead | 0.0039 lb/hr | -- |
| | Manganese | 0.0092 lb/hr | 0.07 lb/hr |
| BOF ESP & SEC Baghouse Combined | Lead | 0.018 lb/hr | 0.067 lb/hr |
| | Manganese | 0.058 lb/hr | 0.10 lb/hr |
| BOF Roof Monitor | Visible Emissions | 4%, 3-minute Average ₍₂₎ | 15% 3-minute Average (FGBOFSHOP) 20% 3-minute Average (EUBOF) |

Notes: (1) One 6-minute average opacity of up to 27% is exempt per hour
 (2) Reported as maximum 3-minute average observed for BOF Roof Monitor and 6-minute average for ESP during all observations



TABLE OF CONTENTS

| | | |
|----------|---|----------|
| 1 | INTRODUCTION..... | 1 |
| 1.1 | Location and Dates of Testing..... | 1 |
| 1.2 | Purpose of Testing..... | 1 |
| 1.3 | Description of Source..... | 1 |
| 1.4 | Personnel Involved in Testing..... | 2 |
| 2 | SUMMARY OF RESULTS..... | 3 |
| 2.1 | Operating Data..... | 3 |
| 2.2 | Applicable Permit Number..... | 3 |
| 3 | SOURCE DESCRIPTION..... | 3 |
| 3.1 | Description of Process and Emission Control Equipment..... | 3 |
| 3.2 | Process Flow Sheet or Diagram (if applicable)..... | 3 |
| 3.3 | Type and Quantity of Raw and Finished Materials..... | 3 |
| 3.4 | Normal Rated Capacity of Process..... | 4 |
| 3.5 | Process Instrumentation Monitored During the Test..... | 4 |
| 4 | SAMPLING AND ANALYTICAL PROCEDURES..... | 5 |
| 4.1 | Description of Sampling Train and Field Procedures..... | 5 |
| 4.1.1 | Stack Velocity, Temperature, and Volumetric Flow Rate Determination USEPA Method 1-4..... | 5 |
| 4.1.2 | Oxygen and Carbon Dioxide USEPA Method 3A..... | 5 |
| 4.1.3 | Particulate Matter and Condensable Particulate Matter USEPA Method 5/202..... | 6 |
| 4.1.4 | Metals (Lead and Manganese) USEPA Method 29..... | 6 |
| 4.1.5 | Visible Emissions USEPA Method 9..... | 7 |
| 4.1.6 | Method Deviations and Comments..... | 7 |
| 4.2 | Description of Recovery and Analytical Procedures..... | 8 |
| 4.3 | Sampling Port Description..... | 8 |



| | | |
|----------|---|----------|
| 5 | TEST RESULTS AND DISCUSSION..... | 9 |
| 5.1 | Detailed Results..... | 9 |
| 5.1.1 | Discussion of Results | 9 |
| 5.2 | Process Upset Conditions During Testing..... | 9 |
| 5.3 | Maintenance Performed in Last Three Months..... | 9 |
| 5.4 | Audit Samples..... | 10 |
| 5.5 | Calibration Sheets | 10 |
| 5.6 | Field Data Sheets | 10 |
| 5.7 | Laboratory Data | 10 |
| 5.8 | Sample Calculations | 10 |

LIST OF TABLES (IN REPORT)

| | | |
|-------------------|--------------------------------|---|
| Table 1.4: | List of Testing Personnel..... | 1 |
| Table 5.1: | Table of Results..... | 4 |

LIST OF TABLES (TABLE TAB)

| | |
|------------------|---|
| Table 1: | Summary of Sampling Parameters and Methodology |
| Table 2A: | Sampling Summary and Sample Log (SVBOFESP) |
| Table 2B: | Sampling Summary and Sample Log (SVBOFBH) |
| Table 3A: | Sampling Summary – Flow Characteristics – SVBOFESP |
| Table 3B: | Sampling Summary – Flow Characteristics - SVBOFBH |
| Table 4A: | Total Particulate Matter and Metals – Averaged Results – SVBOFESP |
| Table 4B: | Metals – Averaged Results - SVBOFBH |
| Table 4C: | Metals – Averaged Results – SVBOFESP + SVBOFBH |
| Table 5: | Visible Emissions Results – SVBOFESP |



1.4 Personnel Involved in Testing

Table 1.4: Testing Personnel

| | | |
|---|--|--|
| David Pate Senior Environmental Engineer | Cleveland-Cliffs Dearborn Works | (313) 323-1261 David.Pate@Clevelandcliffs.com |
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| Jeffrey Peitzsch | | Montrose Air Quality Services |



2 SUMMARY OF RESULTS

2.1 Operating Data

CCDW personnel monitored the process during the course of the testing. All process data can be found in **Appendix A**. During the testing, production averaged 326.9 TPH of liquid steel. The ESP operated at 30 equivalent fields during the testing. This will be used as the ESP operating standard as defined by the draft consent decree from the date of completion of this test.

2.2 Applicable Permit Number

MI-ROP-A8640-2016a

3 SOURCE DESCRIPTION

3.1 Description of Process and Emission Control Equipment

Primary emissions from oxygen blowing are controlled by an ESP (SVBOFESP). The emissions enter the ESP where the particulate is electrically charged. The charged particles then flow over positively charged collector plates, where the particles are collected. Vibration to both the discharge electrodes and the collection plates dislodge the particulate matter. The exhaust gas is then discharged from the ESP outlet.

The BOF also utilizes a secondary emission control (SEC) baghouse (SVBOFBH). The SEC baghouse controls particulate emissions during the hot metal charging, tapping, and reladling operations during the steel making process.

3.2 Process Flow Sheet or Diagram (if applicable)

Process flow diagram can be provided upon request.

3.3 Type and Quantity of Raw and Finished Materials

Approximately 250 tons of molten steel and 30 tons of slag is produced at the BOF during each heat. A typical heat will process approximately 200 tons of liquid iron and 60-80 tons of scrap. Lime is added as a flux and various alloys are added based on the final specifications of the steel being produced.



The run commenced after the completion of the scrap charge. However, an additional scrap charge was sampled for the following heat prior to the end of the test run. The VE conducted during run 2 captured the initial scrap charge through the end of the heat. Production for run 2 is calculated using the times for the initial heat.

The following additional comments are noted:

5. EGLE requested in the test plan approval letter that lead concentration be measured in the hot metal per heat. The samples to be analyzed for lead were inadvertently disposed of by Cleveland-Cliffs and could not be analyzed. Correspondence with EGLE in relation to this is presented in Appendix I.

4.2 Description of Recovery and Analytical Procedures

The recovery followed USEPA Method 5, 202, and 29.

4.3 Sampling Port Description

EUBOF ESP (SVBOFESP) is a circular stack with an inner diameter of 204". 4 ports are used for testing.

FGBOFSHOP (SVBOFBH) is a circular stack with an inner diameter of 222". 4 ports are used for testing.



5 TEST RESULTS AND DISCUSSION

5.1 Detailed Results

Table 5.1: Test Results

| Source | Parameter | Concentration | |
|---------------------------------|---|--|--|
| | | Average Emission Rate | Emission Limit |
| BOF ESP | PM | 0.0030 gr/dscf | 0.0152 gr/dscf |
| | Filterable only | 10.9 lb/hr | 62.6 lb/hr |
| | PM ₁₀ (Filterable + Condensable) | 15.4 lb/hr | 47.5 lb/hr |
| | PM _{2.5} (Filterable + Condensable) | 15.43 lb/hr | 46.85 lb/hr |
| | Lead | 0.014 lb/hr | -- |
| | Manganese | 0.049 lb/hr | -- |
| | Visible Emissions | 1%, 6-minute average ⁽¹⁾⁽²⁾ | 20%, 6-minute average ⁽¹⁾ |
| BOF SEC Baghouse | Lead | 0.0039 lb/hr | -- |
| | Manganese | 0.0092 lb/hr | 0.07 lb/hr |
| BOF ESP & SEC Baghouse Combined | Lead | 0.018 lb/hr | 0.067 lb/hr |
| | Manganese | 0.058 lb/hr | 0.10 lb/hr |
| BOF Roof Monitor | Visible Emissions | 4%, 3-minute average ⁽²⁾ | 15%, 3-minute average (FGBOFSHOP) 20%, 3-minute average (EUBOF) |

Notes: (1) One 6-minute average opacity of up to 27% is exempt per hour
 (2) Reported as maximum 3-minute average observed for BOF Roof Monitor and 6-minute average for ESP during all observations

5.1.1 Discussion of Results

Detailed results for the program are provided in the following Appendices:

- SVBOFESP (ESP) – **Appendix B**
- SVBOFBH (Secondary Baghouse) – **Appendix B**
- 3rd Party Visible Emissions – **Appendix H**

5.2 Process Upset Conditions During Testing

There were no process upsets during testing.

5.3 Maintenance Performed in Last Three Months

The final phase of the ESP Rebuild Project was completed on March 31, 2023 when ESP casing 3 was placed into service. Other than the completion of the ESP rebuild project, only routine maintenance was performed within the last three months.



5.4 Audit Samples

This test did not require any audit samples.

5.5 Calibration Sheets

Calibration sheets can be found in **Appendix D**.

5.6 Field Data Sheets

Field data sheets can be found in **Appendix E**.

5.7 Laboratory Data

Laboratory data can be found in **Appendix F**.

5.8 Sample Calculations

Sample calculations can be found in **Appendix G**.

TABLES

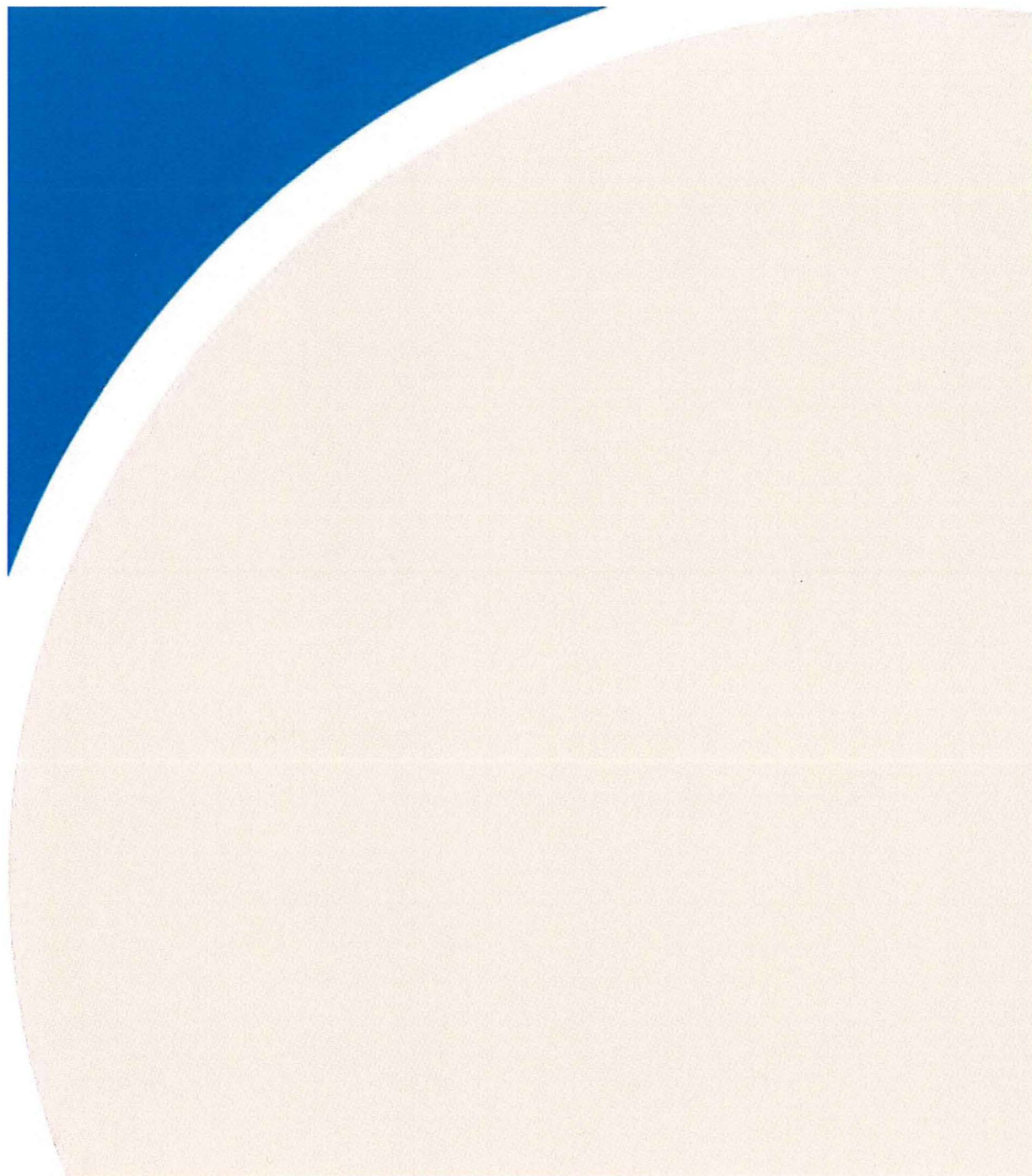


Table 1: Summary of Sampling Parameters and Methodology

| Source Location | No. of Tests per Stack | Sampling Parameter | Sampling Method |
|---------------------------------|------------------------|---|--|
| ESP (SVBOFESP) | 3 | Velocity, Temperature and Flow Rate | U.S. EPA ^[1] Methods 1-4 |
| | 3 | PM / PM ₁₀ / PM _{2.5} | U.S. EPA [1] Method 5/202 |
| | 3 | Lead / Manganese | U.S. EPA [1] Method 5/29 |
| | 3 | Oxygen / Carbon Dioxide | U.S. EPA [1] Method 3A |
| | 3 | Visible Emission | U.S. EPA [1] Method 9 |
| Secondary Baghouse (SVBOFBH) | 3 | Velocity, Temperature and Flow Rate | U.S. EPA ^[1] Methods 1, 2 and 4 |
| | 3 | Lead / Manganese | U.S. EPA [1] Method 29 |
| | 3 | Oxygen / Carbon Dioxide | U.S. EPA [1] Method 2 |

Notes:

[1] U.S. EPA - United States Environmental Protection Agency

Table 2A: Sampling Summary and Sample Log (SVBOFESP)

| Source and Test # | Sampling Date | Start Time | End Time | Filter ID / Trap ID |
|--|---------------|------------|----------|---------------------|
| SVBOFESP - Velocity / Total Particulate | | | | |
| Blank | 17-May-23 | - | - | QZ65 |
| Test #1 | 16-May-23 | 8:39 AM | 11:46 AM | QZ92 |
| Test #2 | 16-May-23 | 1:44 PM | 3:40 PM | QZ86 |
| Test #3 | 17-May-23 | 7:58 AM | 9:35 AM | QZ82 |
| SVBOFESP - Velocity / Lead / Manganese | | | | |
| Blank | 17-May-23 | - | - | QZ81 |
| Test #1 | 16-May-23 | 8:39 AM | 11:46 AM | QZ87 |
| Test #2 | 16-May-23 | 1:44 PM | 3:17 PM | QZ85 |
| Test #3 | 17-May-23 | 7:58 AM | 9:35 AM | QZ83 |
| SVBOFESP - Visible Emissions | | | | |
| Test #1 | 16-May-23 | 8:39 AM | 9:38 AM | -- |
| Test #2 | 16-May-23 | 1:41 PM | 2:40 PM | -- |
| Test #3 | 17-May-23 | 7:58 AM | 8:57 AM | -- |

Table 2B: Sampling Summary and Sample Log (SVBOFBH)

| Source and Test # | Sampling Date | Start Time | End Time | Filter ID / Trap ID |
|--|---------------|------------|----------|---------------------|
| SVBOFBH - Velocity / Lead / Manganese | | | | |
| Blank | 17-May-23 | - | - | QZ81 |
| Test #1 | 16-May-23 | 8:39 AM | 11:44 AM | QZ89 |
| Test #2 | 16-May-23 | 1:41 PM | 3:38 PM | QZ80 |
| Test #3 | 17-May-23 | 7:58 AM | 9:31 AM | QZ84 |

Table 3A: Sampling Summary - Flow Characteristics - SVBOFESP

| Stack Gas Parameter | | Test No. 1 | | Test No. 2 | | Test No. 3 | | Average |
|--------------------------|------|-------------|----------------|-------------|----------------|-------------|----------------|---------|
| | | Particulate | Lead/Manganese | Particulate | Lead/Manganese | Particulate | Lead/Manganese | |
| Testing Date | | 16-May-23 | | 16-May-23 | | 17-May-23 | | |
| Stack Temperature | °F | 250 | 251 | 264 | 262 | 250 | 251 | 255 |
| Moisture | % | 13.1% | 13.6% | 15.5% | 15.4% | 14.1% | 13.8% | 14.3% |
| Velocity | ft/s | 50.4 | 48.9 | 51.8 | 50.9 | 50.7 | 46.9 | 49.9 |
| Referenced Flow Rate | CFM | 432,265 | 416,647 | 424,135 | 417,934 | 430,742 | 409,842 | 421,928 |
| Sampling Isokinetic Rate | % | 99.9 | 99.6 | 102.8 | 95.7 | 101.1 | 96.7 | 99.3 |

Notes:

[1] Referenced flow rate expressed as dry at 101.3 kPa, 68 °F, and Actual Oxygen

Table 3B: Sampling Summary - Flow Characteristics - SVBOFBH

| Stack Gas Parameter | | Test No. 1 | Test No. 1 | Test No. 3 | Average |
|--------------------------|------|----------------|----------------|----------------|---------|
| | | Lead/Manganese | Lead/Manganese | Lead/Manganese | |
| Testing Date | | 16-May-23 | 16-May-23 | 17-May-23 | |
| Stack Temperature | °F | 100 | 109 | 85 | 98 |
| Moisture | % | 0.8% | 1.0% | 1.2% | 1.0% |
| Velocity | ft/s | 34.8 | 34.6 | 30.3 | 33.2 |
| Referenced Flow Rate | CFM | 509,655 | 498,550 | 456,178 | 488,128 |
| Sampling Isokinetic Rate | % | 100.3 | 98.6 | 98.6 | 99.2 |

Notes:

[1] Referenced flow rate expressed as dry at 101.3 kPa, 68 °F, and Actual Oxygen

