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John S. Lyons
SECRETARY

July 13, 2026

Mr. Kevin McOmber
Regional Administrator
U.S. EPA, Region 4
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, Georgia 30303

RE: Submittal of the proposed Kentucky State Implementation Plan revision, satisfying the Attainment Demonstration Requirements for the Partial Counties of Henderson and Webster Located within the Kentucky 2010 1-Hour Sulfur Dioxide Nonattainment Area

Dear Mr. McOmber:

The Kentucky Energy and Environment Cabinet (Cabinet) submits this letter concurrently with a proposed revision to the Kentucky State Implementation Plan (SIP) including an attainment demonstration for the partial counties of Henderson and Webster located within the Kentucky 2010 1-hour SO₂ nonattainment area. The accompanying submittal satisfies the attainment demonstration requirements outlined in Clean Air Act Section 172(c); thus, the Cabinet formally requests EPA approve this SIP revision.

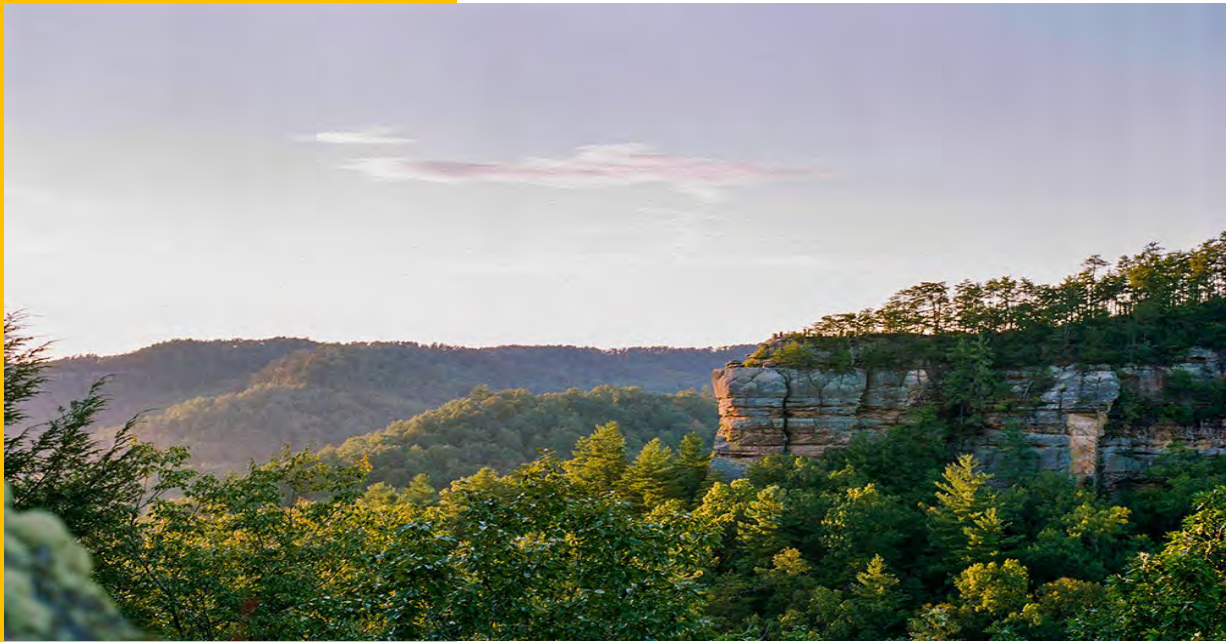
In accordance with 40 CFR 51.102, the proposed SIP revision was available for public review and comment from August 15, 2024, until September 20, 2024. The Cabinet received comments from EPA and the public, and responses can be found in Appendix M. If you have any questions, please contact Mr. Michael Kennedy, Kentucky Division for Air Quality Director, at (502) 782-6997 or michael.kennedy@ky.gov.

Sincerely,



John Lyons, Secretary

cc: Denisse Diaz, U.S. EPA Region 4
Lynorae Benjamin, U.S. EPA Region 4



Commonwealth of Kentucky

Attainment Demonstration for the Partial Counties of Henderson and Webster Located within the Kentucky 2010 1-Hour Sulfur Dioxide Nonattainment Area

Prepared for: U.S. Environmental Protection Agency

Prepared by: Kentucky Energy and Environment Cabinet,
Division for Air Quality

July 13, 2026, Final Draft

Publication Information:

This document is available on the Division for Air Quality's website at:

[Air Quality Public Notices - Kentucky Energy and Environment Cabinet](#)¹

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¹ <https://eec.ky.gov/Environmental-Protection/Air/Pages/Public-Notices.aspx>.

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BREC - HMP&L Station 2 Retirement Letter;

BREC - Green Permit (For informational purposes only)

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EXECUTIVE SUMMARY

The Kentucky Division for Air Quality (Division) is hereby submitting a revision to the Commonwealth of Kentucky's State Implementation Plan (SIP) under the federal Clean Air Act (CAA). In the fourth and final set of actions to designate areas of the U.S. for the 2010 1-hour sulfur dioxide (SO₂) National Ambient Air Quality Standards (NAAQS), U.S. Environmental Protection Agency (EPA) formally designated a portion of Henderson and Webster counties as a nonattainment area for the 2010 1-hour SO₂ standard, based on relevant monitoring data that indicated violations. The final area designations were published on March 26, 2021, and became effective April 30, 2021.² The designation of the Henderson-Webster Nonattainment Area (hereinafter "the Area") was included in this action.

Pursuant to CAA Section 172(a)(2)(A), the attainment date for an area designated nonattainment shall be the date by which attainment can be achieved as expeditiously as practicable, but no later than 5 years from the date such area was designated nonattainment. Thus, the attainment date for the Area is April 30, 2026.

Kentucky is submitting three separate SIP revisions to address the nonattainment planning requirements for the Area. These SIP revisions address three separate requirements of the CAA: 1) nonattainment new source review (NNSR) requirements, submitted January 16, 2024 (§172(c)(5)); 2) an accurate base year emissions inventory of current emissions for all sources of SO₂ within the nonattainment area, submitted February 15, 2024 (§172(c)(3)); and 3) an attainment demonstration that includes a modeling analysis showing that the enforceable emissions limitations and other control measures taken by the Division will provide for expeditious attainment of the NAAQS for SO₂ (§172(c)).³ The Division has submitted and the EPA approved the first two SIP revisions on January 8, 2026.⁴

As described below, this SIP revision addresses the attainment demonstration components of Kentucky's Attainment Plan for the Area. This proposed Attainment Demonstration includes modeling runs developed by Trinity Consultants on behalf of Century Aluminum and verified by the Division. Based on modeling runs alone, the results indicate that the Area will come close to attaining, but not attain, the NAAQS with the control strategy chosen. However, when combined with a weight of evidence approach there is ample evidence that the Area will attain the NAAQS based on 1) lowered point source emissions within the Area; 2) adoption of a new federally enforceable annual allowable SO₂ emission limit for Century Aluminum; and 3) the installation of a new stack for Century Aluminum's anode bake furnace (ABF).

² 86 FR 16055. (March 26, 2021).

³ NNSR and Base Year Submittals can be seen on the Division's website at: [https://eec.ky.gov/Environmental-Protection/Air/Pages/State Implementation Plan Revisions.aspx](https://eec.ky.gov/Environmental-Protection/Air/Pages/State%20Implementation%20Plan%20Revisions.aspx)

⁴ 91 FR 609. (January 8, 2026).

I. INTRODUCTION

A. Background

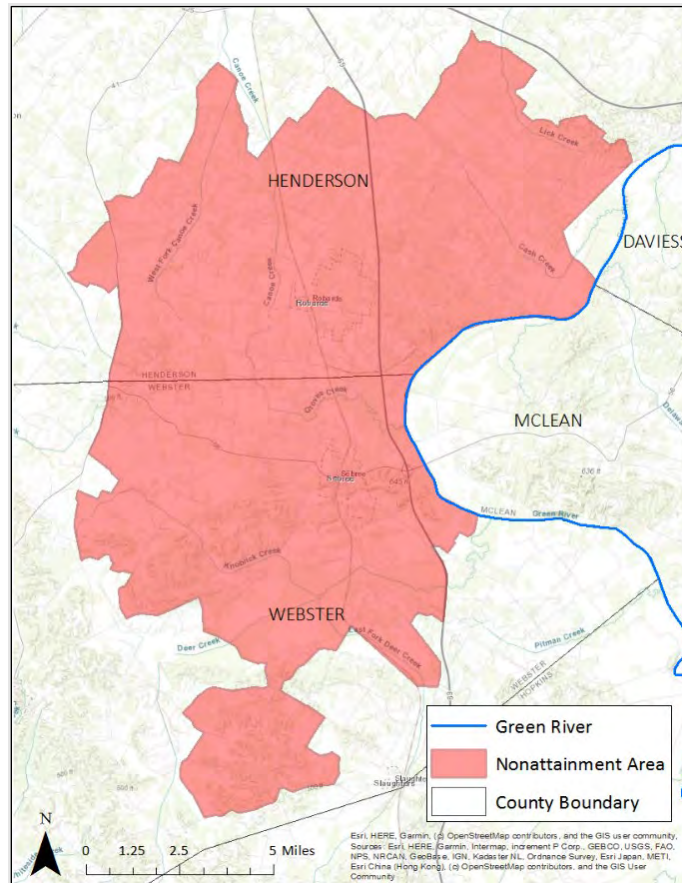
On June 22, 2010 (effective August 23, 2010), EPA revised the primary NAAQS for the criteria pollutant SO₂.⁵ Revoking both the existing 24-hour and annual primary standards, EPA established a new primary one-hour SO₂ standard of 75 parts per billion (ppb). This standard is based on a three-year average of the annual 99th percentile of one-hour daily maximum concentrations.

The nonattainment portion of Henderson and Webster counties is located in a mostly undeveloped area, consisting of pasture and farmland. The Area is bound to the east by the Green River and expands westward into Henderson and Webster counties, where it is bound by the Edward T. Breathitt Pennyrile Parkway (I-69), light industry, and farmland/wooded areas. The complete coordinates are in Appendix A, and a map is shown in Figure 1. The remainder of Henderson and Webster counties do not contain any sources that emitted greater than 2,000 tons per year (tpy) of SO₂ in 2017 – 2019 and are therefore designated as attainment/unclassifiable. The official boundaries of the Area were established by EPA in a final rule, effective April 30, 2021.⁶

⁵ 75 FR 35520. (June 22, 2010).

⁶ *Supra* note 2.

Figure 1 - Map of the Henderson-Webster Nonattainment Area Boundary



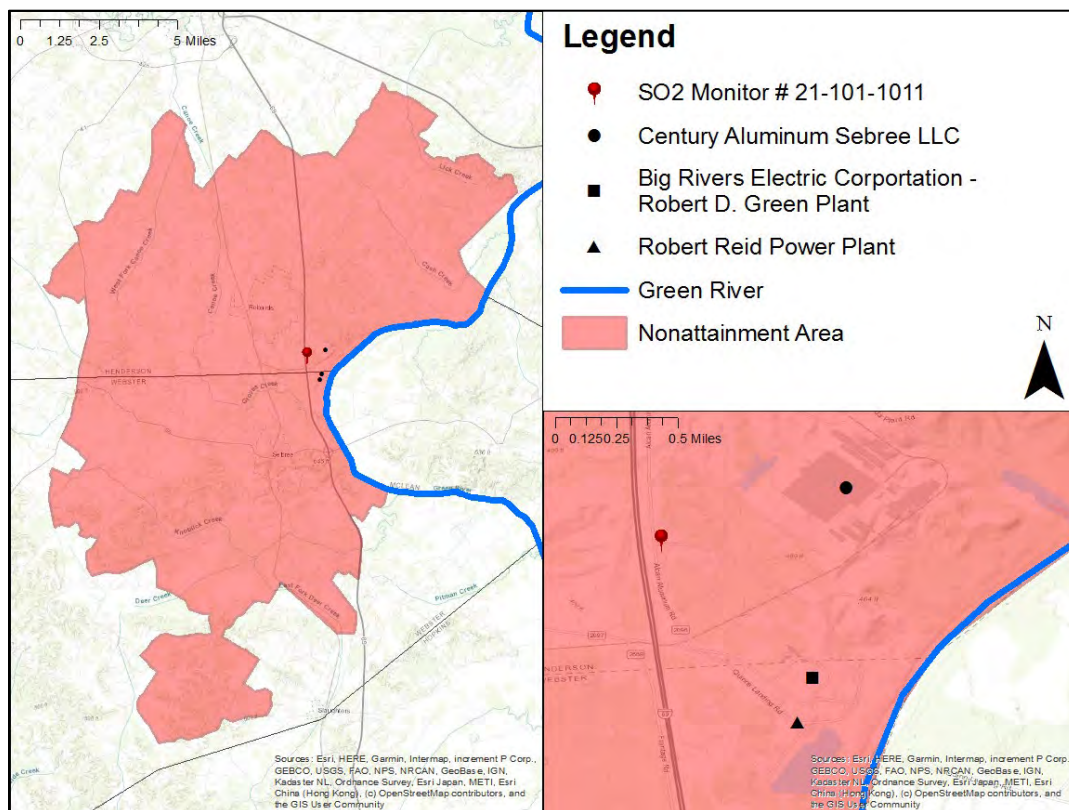
SO₂ is a source-oriented pollutant that is not naturally present in the environment in high concentrations and is not formed in large quantities by any atmospheric process. Elevated concentrations are often due to a single, large industrial source or group of sources with localized impacts.

At the time of the Area's designation, the Division identified three significant sources contributing to SO₂ emissions within the Area:

- Big Rivers Electric Corporation's Robert A. Reid Station (BREC - Reid) and Henderson Municipal Power and Light Station 2 (HMP&L Station 2). It should be noted that the Robert A. Reid Station/HMP&L Station 2 is a single stationary source with one operating permit, however, two of the coal-fired units at the facility were owned by HMP&L Station 2 and operated by BREC. Collectively, these facilities will be referred to as BREC - Reid in the remainder of this document;
- Big Rivers Electric Corporation's Robert D. Green Station (BREC - Green Station);
- Century Aluminum Sebree, LLC (Century).

Figure 2 shows the location of the Sebree monitor that was sited to characterize the maximum 1-hour SO₂ concentrations in the area surrounding the three significant sources. All three sources are located within 2 kilometers (km) of the monitor.

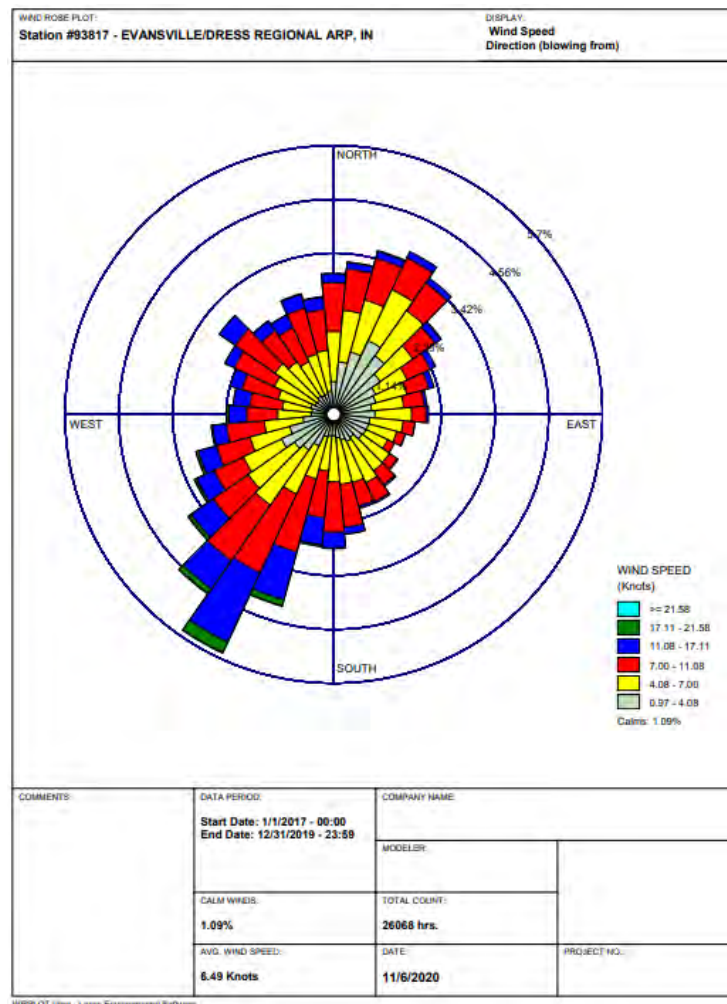
Figure 2 - Primary SO₂ Contributors of the Henderson-Webster Nonattainment Area and Monitor Location



Additionally, at the time of designation, wind rose plot analysis indicated that exceedances of the SO₂ standard at the Sebree Data Requirements Rule (DRR) monitoring site were due to emissions from both the Century and BREC facilities.⁷ The frequency and magnitude of wind speed and direction depicted in the wind rose in Figure 3 are defined in terms of from where the wind is blowing. This wind rose indicates that the predominant wind direction in the Evansville, IN area, due north of Henderson and Webster counties, is winds blowing from the southwest along with winds blowing from the northeast a significant amount of time. The complete technical support document (TSD) for the original area designations is available in Appendix B. It should be noted that both the BREC facilities have made significant reductions in SO₂ emissions in recent years; therefore, Century is currently the primary stationary source of SO₂ emissions in the Area.

⁷ EPA. (2020). *Technical Support Document (TSD) Final Round 4 Area Designations for the 2010 1-Hour SO₂ Primary National Ambient Air Quality Standard for Kentucky*. https://www.epa.gov/sites/default/files/2020-12/documents/03-ky-rd4_final_so2_designations_tsd.pdf.

**Figure 3 – Henderson-Webster, Kentucky Cumulative Annual Wind Rose for
Years 2017-2019**



caused higher SO₂ emissions.⁸ The Annual 99th percentile value dropped again in 2024-2025, as the facility no longer used the recycled anode materials, and 2023 is shown as an outlier compared with the past six years of available data.

Table 1 – Annual 99th Percentile One-Hour Daily Maximum Concentration for the Sebree DRR Monitor (ppb)

Year	Annual 99th Percentile One-Hour Daily Maximum Concentration
2017	94.0
2018	102.0
2019	99.0
2020	73.0
2021	68.0
2022	72.6
2023	94.3
2024	78.7
2025	71.2

As shown below in Table 2, the three-year design value for the Area attained the standard for the years 2020-2022. However, the three-year design value from 2021-2023 exceeded the standard. All monitoring data relied upon in this SIP submittal can be found in Appendix C.

Table 2 – Three-Year Design Values for the Sebree DRR Monitor (ppb)

Site	2017 - 2019	2018 - 2020	2019 - 2021	2020 - 2022	2021 - 2023	2022 - 2024	2023 - 2025
21-101-1011	98	91	80	71	78	82	81

⁸ Please see the “Weight-of-Evidence” Analysis from Trinity Consultants found in Appendix H.

II. SO₂ ATTAINMENT DEMONSTRATION

A. Projected Attainment Year Emissions Inventory

EPA's 2014 SO₂ Nonattainment Area SIP Guidance suggests states should submit a projected attainment year inventory, which reflects projected emissions for the attainment year for all SO₂ sources in the Area and accounts for emission changes that are expected after the base year.⁹ Such emissions changes would include any expected emission reductions from existing control measures, emission reductions from any previously unaccounted for source shutdowns, so long as the existing and new control measures and source shutdowns are enforceable; and would include any expected emission increases due to new sources or growth by existing sources pursuant to section 172(c)(4) of the CAA. Thus, the Division is submitting a comprehensive projected Attainment Inventory of SO₂ emissions as a component of this SIP revision. The Division is working to ensure emission levels attain the 2010 1-hour SO₂ NAAQS within the Area as expeditiously as possible.

The Attainment Year Emissions Inventory is broken down into four emission categories: point, nonpoint, onroad and nonroad. Nonpoint, onroad and nonroad emission totals for the Area are partial county totals based on census tract population data, as the Area does not incorporate the entirety of either Henderson or Webster County.¹⁰ Tables 3 and 4 summarize the Attainment Year Emissions Inventory for the Area by emission category.

**Table 3: 2026 Attainment Year Emissions Inventory for the Henderson County
Portion of the Nonattainment Area (tpy)**

	Point	Nonpoint	Onroad	Nonroad
Emissions Total County	4,293.56	10.569	0.086	0.203
Area Percent Adjustment (8%)	N/A	0.846	0.007	0.016
Nonattainment Area Emissions	4,293.56	0.846	0.007	0.016

⁹ EPA. (2014). *Guidance for 1-Hour SO₂ Nonattainment Area SIP Submissions*.

<https://www.epa.gov/system/files/documents/2025-09/guidance-for-1-hour-so2-nonattainment-area-sip-submissions.pdf>.

¹⁰ NNSR and Base Year Submittals can be seen on the Division's website at: <https://eec.ky.gov/Environmental-Protection/Air/Pages/State Implementation Plan Revisions.aspx>.

**Table 4: 2026 Attainment Year Emissions Inventory for the Webster County
Portion of the Nonattainment Area (tpy)**

	Point	Nonpoint	Onroad	Nonroad
Emissions Total County	4.82	6.178	0.029	0.059
Area Percent Adjustment (25%)	N/A	1.545	0.007	0.015
Nonattainment Area Emissions	4.82	1.545	0.007	0.015

The following sections describe how data for each emission category was obtained and analyzed. The Attainment Year Emissions Inventory is available in Appendix D. The Base Year Emissions Inventory was submitted to EPA in a separate SIP submittal; comparisons between the Attainment Year and the Base Year Emissions Inventories are included in the following analysis to highlight changes that occurred in the Area.

Point Sources

Actual point source electric generating units (EGU) emissions and non-EGU data from 2017-2023 were obtained from the Kentucky Emissions Inventory System (KyEIS). For Henderson County, the Division used Excel's Linear Forecast Function on the 2017-2019 and 2022-2023 data to project emissions for the 2026 attainment year. The Division chose to omit data for 2020 and 2021 from the forecast due to decreased emissions resulting from the COVID-19 pandemic. In Webster County, point source emissions changed drastically over the 2017-2023 period, following the conversion of BREC - Green Station to natural gas. Natural gas is the only fuel source allowed under BREC – Green Station's updated operating permit, thus these emissions are expected to remain consistent. The Division anticipates that future emissions within Webster County will remain consistent with 2023 emission levels, approximately five tons, into the future and are representative of what emissions in 2026 will be due to no anticipated future changes or growth.

Furthermore, since the EGU and non-EGU source information from the KyEIS database was located specifically within the Nonattainment Area, calculations to account for partial county emissions were not required. Below is a comprehensive analysis of the three major point sources in the Area, accounting for changes made to the facilities that will reduce their emissions and help the Area reach attainment.

(i) Century Aluminum Sebree LLC

Century was the largest source of SO₂ emissions in the Area in the 2018 base year, accounting for approximately 46% of all emissions in the Area. It remains the largest source of SO₂ emissions in the Area. In 2026, SO₂ emissions from Century are projected to account for approximately 99.9% of total emissions in the Area. Table 5 compares base year emissions to projected attainment year emissions for Century, which are not expected to change

significantly. It should be noted that the 2026 attainment year shows a slight increase from the 2018 base year. Of the abovementioned years included in the emissions inventory, 2018 had the lowest emissions reported and thus, the linear forecast projected a slightly higher number for the 2026 attainment year.

Table 5 – Base Year vs. Attainment Year SO₂ Emissions for Century Aluminum (tpy)

2018 Base Year	2026 Attainment Year
4,239.26	4,292.33

(ii) Big Rivers Electric Corporation – Robert Reid and HMP&L Station 2

Prior to 2019, the BREC - Robert Reid Station and HMP&L Station 2 facilities were significant contributors to SO₂ concentrations within the Area, however, as previously mentioned, both facilities have since been retired; documentation of the facilities' retirements can be found in a letter from the facility to the Division, located in Appendix E. Tables 6 and 7 show a comparison of base year vs. attainment year emissions for these two facilities, both clearly demonstrating that these facilities will no longer contribute to SO₂ concentrations within the Area by the attainment year.

Table 6 – Base Year vs. Attainment Year SO₂ Emissions for BREC - Robert Reid Station (tpy)

2018 Base Year	2026 Attainment Year
0.0	0.0

Table 7 – Base Year vs. Attainment Year SO₂ Emissions for BREC - HMP&L Station 2 (tpy)

2018 Base Year	2026 Attainment Year
848.40	0.0

(iii) Big Rivers Electric Corporation – Green Station

Effective May 26, 2022, both emission units at BREC - Green Station have been converted from coal to natural gas; documentation of the completion of the natural gas conversion project can be found in a letter from the facility to the Division, located in Appendix E. Emissions for this facility decreased dramatically in 2023, demonstrating that the fuel switch had a significant impact on reducing SO₂ emissions in the Area. The Division expects SO₂ emissions at the facility to remain low through the attainment year and beyond, following the completion of the natural

gas conversion project and permitting changes that no longer allow for coal to be used as a fuel source. Table 8 compares SO₂ emissions between the base year and the projected attainment year for this facility.

Table 8 – Base Year vs. Attainment Year SO₂ Emissions for BREC - Green Station (tpy)

2018 Base Year	2026 Attainment Year
4,114.50	0.62

Onroad Sources

Onroad source emissions data for 2026 were developed from emission factors produced by EPA's Motor Vehicle Emission Simulator (MOVES3.0.4) software program. Raw fleet data inputs were obtained from the Kentucky Transportation Cabinet (KYTC). The Louisville Metro Air Pollution Control District (LMAPCD) of Jefferson County, Kentucky, supplied the Vehicle Type VMT, Road Type Distribution, and Source Type Population inventory. RoadTypeDistrib.csv, VehTypeVMT.csv, and SourceTypePop.csv files were developed using VMT data provided by Evansville, Indiana's MPO and fleet data from KYTC. Area percent adjustments were applied to data inputs by scaling the fleet population with county population ratios to account for partial counties. More detailed information regarding how onroad sources were projected can be found in Appendix F.

Overall, emissions from onroad sources accounted for less than 0.1% of total projected emissions for the Area in the 2026 attainment year, as shown in Table 3 above.

Nonpoint Sources/Nonroad Sources

Emissions data from 2017 was pulled from EPA's 2016v2 Modeling Platform for the counties in the Area. SO₂ emissions for the 2026 attainment year were then interpolated from the 2017 data using Excel's Linear Forecast Function. Area percent adjustments were applied to account for partial counties.

Overall, nonpoint and nonroad emissions sources accounted for less than 0.1% of total projected emissions for the Area in the 2026 attainment year, as shown in Tables 3 and 4 above.

B. RACT/RACM

Section 172(c)(1) of the CAA requires that SIPs for nonattainment areas "provide for the implementation of all reasonably available control measures (RACM) as expeditiously as practicable (including such reductions in emissions from existing sources in the area as may be

obtained through the adoption, at a minimum, of reasonably available control technology [RACT]) and shall provide for attainment of the national primary ambient air quality standards.”

EPA has defined RACT as: “the lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility.”¹¹ RACT requirements are specifically intended to impose emission controls for the attainment and maintenance of the NAAQS within a specific nonattainment area. EPA has interpreted the terms RACT and RACM as the level of emissions control necessary to provide for expeditious attainment of the NAAQS within a nonattainment area.

(i) Control Strategy for Century Aluminum

Century has numerous sources of SO₂ emissions, including a natural gas fired remelt furnace, two groups of natural gas fired holding furnaces, four homogenizing furnaces, small natural gas boilers and pre-heaters, and six emergency generators. However, these sources account for less than 0.1% of the facility's total SO₂ emissions. As these emission sources made an insignificant contribution to the Area's nonattainment status, additional control measures on these sources would not contribute to attainment of the NAAQS. Therefore, these sources were not evaluated for RACT/RACM.

The vast majority of SO₂ emissions from Century are from the facility's potlines and the ABF. Trinity Consultants provided the Division with an SO₂ control strategy analysis for Century on November 8, 2021; this document has been included as Appendix G. Following public requests made during the comment period, the Division requested an updated control strategy analysis. Century provided the analysis on December 8, 2025; this document has been included as Appendix H. The cost estimates and assumptions provided below are available in the appendix.

1. Scrubbers

In the SO₂ control strategy analysis provided by Trinity Consultants, it is described that the exhaust characteristics of potline gases make the application of control strategies used on other types of industrial sources and combustion units challenging. The electrolytic process generates a high volume of exhaust gas with a relatively low SO₂ concentration. At low concentrations, the mass transfer of SO₂ to a sorbent is low and results in reduced efficiencies. In addition, the exhaust temperature from a stack test indicated that temperatures were too low for efficient use of dry scrubbers. Century currently has dry alumina scrubbers as a control strategy for fluoride removal from potline exhaust. These scrubbers cannot be used to control SO₂, as the

¹¹ 44 FR 53762. (September 17, 1979).

fluoride prevents the SO₂ from bonding to the scrubbing media. Thus, any additional dry scrubber would have to work in conjunction with the existing systems.

Installation of wet scrubbing technology was considered by the previous owners of the facility, Rio Tinto Alcan, during a best available control technology (BACT) analysis completed as a requirement of a Prevention of Significant Deterioration (PSD) permit application in 2010. The BACT analysis from this PSD permit application has been included as Appendix I. Adjusted for inflation from the 2008 estimate, the estimated annualized cost for the installation of a wet-scrubber would be \$39-\$76 million/year in 2025 dollars.

Due to the complexities of adding additional scrubbing technologies and the extensive time and cost for construction of a wastewater treatment plant, the Division concurs with Trinity Consultants that these options for RACT/RACM are infeasible.

2. Reduced Sulfur Content

Minimizing the sulfur content of the coke and pitch purchased by Century was also considered as a control strategy. According to Trinity Consultants, Century purchases coke from the Gulf Region of the United States (U.S.), with a maximum sulfur content specification of 3%, in compliance with the terms of the existing Title V permit. This is the standard sulfur content specification in the market for U.S. Gulf Region-sourced coke. To reduce the sulfur content below 3%, green cokes would need to be imported from South America and blended with U.S. cokes. Although this could result in lower sulfur content petroleum coke, there would be a significant increase in overall environmental impact, including greenhouse gas emissions, given the significantly longer transportation distances.

Additionally, the cost for reducing coke sulfur content from 3% to 2.5% would add \$51.90 per metric ton. Based on coke consumption rates at the facility, this would add an additional annual cost of \$5,200,000 and produce an estimated cost effectiveness of \$6,300/ton of SO₂. The 0.5% reduction in sulfur content would yield an 824 tpy reduction in SO₂ emissions.

In addition to the cost, decreased sulfur content increases anode reactivity, creating carbon dust in the pots that lowers the efficiency of production, increases power consumption, and can lead to higher emissions of other pollutants.

The cost impact analysis would jeopardize the economic sustainability of the facility. Combined with the increased reactivity of anodes generated through the use of low-sulfur coke, the Division concurs with Trinity Consultants that this option for RACT/RACM can be ruled out due to cost-effectiveness and efficiency.

3. Increased Stack Height

In the SO₂ control strategy analysis provided by Trinity Consultants, Century considered improvements to the design and configuration of the stacks on the ABF and potlines as a possible control strategy. Century contacted six engineering firms to assess the feasibility of altering the stacks at the facility but did not receive commitments from any of the firms to complete an engineering study. This control strategy analysis stated that a report on the feasibility and cost of this option would be provided to the Division in 4-6 months, but a subsequent report was not received.

Following a review of all potential control strategies, Century informed the Division on August 7, 2024, that the control strategy to be implemented consists of replacing the stacks at the ABF. At the time, there were three existing stacks on the ABF that are 70 ft tall and 4.2 ft in diameter. Century replaced those three stacks with a new singular stack on the ABF that is 213.2 ft tall and 8.5 ft in diameter. The fabrication of the stack is complete, and the final installation processes are underway. The stack is currently expected to be operational in August 2026. The cost to replace the stacks was estimated to be \$4 million. Modeling outlined in Section D and Appendix J, shows significant improvements to air quality will occur once the new stack is operational.

Century submitted a permit application including the parameters of the new ABF stack. The permit application has been included in Appendix K. The Division's Permit Review Branch is currently preparing a draft permit that will go out for public comment in 2026. The terms of the final permit will be no less stringent than those listed in the permit application. The Division will provide a supplemental submission for this SIP to the EPA, including the final permit once it has undergone the appropriate public comment and revision process; this will make the changes to the stack permanent and federally enforceable. Because replacing the stack for the ABF is the most cost-effective control strategy reported to the Division, it was determined to be a sufficient control strategy and constitutes as RACT/RACM for the Area.

(ii) Permanent and Enforceable Emissions Reductions at BREC - Green Station

BREC - Green Station's transition to natural gas has been made permanent through the air quality permit revision (permit number: V-19-020 R2) issued to the facility on January 17, 2022, which required emission units 1 and 2 to no longer utilize coal, petroleum coke, or No. 2 fuel oil and only utilize natural gas as a fuel. This permit has been included in Appendix E for informational purposes only.

On July 29, 2022, BREC sent a letter to the Division, stating that BREC - Green Station's natural gas conversion project was completed on May 26, 2022. This letter is included in Appendix E.

The permit revision also limited the fuel heat input to emission units 1 and 2 to no more than 40,410,722 MMBtu/yr on a 12-month rolling total basis, which is significantly lower than the previous 46,603,200 MMBtu/yr input capacity. Further, SO₂ emissions from each unit cannot exceed 0.8 lb/MMBtu actual heat input. With the additional emission limits included in the permit revision, emissions within the Area have been significantly reduced.

The Division considers that BREC - Green Station's conversion to natural gas sufficiently constitutes as RACT for the facility. This rationale is supported due to the fact that other alternatives for BREC - Green Station would be costly and result in potential closures of the facility and not contribute to improvement of the Area's nonattainment status.

C. Air Dispersion Modeling Demonstration

The final rule preamble for the 2010 SO₂ standard requires air dispersion modeling to demonstrate compliance in nonattainment areas.¹² EPA's 2014 SO₂ Nonattainment Area SIP Guidance recommends using the American Meteorological Society/EPA Regulatory Model Modeling System (AERMOD) for the SO₂ analysis. It is a steady-state plume model that incorporates air dispersion based on a planetary boundary layer turbulence structure and scaling concepts.

Trinity Consultants utilized the most recent AERMOD version (23132) to model for each stack and other types of source units at Century as well as other nearby sources. Trinity Consultants also used the following preprocessors to determine compliance with the 2010 SO₂ standard. The AERMOD preprocessors include:

- AERMET – meteorological data processor for AERMOD (version 23132)
- BPIP PRIME – building profile input processor (version 04274)
- AERMINUTE – one-minute ASOS winds pre-processor to AERMET (version 15272)
- AERSURFACE – surface characteristics processor for AERMET (version 20060)

Regulatory default options were used in all available cases. AERMOD files used can be accessed in Appendix L. Despite the rural nature of the Area, Trinity Consultants used the urban designation with an equivalent population of 2 million when modeling Century emissions due to a heat island effect generated by the industrial processes. For all other sources in the Area, Trinity Consultants used the rural designation.

In addition to proposing a stack height change on the ABF, the impending permit action for Century referenced in Section B will lower Century's annual allowable SO₂ emissions limit. Trinity Consultants utilized this lower emissions limit in their modeling demonstration. The

¹² *Supra* note 5.

facility's current permitted annual allowable emission rate is 5,853 tpy. The facility's anticipated future annual allowable emission rate is 4,946 tpy, however, this rate has not been finalized and will be subject to agreement from the Division and the facility during the impending permit revision process.

(i) Ambient Air Boundary

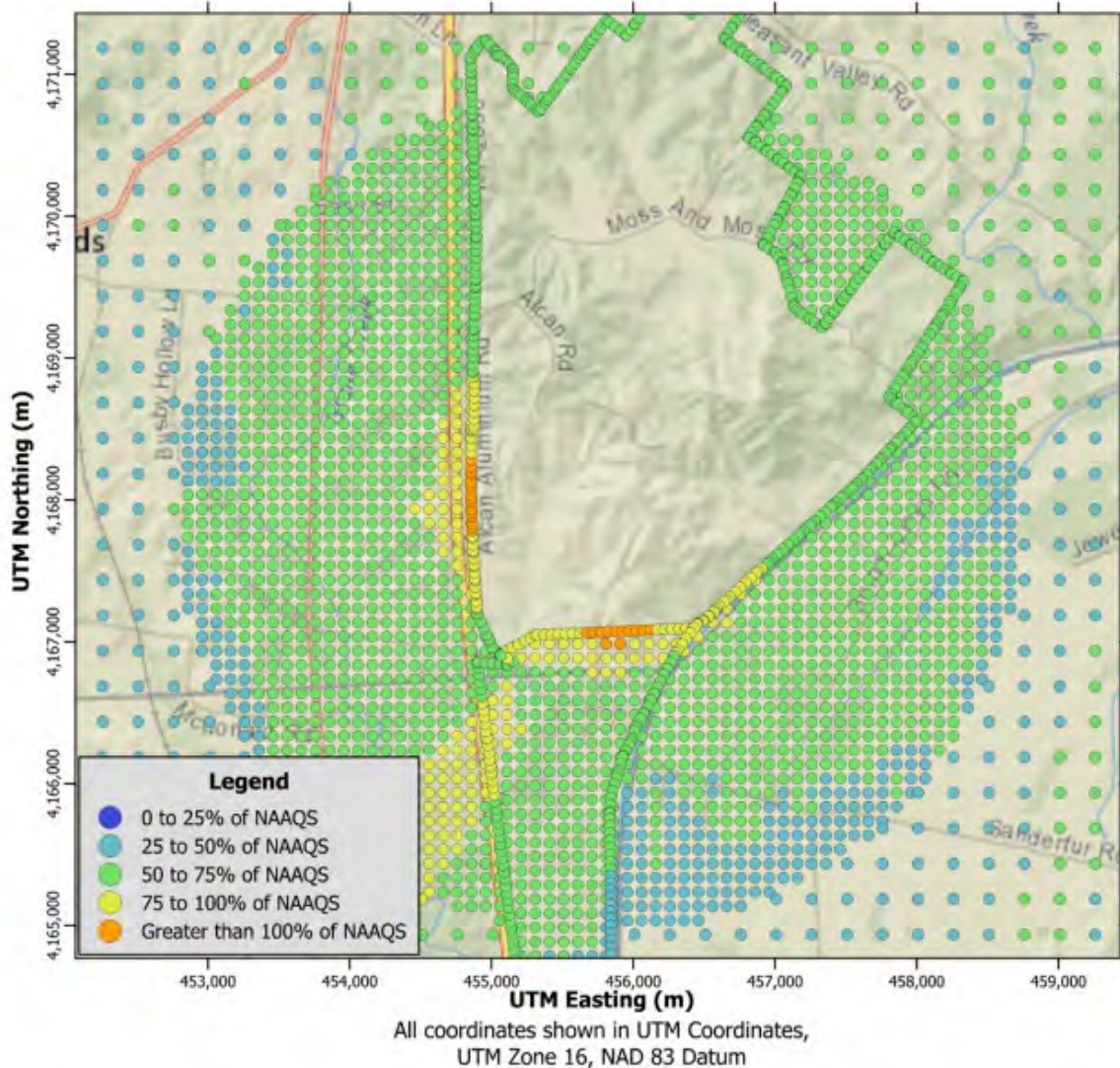
The area surrounding Century is rural, but a small population lives within the vicinity of the facility. In order to ensure that the facility property is not considered ambient air, Century added additional fencing to the perimeter of their property in addition to a rolling gate along an access road in October 2024. EPA provides guidance on how natural physical barriers may be utilized to preclude public access.¹³ Portions of Century's perimeter not fenced or gated off are blocked from the public by dense vegetation, stream gullies, and monitored by camera feeds to prevent public access. In addition, the facility has posted 'No Trespassing' signage at strategic points around the property. Photos of signage and fencing can be seen in section 3 of Appendix H.

(ii) Modeling Results

The modeling demonstration and accompanying modeling runs, performed by Trinity Consultants, are in Appendix J. According to the modeling demonstration, the 3-year average of the maximum highest 4th high impacts modeled using AERMOD are above the 2010 SO₂ standard. The model predicted possible exceedances at 0.6% of receptors included in the analysis. As seen in Figure 4, all receptors predicting possible exceedances are either near or on the Century property line.

¹³ EPA. (December 2, 2019). *Revised Policy on Exclusions from "Ambient Air"*. https://www.epa.gov/sites/default/files/2019-12/documents/revised_policy_on_exclusions_from_ambient_air.pdf.

Figure 4 - Century Aluminum Modeled Impacts



(iii) Correction for Overprediction

Trinity Consultants outlines a weight of evidence approach in the modeling demonstration that shows the modeled results are conservative and overpredict concentrations recorded at the ambient monitor. The analysis shows that the urban AERMOD model output overpredicts the SO₂ impacts from Century by 1.21 times when compared to monitored values. In addition, Trinity Consultants applied a relative response factor to determine a more accurate prediction of the attainment year design value. The relative response factor is the ratio comparing the current modeling stack configuration to the future stack configuration detailed above. This ratio of 0.73 was then applied to the current design value to estimate the attainment year design value at 55 parts per billion. After correcting for this overprediction, the stack reconfiguration

and the reduced annual allowable SO₂ emissions limit at Century will allow the Area to attain the 2010 1-hour SO₂ standard.

D. Conformity

CAA Section 176(c) establishes that no federal agency shall support or approve any activity in a nonattainment or maintenance area that does not conform to the approved SIP. Pursuant to CAA Section 176(c)(1)(B)(i-iii), federal actions will not “cause or contribute to any new violation of any standard in any area; increase the frequency or severity of any existing violation of any standard in any area; or delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.” Requirements for complying with CAA Section 176(c) and conforming to the SIP fall under two categories: general conformity requirements, which are codified under 40 CFR Part 93, Subpart B, and transportation conformity requirements, which are codified under 40 CFR Part 93, Subpart A.

General conformity regulations apply to all federal actions in all nonattainment and maintenance areas for all six criteria air pollutants (CAPs) except for those related to transportation plans, programs, and projects developed, funded, or approved under Title 23 United States Code (U.S.C.) or the Federal Transit Act. Specifically, these are transportation-related actions by the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA). The Area became subject to general conformity requirements on April 30, 2022, which is one year after the effective date of the nonattainment designation. In accordance with 40 CFR §93.158, federal actions that are expected to meet or exceed 100 tpy are required to demonstrate general conformity requirements established under 40 CFR Part 93, Subpart B. The Division will ensure that federal actions, in consultation with federal agencies, will continue to conform to the SIP.

Transportation conformity addresses emissions from onroad mobile sources. Under 40 CFR §93.102(b)(1), it states that federal transportation conformity regulations are only applicable to the following transportation-related NAAQS: ozone, carbon monoxide (CO), nitrogen dioxide (NO₂), and both types of particulate matter (PM₁₀ and PM_{2.5}). SO₂ is not considered a transportation-related NAAQS and therefore, is not subject to transportation conformity requirements. However, 40 CFR §93.102(b)(2)(v) specifies that if transportation-related emissions of SO₂, as a precursor, significantly contribute to a PM_{2.5} nonattainment and maintenance area, the pollutant would be subject to transportation conformity requirements. Since this is not the case for the Area, transportation conformity obligations do not apply, nor is it necessary for this SIP revision to include a motor vehicle emissions budget (MVEB).

E. Reasonable Further Progress

CAA Section 171(1) defines Reasonable Further Progress (RFP) as "such annual incremental reductions in emissions of the relevant air pollutant as are required by this part (part D) or may reasonably be required by the EPA for the purpose of ensuring attainment of the applicable NAAQS by the applicable attainment date." This is most appropriate for pollutants that are emitted by numerous and diverse sources, where the relationship between any individual source and the overall air quality is not explicitly quantified, and where the emission reductions necessary to attain the NAAQS are inventory-wide.

EPA's 2014 SO₂ Nonattainment Area SIP Guidance states that since "SO₂ concentrations are often dominated by emissions from a limited number of sources, and emissions controls often yield swift and dramatic air quality improvement," "adherence to an ambitious compliance schedule" would constitute RFP for SO₂.¹⁴ This means that the air agency must ensure that sources implement appropriate control measures as expeditiously as practicable.

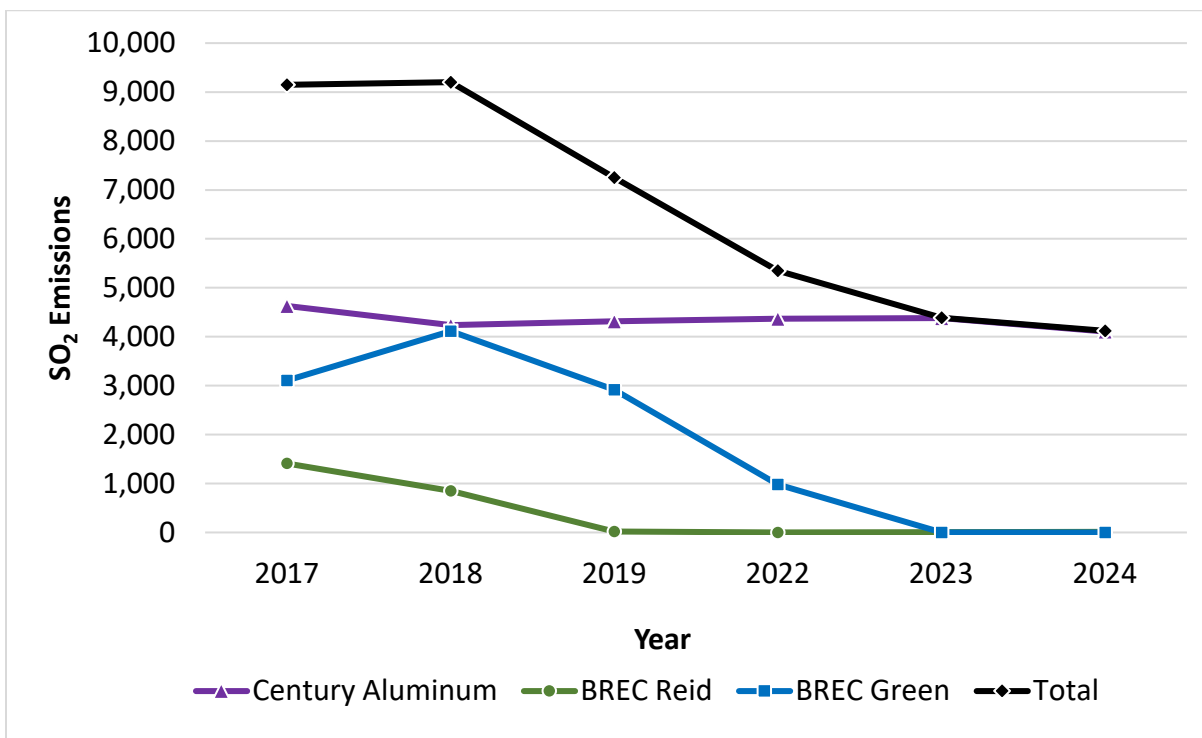
Major point source emissions in the Area have decreased by approximately 50% since the base year, as shown in Table 10 and Figure 5. The remaining emissions, from Century, are relatively stable. Please note that the emissions reported for BREC - Reid from 2022 to 2024 are derived from a natural gas combustion turbine that was originally operating under the BREC - Reid permit until it was moved to the operating permit of BREC - Green on January 17, 2022. Because the facilities were under the same ownership and on a contiguous property, emissions continued to be reported under BREC - Reid after 2022. The increase from 2023 to 2024 is attributed to greater turbine use.

Table 10 – Major Source Emissions within the Henderson-Webster Nonattainment Area (tpy)

	2017	2018	2019	2022	2023	2024
Century Aluminum	4,629.26	4,239.26	4,314.50	4,366.83	4,384.04	4,105.58
BREC - Reid	1,409.33	848.40	19.85	0.63	4.19	12.1
BREC - Green	3,108.14	4,114.50	2,915.63	980.73	0.62	2.61

¹⁴ *Supra* note 9.

Figure 5 – Major Source Emissions within Henderson-Webster Nonattainment Area (tpy)



Century has informed the Division that it intends to establish a lower annual allowable SO₂ emissions limit for the facility. As detailed above in Section C, a lower annual allowable SO₂ emissions limit will improve progress toward attainment of the NAAQS. The Division believes that by taking a lower annual allowable SO₂ emissions limit the facility is committed to making RFP to improve air quality in the Area.

The Division does not believe additional incremental reductions are necessary for Century due to the immediate improvements that will occur once it has raised the stack height of the ABF, as outlined in previous sections.

Further, the Division does not believe that additional incremental reductions are necessary at BREC - Green Station due to the natural gas conversion project that occurred at the facility in 2022, resulting in significant reductions in SO₂ emissions within the Area.

Lastly, the Division asserts there are no other major sources of SO₂ emissions in the Area that require a need to be evaluated and provide RFP.

F. Contingency Measures

Per section 172(c)(9) of the CAA, contingency measures are to become effective without further action by the state or the EPA, where the area has failed to (1) achieve RFP or (2) attain the NAAQS by the statutory attainment date for the affected area. These control measures are to

consist of other available control measures that are not included in the control strategy for the attainment plan SIP for the affected area. EPA's 2014 SO₂ Nonattainment Area SIP Guidance states that contingency measures need to be a fully adopted provision in the SIP that becomes effective if the area fails to meet RFP or attain the standard by the statutory attainment date. EPA's 2014 SO₂ Nonattainment Area SIP Guidance states that “contingency measures” can mean that the air agency has a comprehensive program to identify sources of violations of the SO₂ NAAQS and to undertake an “aggressive” follow-up for compliance and enforcement.

The chosen control strategy will not be implemented by the attainment date. However, the comprehensive timeline provided for construction and regular meetings between the facility and the Division serves as RFP at this time. Upon completion of construction and the commencement of operation of the retrofitted ABF stack, the Division is committed to monitoring the Area to ensure that RFP continues until attainment is met.

The Division will notify Century if the Sebree DRR monitor has registered four validated ambient SO₂ concentrations in excess of the standard in a calendar year, or if a monitored SO₂ violation based on the three-year annual design value occurs. Century will be required to, without any further action by the Division or EPA, undertake a full system audit. Century will submit a written system audit report to the Division within 30 days of the notification. The system audit report must detail the operating parameters of all emissions units for four 10-day periods up to and including the date upon which the reference monitor registered each exceedance, together with recommended provisional SO₂ emission control strategies for each affected unit and evidence that these control strategies can and will be deployed, as appropriate.

Upon receipt of the system audit report, the Division will immediately begin a 30-day evaluation period to diagnose the cause of the monitored exceedance. This evaluation will be followed by a 30-day consultation period with Century to develop and agree upon operational changes necessary to prevent future monitored violations of the standard. These changes may include using coke with a low-sulfur content as the facility’s fuel source, physical or operational reductions of production capacity at the facility, or other changes as appropriate. Once the Division and Century agree to a control strategy, the facility will have 12 months to fully implement the chosen controls. If a permit modification is deemed necessary, the Division would issue a final permit within the statutory timeframes required in 401 KAR 52:020 and any new emissions limits required by such a permit would be submitted to EPA as a SIP revision.

G. Public Participation

In accordance with 40 CFR 51.102, the SIP revision was available for public review and comment from August 15, 2024 - September 20, 2024.

The SIP revision package was made available on the Division’s website during the 37-day comment period from August 15, 2024, until September 20, 2024. A virtual public hearing was scheduled for September 20, 2024, at 10:00 a.m. (EDT). During the public comment period the

Division received written comments from an anonymous commenter, Nancy and Jonathan Guy, collective comments from the Kentucky Resources Council, the Environmental Integrity Project, and the Sierra Club, along with the U.S. Environmental Protection Agency. The Division's response to those comments is provided in Appendix M along with a copy of the public hearing notice.

III. CONCLUSION

As demonstrated above, this Attainment Demonstration is dependent upon the permanent and enforceable operational changes from raising the stack height of Century Aluminum's ABF. In conjunction with the reduced emissions demonstrated at BREC's facilities, the Division asserts the demonstrated changes will result in the Area achieving attainment. The Division requests that EPA approve the specified components of this submittal into Kentucky's SIP, as these components are expected to provide for attainment of the 2010 SO₂ NAAQS in the Henderson-Webster Nonattainment Area.

APPENDIX A

Coordinates of the Nonattainment Area

The nonattainment portion of Henderson and Webster counties is encompassed by a polygon with 48 vertices using Universal Traverse Mercator (UTM) coordinates of North American Datum 1983 (NAD83) as follows:

(1) KY 520, Upper Delaware Rd to the Green River boundary at 463979.00 Easting (E), 4171000.03 Northing (N); (2) The Green River boundary to JZ Shelton Rd 459058.03 E, 4160832.96 N; (3) JZ Shelton Rd to KY 370 457811.00 E, 4159192.96, N; (4) KY 370 to Pennyrile Parkway I 69 457089.96 E, 4159452.95 N; (5) Pennyrile Parkway I 69 to Sassafras Grove Rd 457675.35 E, 4156244.55 N; (6) Sassafras Grove Rd to US 41 456236.68 E, 4156125.75 N; (7) US 41 to Slaughters Elmwood Rd 457442.82 E, 4153425.68 N; (8) Slaughters Elmwood Rd to Railroad Track (NW) 456589.41 E, 4153424.43 N; (9) Railroad Track (NW) to Breton Rd 453677.09 E, 4155992.29 N; (10) Breton Rd to KY 1835 453079.74 E, 4154924.00 N; (11) KY 1835 to KY 138 450702.89 E, 4153141.51 N; (12) KY 138 to Crowder Rd 452587.06 E, 4152032.38 N; (13) Crowder Rd to KY 120 453030.14 E, 4149175.08 N; (14) KY 120 to Gooch Jones Rd 447528.25 E, 4147663.88 N; (15) Gooch Jones Rd to John Roach Rd 446551.75 E, 4150042.51 N; (16) John Roach Rd to Old Dixon Slaughters Rd 447462.17 E, 4151329.04 N; (17) Old Dixon Slaughters Rd to Old Dixon Rd 446532.28 E, 4152143.23 N; (18) Old Dixon Rd to KY 138 446849.49 E, 4152437.09 N; (19) KY 138 to Carnel Brooks Rd 450196.38 E, 4153305.18 N; (20) Carnel Brooks Rd to Rakestraw Bottoms Rd 450079.34 E, 4154326.39 N; (21) Rakestraw Bottoms Rd to KY 132 447141.40 E, 4157145.04 N; (22) KY 132 to KY 283 444025.55 E, 4156172.90 N; (23) KY 283 to Beckley Osbourne Rd 444300.82 E, 4158111.35 N; (24) Beckley Osbourne Rd to Dixon Wanamaker Rd 442067.07 E, 4158641.90 N; (25) Dixon Wanamaker Rd to KY 191 441887.88 E, 4161614.33 N; (26) KY 191 to D Melton Rd 442743.25 E, 4161250.11 N; (27) D Melton Rd to Knoblick Creek Rd 443688.82 E, 4162093.08 N; (28) Knoblick Creek Rd to US 41A 442319.35 E, 4163220.45 N; (29) US 41A to Dixon 1 Rd 443500.62 E, 4170518.52 N; (30) Dixon 1 Rd to GF Sights Rd 443094.58 E, 4170166.59 N; (31) GF Sights Rd to Cairo Dixie Rd 441341.46 E, 4170978.60 N; (32) Cairo Dixie Rd to Liles Cairo Rd 442919.00 E, 4173140.24 N; (33) Liles Cairo Rd to US 41A 443124.23 E, 4173204.51 N; (34) US 41A to Cairo Hickory Grove Rd 442860.28 E, 4174017.18 N; (35) Cairo Hickory Grove Rd to Pruitt Agnew Rd 446056.06 E, 4175740.98 N; (36) Pruitt Agnew Rd to KY 1299 447662.11 E, 4180049.93 N; (37) KY 1299 to Anthoston Frog Island Rd 448905.37 E, 4176327.31 N; (38) Anthoston Frog Island Rd to KY 136 452613.63 E, 4179047.02 N; (39) KY 136 to Upper Delaware Rd 454451.59 E, 4177687.26 N; (40) Upper Delaware Rd to Barren Church Rd S 456153.23 E, 4177723.20 N; (41) Barren Church Rd S to Barren Church Rd N 457912.85 E, 4180247.83 N; (42) Barren Church Rd N to KY 1078 458542.52 E, 4181615.55 N; (43) KY 1078 to Jones Brothers Rd 461322.00 E, 4179952.85 N; (44) Jones Brothers Rd to KY 416

461209.84 E, 4177755.55 N; (45) KY 416 to KY 1078 463492.08 E, 4178026.50 N;
(46) KY 1078 to Onionville Rd 464177.31 E, 4177054.13 N; (47) Onionville Rd to
Work Road 465476.34 E, 4176076.78 N; (48) Work Road to Upper Delaware Rd
462529.15 E, 4173036.52 N.

APPENDIX B

Technical Support Document - Chapter 3:

Final Round 4 Area Designations for the 2010 1-Hour SO₂ Primary National Ambient Air Quality Standard for Kentucky

Technical Support Document:

Chapter 3

Final Round 4 Area Designations for the 2010 1-Hour SO₂ Primary National Ambient Air Quality Standard for Kentucky

1. Summary

Pursuant to section 107(d) of the Clean Air Act (CAA), the U.S. Environmental Protection Agency (EPA, we, or us) must designate areas as either “nonattainment,” “attainment,” or “unclassifiable” for the 2010 1-hour sulfur dioxide (SO₂) primary national ambient air quality standard (NAAQS) (2010 SO₂ NAAQS). On or about August 13, 2020, EPA sent states our responses to certain designation recommendations for the 2010 SO₂ NAAQS. On August 21, 2020, EPA published a notice of availability (NOA) in the *Federal Register* (see 85 FR 51694), initiating a 30-day public comment period. The NOA and the technical support document (TSD) for EPA’s intended designations provided background on the relevant CAA definitions and the history of the designations for this NAAQS. The TSD for EPA’s intended designations also described Kentucky’s recommended designations and EPA’s assessment of the available information.

This TSD for EPA’s final Round 4 area designations for Kentucky addresses any change in Kentucky’s recommended designations since EPA communicated its intended designations in August 2020 and provides our assessment of additional relevant information that was submitted by Kentucky or other parties since the publication of the NOA. This TSD does not repeat information contained in the TSD for EPA’s intended designations except as needed to explain our assessment of the newer information and to make clear the final action we are taking and its basis, but that information is incorporated as part of our final designations. If the assessment of the information that was already considered in the TSD for EPA’s intended designations has changed based on new information and we are finalizing a designation based on such change in our assessment, this TSD also explains that change. For areas of Kentucky that are not explicitly addressed in this chapter, we are finalizing the designations described in our 120-day letters and Chapter 2 of the TSD for EPA’s intended Round 4 area designations as explained in those documents.

In letters dated October 16, 2020, and November 12, 2020, Kentucky responded to EPA’s intended designations and superseded its July 7, 2020, recommendation, by providing additional information including alternative designation recommendations and additional technical information to support its November 12, 2020, recommendation. EPA also received public comments regarding the intended designation for the Henderson-Webster, Kentucky area. These comments are addressed in the Response to Comments document associated with this final action.

Table 1 identifies Kentucky’s current designation recommendations, EPA’s final Round 4 designations, and the areas in Kentucky to which those designations apply. Chapter 1 of this

TSD for EPA’s final designations explains the definitions we are applying in the final designations process.

Table 1. Summary of EPA’s Final Designations and the Designation Recommendations by Kentucky

Area/County	Kentucky’s Recommended Area Definition	Kentucky’s Recommended Designation	EPA’s Intended Designation	EPA’s Final Area Definition	EPA’s Final Designation
Henderson-Webster, Kentucky Area	Henderson County (partial); Webster County (partial)	Nonattainment	Nonattainment	Same as Commonwealth’s Revised Recommendation	Nonattainment
Remaining portion of Henderson County	Henderson County (partial)	Attainment/Unclassifiable	Attainment/Unclassifiable	Same as Commonwealth’s Revised Recommendation	Attainment/Unclassifiable
Remaining portion of Webster County	Webster County (partial)	Attainment/Unclassifiable	Attainment/Unclassifiable	Same as Commonwealth’s Revised Recommendation	Attainment/Unclassifiable

Areas that EPA previously designated in Round 1 (see 78 FR 47191), Round 2 (see 81 FR 45039 and 81 FR 89870), and Round 3 (see 83 FR 1098 and 83 FR 14597) are not affected by the designations in Round 4 unless otherwise noted.

2. Technical Analysis for the Henderson-Webster, Kentucky Area

2.1. Introduction

EPA must designate the Henderson-Webster, Kentucky area by December 31, 2020, because the area has not been previously designated, and Kentucky began operating a new EPA-approved monitor pursuant to EPA's SO₂ Data Requirements Rule (DRR).¹ This section presents all the available air quality information for the portions of Henderson and Webster Counties that include the following SO₂ sources around which the DRR required the Commonwealth to characterize air quality:

- The Century Aluminum Sebree LLC (Century Aluminum) facility emits 2,000 tons or more of SO₂ annually. Specifically, Century Aluminum emitted 4,739 tons of SO₂ in 2014. This source meets the DRR criteria and thus is on the SO₂ DRR Source list, and Kentucky has chosen to characterize it via monitoring.
- The Big Rivers Electric Corporation's Robert A. Reid Station/Henderson Municipal Power and Light (HMP&L) Station 2 (BREC Reid/HMP&L Station 2) facility emits 2,000 tons or more of SO₂ annually. Specifically, BREC Reid/HMP&L Station 2 emitted 12,202 tons of SO₂ in 2014. This source meets the DRR criteria and thus is on the SO₂ DRR Source list, and Kentucky has chosen to characterize it via monitoring.
- The Big Rivers Electric Corporation's Robert D. Green Station (BREC Green Station) emits 2,000 tons or more of SO₂ annually. Specifically, BREC Green Station emitted 3,999 tons of SO₂ in 2014. This source meets the DRR criteria and thus is on the SO₂ DRR Source list, and Kentucky has chosen to characterize it via monitoring.

The Sebree DRR monitor (AQS ID: 21-101-1011) was sited to characterize the maximum 1-hour SO₂ concentrations in the area surrounding all three DRR sources mentioned above. As seen in Figure 1 and Figure 2 below, all 3 facilities are located less than 2 kilometers (km) from the violating monitor in Henderson County, Kentucky. Century Aluminum is located to the northeast of the violating monitor in Henderson County. The BREC Reid/HMP&L Station 2 and the BREC Green Station are both located in Webster County to the southeast of the monitor and both facilities are owned by the Big Rivers Electric Corporation (BREC). Additionally, the Robert A. Reid Station/HMP&L Station 2 is a single stationary source with one operating permit, however two of the coal-fired units at the facility are owned by HMP&L and operated by BREC.

¹ See 80 FR 51052 (August 21, 2015), codified at 40 CFR part 51 subpart BB.

Figure 1. Map of the Henderson-Webster, Kentucky Area Addressing Century Aluminum, BREC Reid/HMP&L Station 2, and BREC Green Station

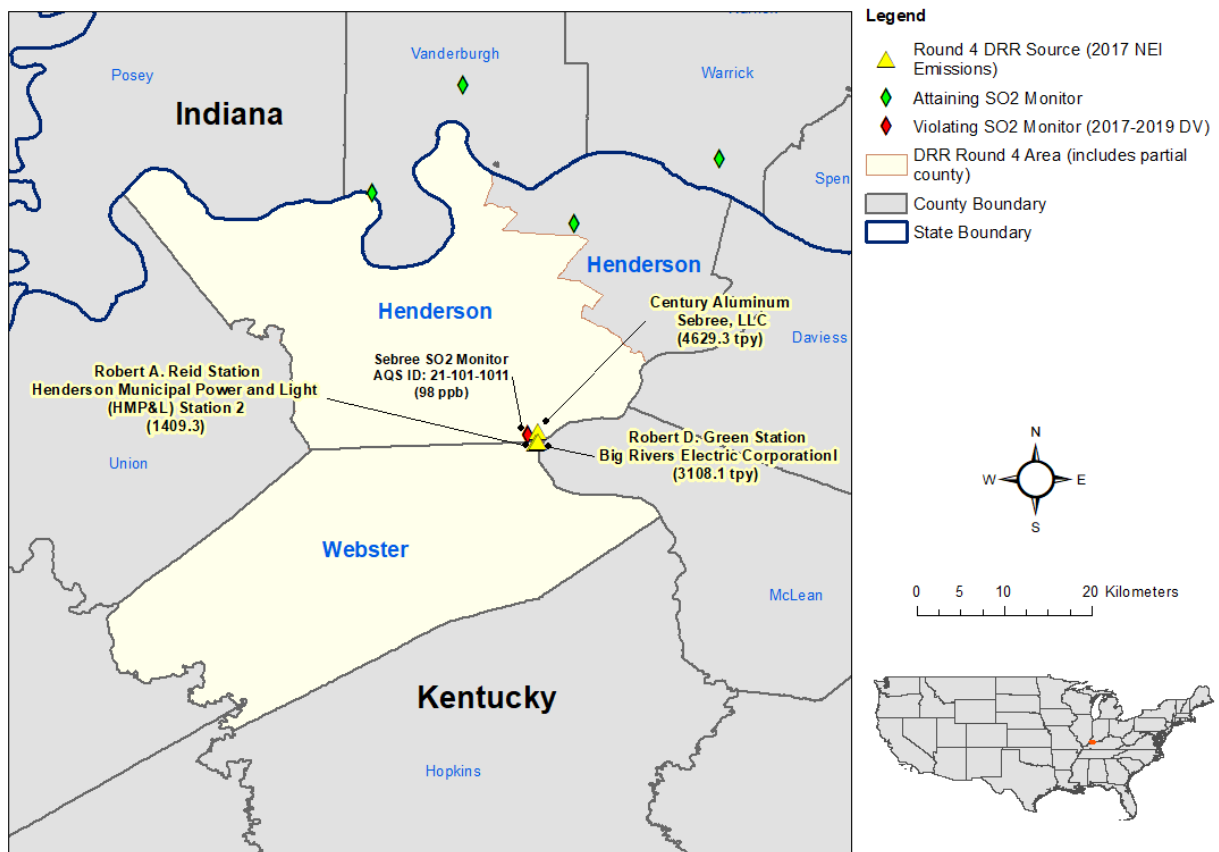
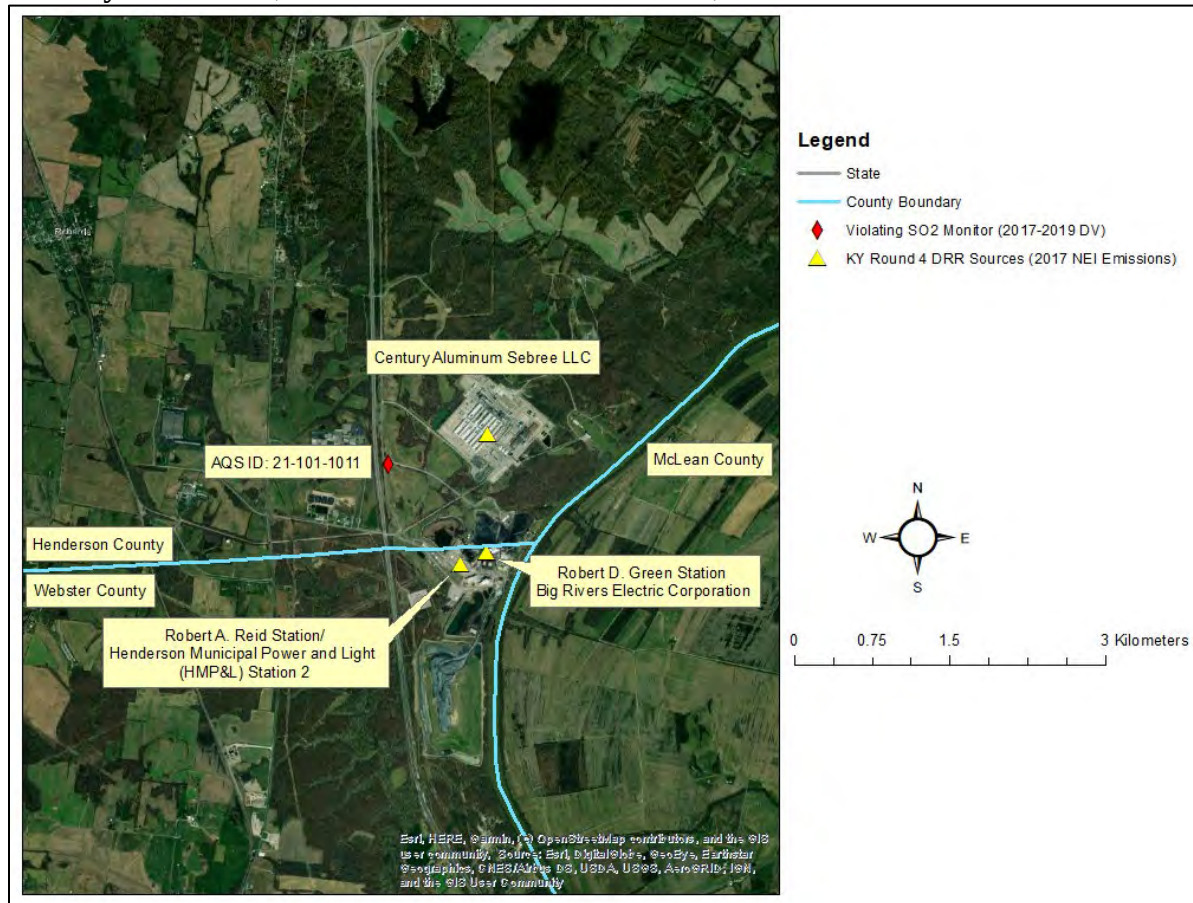


Figure 2. Close-up Image of the Henderson-Webster County, Kentucky Area, including Century Aluminum, BREC Reid/HMP&L Station 2, and BREC Green Station



2.2. Summary of Information Reviewed in the TSD for the Intended Round 4 Area Designations

In its July 7, 2020, recommendation letter, Kentucky recommended that a portion of Henderson County be designated as nonattainment for the 2010 SO₂ NAAQS, based on monitored air quality from 2017-2019. Kentucky recommended that the remainder of Henderson County and all of Webster County be designated attainment for the 2010 1-hour SO₂ NAAQS. Specifically, the Commonwealth's recommended nonattainment boundary for Henderson County consisted of the area located between Edward T. Breathitt Pennyridge Parkway (to the west) and the Green River (to the east), south of Moss and Moss Road, and north of the Century Aluminum railroad spur and Big Rivers Electric coal haul road which included the ambient air DRR monitor (AQS ID: 21-101-1011) and only one of three DRR source Century Aluminum as shown in Figure 3. EPA's intended designation did not agree with Kentucky's recommendation as to the designation category, in part because Kentucky's original recommended boundary excluded some of the sources contributing to the violating monitor, and EPA intended to designate a portion of Henderson County, Kentucky and Webster County, Kentucky, as described in the intended designations TSD, as nonattainment for the 2010 SO₂ NAAQS based upon currently available

monitoring information for the 2017-2019 period. Our intended boundaries were different than the Commonwealth's recommended boundaries.

Figure 3. Kentucky's Recommendation for the Henderson-Webster, Kentucky Area for Intended Round 4 Designations



Kentucky provided a discussion and figures of a dispersion modeling analysis performed to evaluate the SO₂ impacts from the BREC Green Station; however, the modeling files were not provided to EPA for review. Kentucky concluded from the dispersion modeling analysis that BREC Green Station is not causing a violation of the 2010 1-hour SO₂ NAAQS. Kentucky did not provide EPA sufficient information to agree with that conclusion, and EPA instead believes the modeling results provided by Kentucky on July 7, 2020, showed that BREC Green Station was likely contributing to violations of the 2010 1-hour SO₂ NAAQS at the Sebree monitor in Henderson County.

In addition to the dispersion modeling analysis performed to evaluate the BREC Green Station, EPA reviewed modeling that Kentucky provided in 2016 which was conducted to support the location of the Sebree ambient air quality monitor in order to characterize all three DRR sources (rather than install and operate separate monitors for each source). As this modeling was not conducted for the purpose of air quality designations, EPA was unable to use this information specifically in determining the exact geographic extent of the 2010 SO₂ NAAQS violations that occurred during the 2017-2019 monitoring period; however, EPA determined that this modeling indicates the potential for elevated SO₂ concentrations extending well beyond the nonattainment boundary proposed by Kentucky, including a larger portion of Henderson County and a portion of Webster County.

Kentucky provided an analysis of the meteorology for the Henderson-Webster, Kentucky Area. EPA preliminarily agreed with Kentucky's conclusion that the HYSPLIT trajectories indicate that the Century Aluminum facility contributes to the monitored violation; however, EPA also believes that other back trajectories, the level of emissions from BREC Green Station, and the fact that it is located approximately 1.25 km from the Sebree monitor, indicate that the facility is potentially contributing to the measured violations of the 2010 1-hour SO₂ NAAQS at the Sebree monitor. Additionally, EPA evaluated wind patterns in the area based on wind rose created from for the nearest NWS meteorological station which indicate that winds blow from all directions, but most commonly from southwest, and, also from the northeast and northwest significant amounts of time. The highest frequency of slow wind speeds (1-4 knots) blow from the northeast, but also a significant amount of time from the southeast, which is the direction of the two BREC facilities.

As a result of evaluation of all the available information, including EPA's qualitative assessment of the modeling conducted to support the location of the ambient air quality monitor, EPA modified Kentucky's July 2020, recommendation for the nonattainment boundary for Henderson County, as well as modified the Commonwealth's designation and boundary determination for a portion of Webster County. EPA believed that the intended nonattainment area, bounded by the portions of Henderson and Webster Counties contained within census block groups 211010209001, 211010208001, 211010208003, 212339601002, 212339601004, 212339601003, and 212339601001. EPA's intended boundary was appropriate to characterize the geographical extent of impacts from all DRR sources based on the available information at the time of intended designations (i.e. the magnitude of the monitoring concentrations coupled with the emissions from the SO₂ sources and the information available for Henderson County and, the boundary and therefore justified the consideration of a bigger boundary than recommended by the Commonwealth absent additional technical support.

EPA intended to designate the remaining portions of Henderson and Webster Counties as attainment/unclassifiable due to a lack of SO₂ emissions sources or any other information that indicates those areas do not meet the 2010 1-hour SO₂ NAAQS. Based on the factors discussed above, EPA believed that the remaining undesignated area neither has violations nor contains any sources that could contribute to air quality in an area that violates the NAAQS. Therefore, we intended to designate the remainder of Henderson and Webster Counties as attainment/unclassifiable.

2.3. Air Quality Monitoring Data for the Henderson-Webster, Kentucky Area

In the TSD for the intended area designations, EPA considered design values for air quality monitors in the Henderson-Webster, Kentucky area. Specifically, EPA determined that the Sebree DRR monitor (AQS ID# 21-101-1011) violated the 2010 SO₂ NAAQS with a 2017-2019 design value of 98 ppb. EPA has no new monitoring information of any other type that warrants revising our prior analysis of available monitoring data.

2.4. Assessment of New Technical Information for the Henderson-Webster, Kentucky Area Addressing Century Aluminum, BREC Reid/HMP&L Station 2, and BREC Green Station

On November 12, 2020, superseding an October 16, 2020, submission, Kentucky submitted new modeling analyzing air quality in the area surrounding the Century Aluminum, BREC Reid/HMP&L Station 2, and BREC Green Station facilities in the Henderson-Webster, Kentucky area to inform the extent of the nonattainment boundary. This assessment and characterization were performed using air dispersion modeling software, i.e., AERMOD, analyzing a mixture of actual and allowable emissions. The Commonwealth's analysis supports a different designation boundary than its original July 7, 2020, recommended boundary and EPA's intended designation boundary for this area. EPA's intended designation for a portion of Henderson-Webster County area was nonattainment, and Kentucky's analysis supports a nonattainment designation, but with a boundary that is larger than its original recommended boundary and smaller than EPA's intended boundary. After careful review of Kentucky's new October and November 2020 assessments, supporting documentation, and all available data, EPA is relying on Kentucky's November 12, 2020, modeling analysis and agrees with the Commonwealth's updated nonattainment boundary recommendation. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

The discussion and analysis that follows below will reference the "SO₂ NAAQS Designations Modeling Technical Assistance Document" (Modeling TAD) and the factors for evaluation contained in EPA's September 5, 2019, guidance, July 22, 2016, guidance and March 20, 2015, guidance, as appropriate.²

For this area, EPA received two modeling assessments from Kentucky (submitted October 16, 2020, and November 12, 2020); however, the November 12, 2020, submission supersedes the October information. To avoid confusion in referring to these assessments, the following table lists them, indicates when they were received, provides an identifier for the assessment that is used in the discussion of the assessments that follow, and identifies any distinguishing features of the modeling assessments.

² <https://www.epa.gov/sites/production/files/2016-04/documents/so2modelingtad.pdf>.

Table 2. Modeling Assessments for the Henderson-Webster Area

Assessment Submitted by	Date of the Assessment	Identifier Used in this TSD	Distinguishing or Otherwise Key Features
Commonwealth of Kentucky	October 16, 2020	October 2020 Modeling	No background concentrations included in the modeling
Commonwealth of Kentucky	November 12, 2020	November 2020 Modeling	Modeling includes representative background concentrations

2.4.1. Modeling Analysis Provided by the Commonwealth

2.4.1.1. Differences Between and Relevance of the Modeling Assessments Submitted by the Commonwealth

As discussed in EPA's TSD for the intended designation for the Henderson-Webster County, Kentucky Area, in the July 7, 2020, recommendation letter, Kentucky provided the results of two limited modeling analyses to support the boundary recommendation: (1) HYSPLIT (Hybrid Single Particle Lagrangian Integrated Trajectory) trajectory modeling, and (2) limited dispersion modeling for the BREC Green Station DRR facility. Neither of these limited modeling analyses provided a comprehensive air modeling analysis that could be used to fully evaluate the ambient SO₂ concentration impacts resulting from emissions from the Century Aluminum, BREC Reid/HMP&L Station 2, and the BREC Green Station facilities.

The following sections provide the details of Kentucky's November 12, 2020, comprehensive AERMOD modeling analysis that were used to evaluate ambient SO₂ concentrations in the area and determine an appropriate nonattainment area boundary.

2.4.1.2. Model Selection and Modeling Components

EPA's Modeling TAD notes that for area designations under the 2010 SO₂ NAAQS, the AERMOD modeling system should be used, unless use of an alternative model can be justified. The AERMOD modeling system contains the following components:

- AERMOD: the dispersion model
- AERMAP: the terrain processor for AERMOD
- AERMET: the meteorological data processor for AERMOD
- BPIPPRM: the building input processor
- AERMINUTE: a pre-processor to AERMET incorporating 1-minute automated surface observation system (ASOS) wind data
- AERSURFACE: the surface characteristics processor for AERMET
- AERSCREEN: a screening version of AERMOD

The Commonwealth used AERMOD version 19191, the most recent version of the model. A discussion of the Commonwealth's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

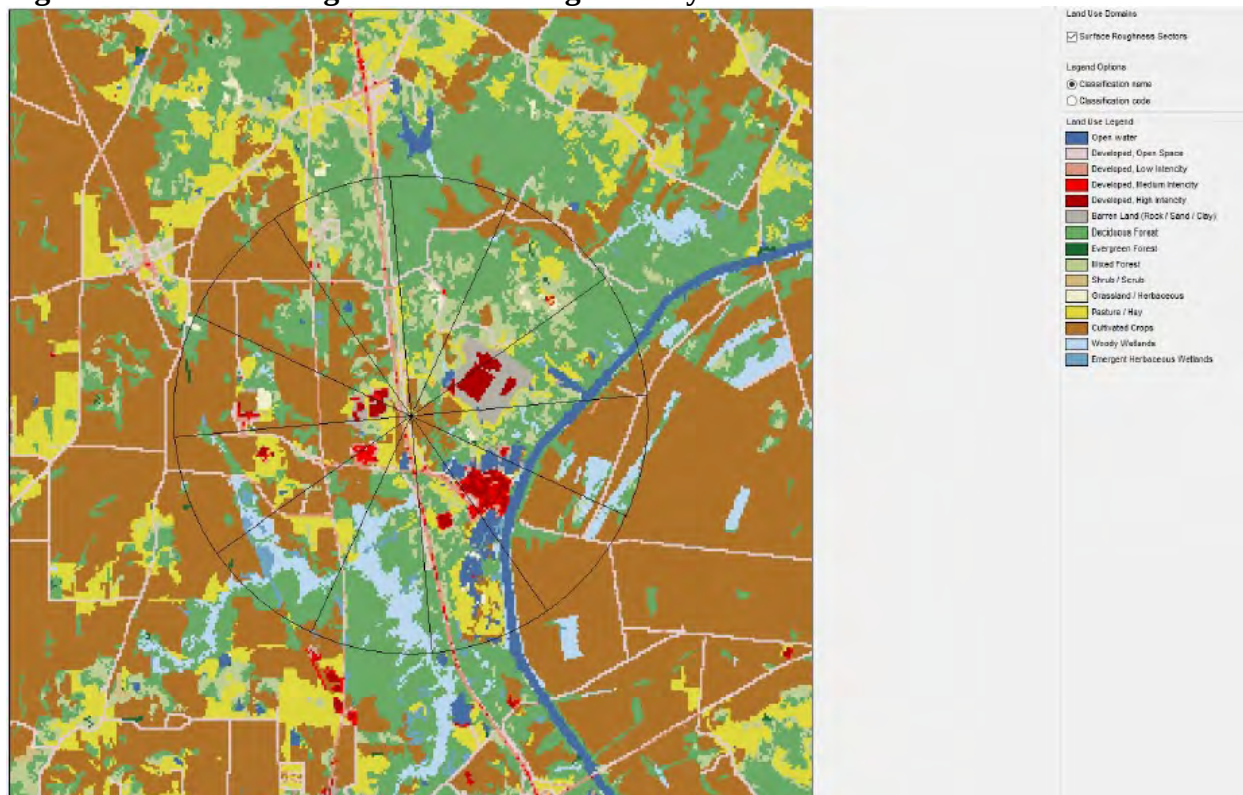
2.4.1.3. Modeling Parameter: Rural or Urban Dispersion

For any dispersion modeling exercise, the determination of whether a source area is “urban” or “rural” is important in determining the boundary layer characteristics that affect the model's prediction of downwind concentrations. For SO₂ modeling, the urban/rural determination is also important because AERMOD invokes a 4-hour half-life for urban SO₂ sources. Section 6.3 of the Modeling TAD details the procedures used to determine if a source area is urban or rural based on land use or population density.

For the purpose of performing the modeling for the area of analysis, the Commonwealth determined that it was most appropriate to run the model in rural mode.

Kentucky used the Auer method to determine the land use status of the area around the facilities. Kentucky used a 3-km radius centered on the Sebree SO₂ Monitor to evaluate land use surrounding the Century Aluminum and BREC facilities, based on the Auer land use categories (USGS NLCD 2016). The results of the Auer land use analysis are presented in Figure 4 (Figure 1 of Kentucky's November 12, 2020, submittal). The analysis indicates that the majority of land use can be categorized as undeveloped, pasture, and farmland.

Figure 4. Land Use Diagram Surrounding Century and BREC



Therefore, the Commonwealth determined that it was most appropriate to run the model with rural dispersion coefficients, and EPA agrees with this determination.

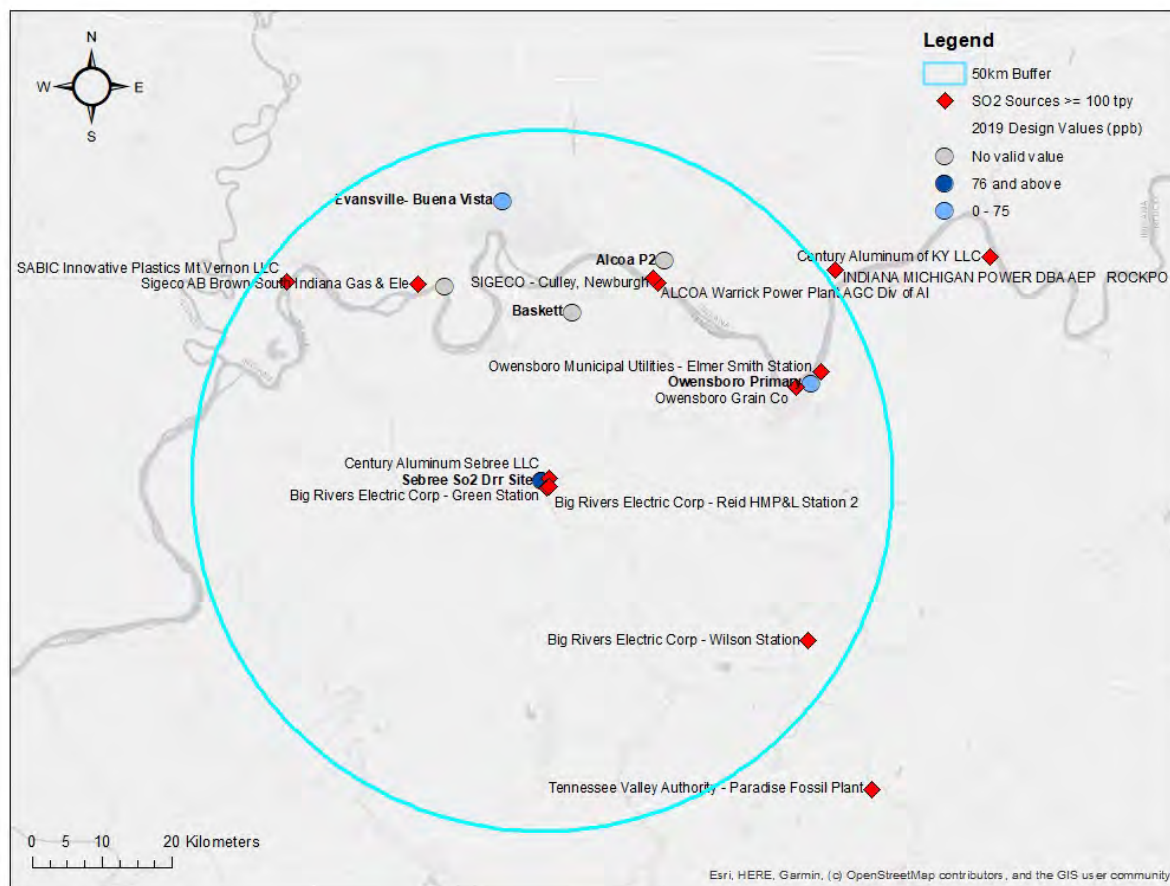
2.4.1.4. Modeling Parameter: Area of Analysis (Receptor Grid)

The Modeling TAD recommends that the first step towards characterization of air quality in the area around a source or group of sources is to determine the extent of the area of analysis and the spacing of the receptor grid. Considerations presented in the Modeling TAD include but are not limited to: the location of the SO₂ emission sources or facilities considered for modeling; the extent of significant concentration gradients due to the influence of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum SO₂ concentrations.

The sources of SO₂ emissions subject to the DRR in this area are described in the introduction to this section. For the Henderson-Webster, Kentucky area, the Commonwealth has included no other emitters of SO₂ within or outside the modeling domain that consists of EPA's intended nonattainment boundary. The Commonwealth determined that this was the appropriate distance to adequately characterize air quality through modeling to include the potential extent of any SO₂ NAAQS violations in the area of analysis and any potential impact on SO₂ air quality from other sources in nearby areas.

EPA has evaluated the need to include in the modeling analysis any additional SO₂ emissions sources within 50 km of the Century Aluminum and BREC DRR facilities. Figure 5 shows the large SO₂ sources within 50 km. Based upon the levels of emissions and distance from the DRR facilities, EPA agrees that no additional SO₂ sources need to be included in the modeling analysis. EPA believes that the background concentrations from the Evansville, Indiana background monitor adequately account for any potential SO₂ impacts from these sources in the modeling domain.

Figure 5. Large SO₂ Emissions Sources within 50 km of the Century Aluminum and BREC DRR facilities



The grid receptor spacing for the area of analysis chosen by the Commonwealth is as follows:

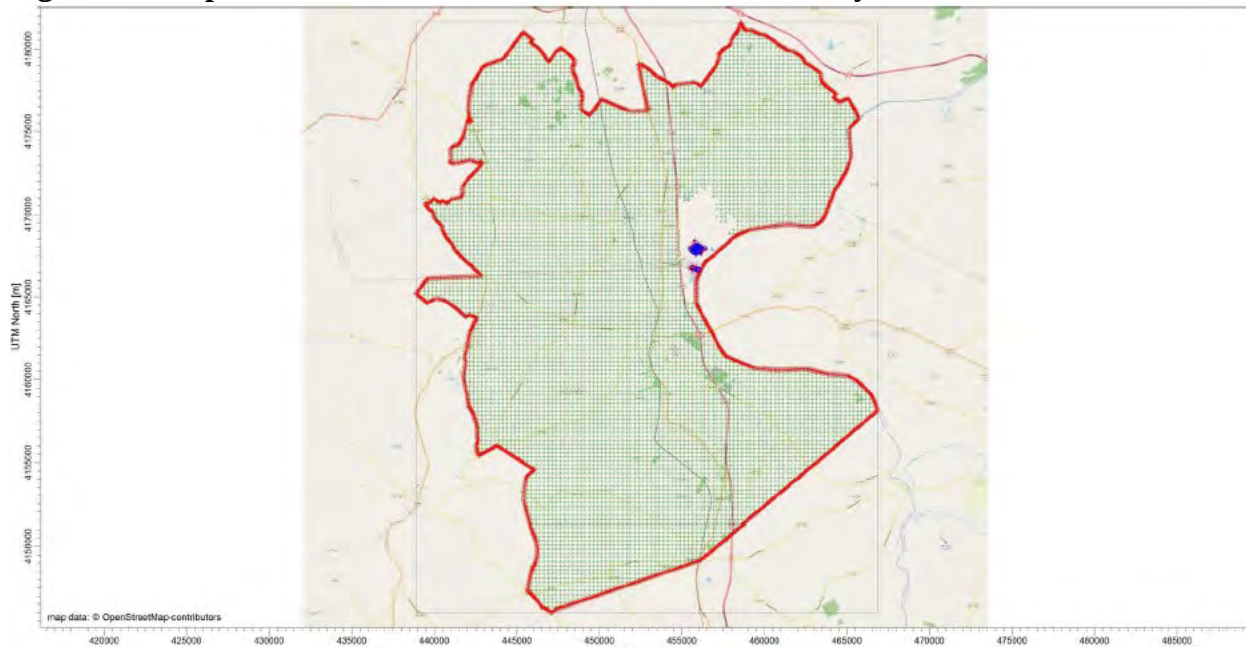
- A cartesian receptor grid with 250 meters spacing between receptors within EPA's intended non-attainment boundary
- Cartesian boundary receptors with 50 meter spacing along EPA's intended nonattainment area boundary.

The receptor network contained 12,160 receptors, and the network covered portions of Henderson and Webster Counties in Kentucky. EPA believes that the 250-meter spacing in the receptor grid is adequate to detect significant gradients in concentrations in the area. As shown in Figure 10 in Section 2.4.1.10, Kentucky's recommended nonattainment area boundary provides an adequate buffer around the receptors with modeled violations of the NAAQS, especially areas with elevated terrain to the southwest of the Century Aluminum and BREC facilities, to account for any areas that could potentially show modeled violations with a denser receptor grid spacing (e.g., 100-meter spacing). Therefore, we believe the 250-meter spacing is adequate for the purposes of defining the nonattainment boundary.

Figure 6, included in the Commonwealth's recommendation, show the Commonwealth's chosen area of analysis surrounding the three facilities, as well as the receptor grid for the area of analysis.

Consistent with the Modeling TAD, the Commonwealth placed receptors for the purposes of this designation effort in locations that would be considered ambient air relative to each modeled facility. With the exception of the areas within the Century Aluminum and BREC facilities' fencelines, the Commonwealth included receptors in all areas within EPA's intended nonattainment boundary, including areas where it would not be feasible to place a monitor. The Commonwealth did not provide any information to substantiate the ambient air boundaries of the Century Aluminum and BREC facilities. However, since the purpose of the modeling is to inform the selection of nonattainment area boundaries, and the modeling results show violations of the NAAQS surrounding each of the facilities, and the facilities are fully encompassed within the Commonwealth's recommended nonattainment boundary, EPA does not believe that it is necessary to precisely delineate the ambient air boundaries at the facilities for this analysis.

Figure 6. Receptor Grid for the Henderson-Webster, Kentucky Area



EPA believes that Kentucky's receptor grid is appropriate for the characterization of the area, considering the impacts of SO₂ emissions from the DRR facilities. Also, EPA believes that the receptor grid used in Kentucky's modeling is adequate to determine the extent of the modeled violations of the 1-hour SO₂ NAAQS in the area and thus can be used to inform selection of the nonattainment boundary. However, in future attainment state implementation plan (SIP) development, the State's modeling will need to include all ambient air receptors.

2.4.1.5. Modeling Parameter: Source Characterization

Section 6 of the Modeling TAD offers recommendations on source characterization including source types, use of accurate stack parameters, inclusion of building dimensions for building downwash (if warranted), and the use of actual stack heights with actual emissions.

Kentucky included the three DRR facilities, Century Aluminum, BREC Reid/HMP&L Station 2, and BREC Green Station, and no other facilities in the modeling demonstration. The BREC facilities have six total emission points that were modeled: two at BREC Green Station: Green Station Boiler 1 and Green Station Boiler 2; two at BREC Reid: Reid Station Unit 1 and Reid Combustion Turbine; and two at HMP&L Station 2: Henderson Station Unit 1 and Henderson Station Unit 2. Century Aluminum consists of an anode bake furnace and potlines as well as a number of smaller and insignificant SO₂ sources. The modeling parameters for these facilities' SO₂ emissions units can be found in Appendix A of Kentucky's November 12, 2020, submittal. As discussed in Section 2.4.1.4 of this TSD, the Commonwealth determined that no other SO₂ emissions sources in the area of analysis needed to be included in the modeling.

The Commonwealth characterized these sources within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the Commonwealth used actual stack heights in conjunction with actual emissions. The Commonwealth also adequately characterized the source's building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. Where appropriate, the AERMOD component BPIPFRM was used to assist in addressing building downwash.

EPA agrees the Commonwealth's characterization of sources in the area. Additionally, the Commonwealth used appropriate parameters for modeling the SO₂ emissions from the sources.

2.4.1.6. Modeling Parameter: Emissions

EPA's Modeling TAD notes that for the purpose of modeling to characterize air quality for use in designations, the recommended approach is to use the most recent 3 years of actual emissions data and concurrent meteorological data.

EPA believes that continuous emissions monitoring systems (CEMS) data provide acceptable historical emissions information, when they are available. These data are available for many electric generating units. In the absence of CEMS data, EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS or the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, EPA recommends using detailed throughput, operating schedules, and emissions information from the impacted sources.

As previously noted, the Commonwealth included Century Aluminum, BREC Reid/HMP&L Station 2, and BREC Green Station and no other emitters of SO₂ within in the area of analysis. For this area of analysis, the Commonwealth has opted to use a hybrid approach, where emissions from certain units at the facilities are expressed as actual emissions, and other units are expressed as potential to emit (PTE) rates. All sources were modeled using actual stack heights. All stack heights for those sources modeled using PTE rates are below the calculated formula Good Engineering Practice (GEP) stack height. The facilities in the Commonwealth's modeling analysis and their associated actual or PTE rates are summarized below.

For BREC Reid/HMP&L Station 2 and BREC Green Station, the Commonwealth provided annual actual SO₂ emissions between 2017 and 2019. The Commonwealth also provided annual

actual SO₂ emissions for the anode bake furnace and potlines at Century Aluminum. This information is summarized in Table 3. A description of how the Commonwealth obtained hourly emission rates is given below this table.

Table 3. Actual SO₂ Emissions Between 2017 – 2019 from Facilities in the Area of Analysis for the Henderson-Webster, Kentucky Area

Facility Name	SO ₂ Emissions (tpy)		
	2017	2018	2019
HMP&L Station 2	1,408	847	17
BREC Reid	1	2	3
BREC Green Station	3,108	4,114	2,916
Century Aluminum	4,489	4,489	4,489
Total Emissions from All Modeled Facilities in the Commonwealth's Area of Analysis	9,006	9,452	7,425

For BREC Reid/HMP&L Station 2 and BREC Green Station, actual hourly-varying emissions measured with CEMS were used in the AERMOD modeling. The Commonwealth obtained the hourly CEMS data from the U.S. EPA's Air Markets Division (CAMD) database³. EPA compared annual emissions values from CAMD to the summed hourly emissions values used in the AERMOD modeling for each of these sources. This comparison confirmed that the modeled emissions match the emissions from CAMD.

Hourly-varying CEMS SO₂ emissions data are not available from the Century Aluminum facility, so the Commonwealth used the most recent stack test data and monthly production records to produce temporally variable actual emissions for the anode bake furnace and potlines. The documentation provided by the Commonwealth contains a spreadsheet that shows the calculations of the monthly-varying emissions. EPA reviewed these calculations and confirmed that they were performed correctly. Also, EPA compared the sum of the emissions used in the modeling to the annual emissions reported for this facility in EPA's Emissions Inventory System (EIS). This comparison showed a small difference between the annual tons per year emissions levels (4,489 tons/year modeled emissions versus 4,629 tons/year reported in the 2017 and 2018 EIS data. EPA believes that the emissions data used in the modeling that is based upon monthly production information and recent stack tests is appropriate for the AERMOD modeling.

For the smaller sources of SO₂ at Century Aluminum, the Commonwealth provided PTE values. This information is summarized in Table 4. A description of how the Commonwealth obtained potential emission rates is given below this table.

³ <https://ampd.epa.gov/ampd/>

Table 4. SO₂ Emissions based on PTE from Select Units at Century Aluminum in the Area of Analysis for the Henderson-Webster, Kentucky Area

Facility Name	SO₂ Emissions (tpy, based on PTE)
Century Aluminum Remelt Furnace	0.17
Century Aluminum Holding Furnaces	0.32
Century Aluminum Homogenizing Furnaces	0.14
Century Aluminum Electrode Boiler	0.03
Century Aluminum Indirect Heat Exchanger	0.03
Total Emissions from Facilities in the Area of Analysis Modeled Based on PTE	0.69

The PTE in tons per year for Century Aluminum’s natural gas-fired emissions units listed in Table 4 were provided to the Commonwealth by Century Aluminum in previous modeling performed for siting the Sebree DRR monitor in 2016. The Commonwealth used PTE emissions rates (grams/second) in the modeling corresponding to hourly emissions representative of worst-case operations. Emissions were assumed to be the same in each modeled year.

EPA agrees with Kentucky’s use of actual hourly-varying emissions for BREC Reid/HMP&L Station 2 and BREC Green Station from CEMS at the facilities. EPA also agrees with using the most recent stack test data and monthly production records to produce temporally variable actual emissions for the anode bake furnace and potlines at Century Aluminum. Additionally, EPA agrees with modeling the smaller, natural gas-fired units at Century Aluminum using potential emissions.

2.4.1.7. Modeling Parameter: Meteorology and Surface Characteristics

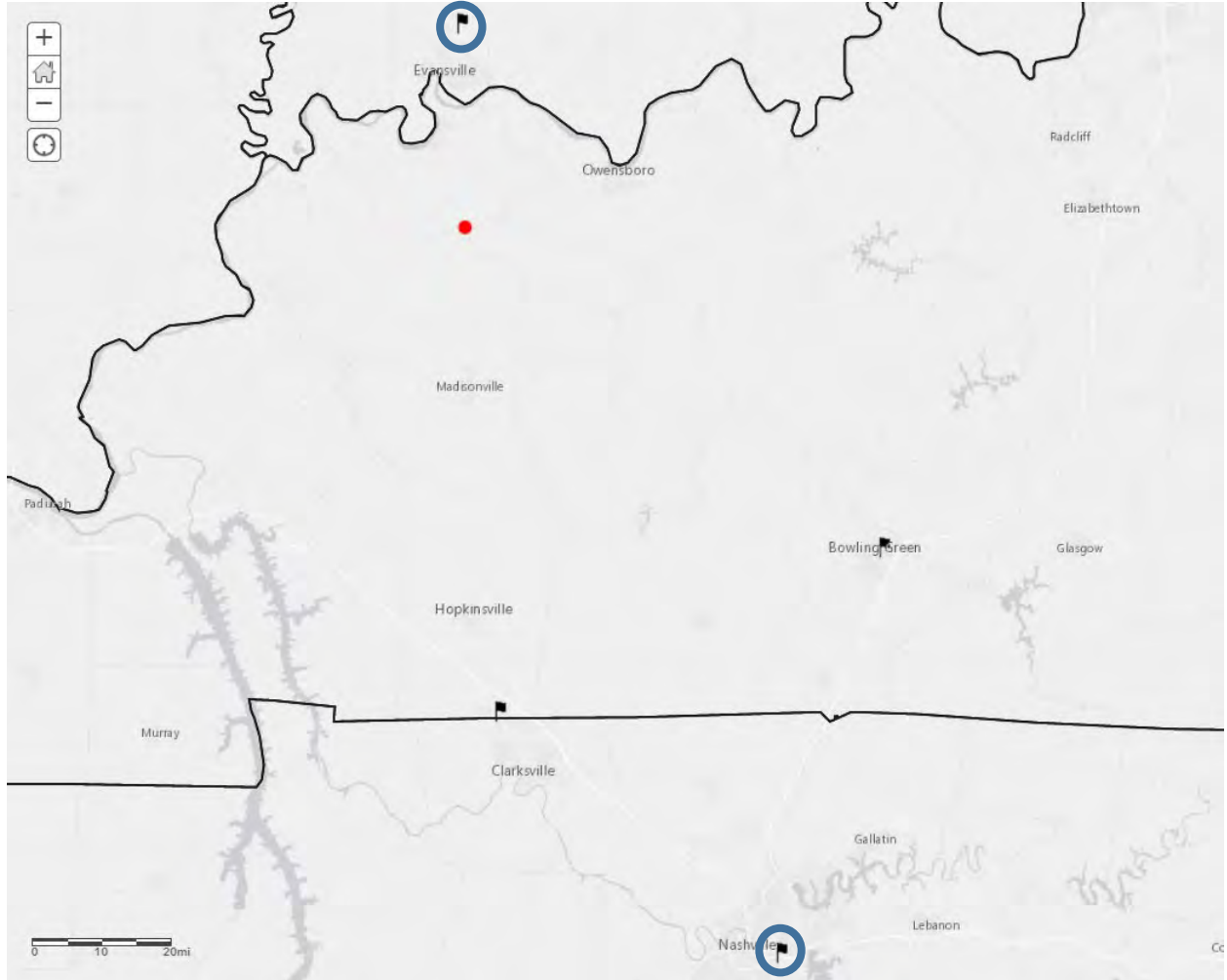
As noted in the Modeling TAD, the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data, for sources modeled with actual emissions) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness of the data is determined based on: 1) the proximity of the meteorological monitoring site to the area under consideration, 2) the complexity of terrain, 3) the exposure of the meteorological site, and 4) the period of time during which data are collected. Sources of meteorological data include National Weather Service (NWS) stations, site-specific or onsite data, and other sources such as universities, Federal Aviation Administration, and military stations.

For the area of analysis for the Henderson-Webster, Kentucky area, the Commonwealth selected the surface meteorology from the Evansville Regional Airport NWS station in Evansville, Indiana, located at 38.044 N, 87.521 W, approximately 43 km to the north of the facilities, and coincident upper air observations from a different NWS station, at Nashville International Airport in Nashville, Tennessee, located at 36.126 N, 86.677 W, approximately 185 km to the southeast of the facilities as best representative of meteorological conditions within the area of analysis.

The Commonwealth used AERSURFACE version 20060 using data from the Evansville NWS station to estimate the surface characteristics of the area of analysis. The Commonwealth estimated values for twelve 30° spatial sectors out to 1 km at a monthly temporal resolution for average conditions. The Commonwealth also estimated values for albedo (the fraction of solar energy reflected from the earth back into space), the Bowen ratio (the method generally used to calculate heat lost or heat gained in a substance), and the surface roughness (sometimes referred to as “Z_o” and is related to the height of obstacles to the wind flow, which is an important factor in determining the magnitude of mechanical turbulence and the stability of the boundary layer).

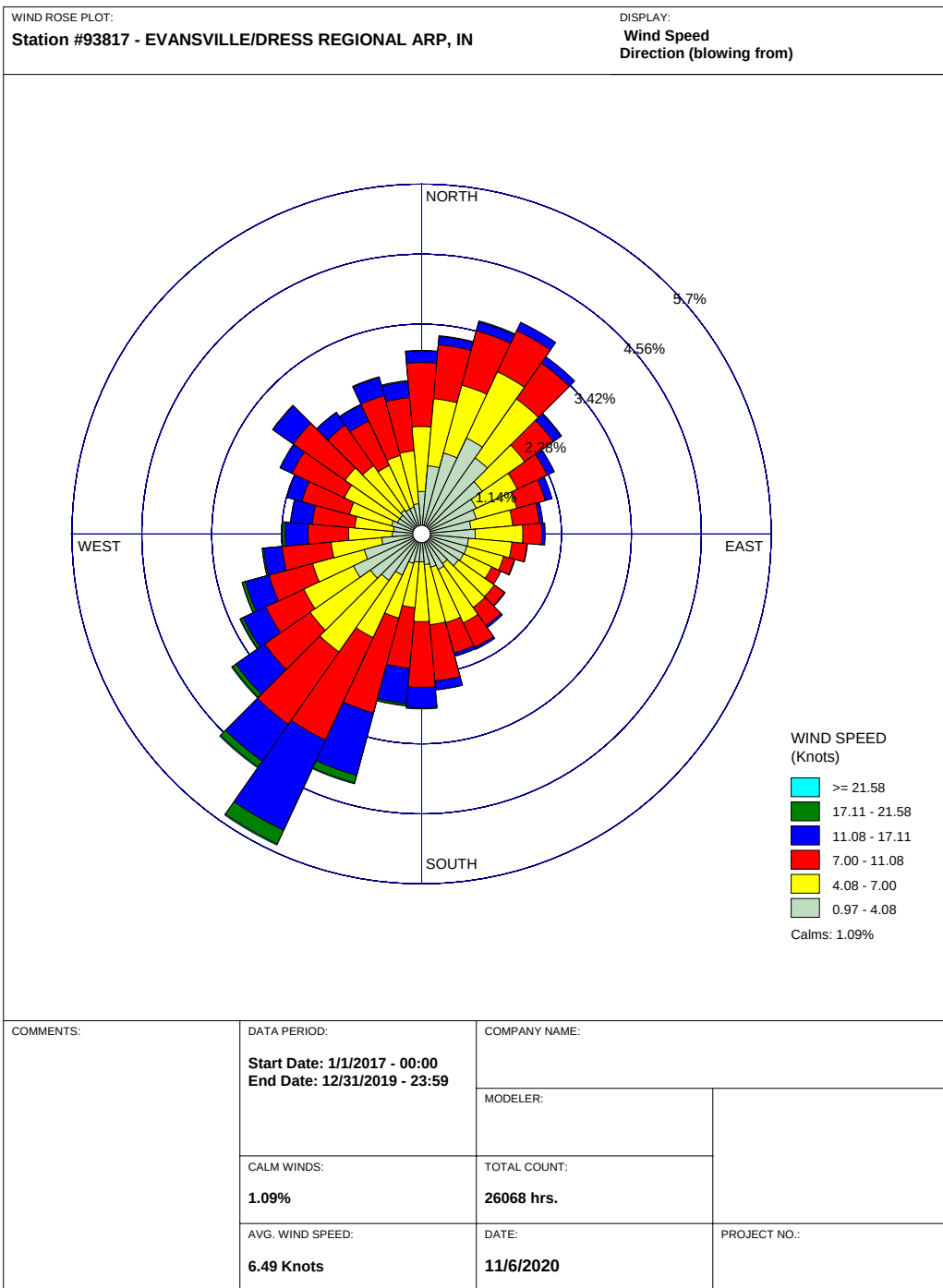
In the figure below, generated by EPA, the locations of these NWS stations are shown relative to the area of analysis.

Figure 7. Area of Analysis and the NWS stations in the Henderson-Webster, Kentucky Area



EPA generated a surface wind rose for the Evansville, Indiana NWS station for the 2017-2019 period using Lakes Environmental's WRPLOT-View software with the AERMET surface data file provided by Kentucky for the modeled period. In Figure 8, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. This wind rose indicates that the predominant wind direction in the Evansville area is winds blowing from the southwest along with winds blowing from the northeast a significant amount of time.

Figure 8. Henderson-Webster, Kentucky Cumulative Annual Wind Rose for Years 2017 – 2019



WRPLOT View - Lakes Environmental Software

Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor (version 19191). The output meteorological data created by the AERMET processor is suitable for being applied with AERMOD input files for AERMOD modeling runs. The Commonwealth followed the methodology and settings

presented in the SO₂ Modeling TAD and the AERMET User's Guide in the processing of the raw meteorological data into an AERMOD-ready format and used AERSURFACE to best represent surface characteristics.

Hourly surface meteorological data records are read by AERMET and include all the necessary elements for data processing. However, wind data taken at hourly intervals may not always portray wind conditions for the entire hour, which can be variable in nature. Hourly wind data may also be overly prone to indicate calm conditions, which are not modeled by AERMOD. In order to better represent actual wind conditions at the meteorological tower, wind data of 1-minute duration was provided from the Evansville NWS station, but in a different formatted file to be processed by a separate preprocessor, AERMINUTE (version 15272). These data were subsequently integrated into the AERMET processing to produce final hourly wind records of AERMOD-ready meteorological data that better estimate actual hourly average conditions and that are less prone to over-report calm wind conditions. This allows AERMOD to apply more hours of meteorology to modeled inputs, and therefore produce a more complete set of concentration estimates. As a guard against excessively high concentrations that could be produced by AERMOD in very light wind conditions, the Commonwealth set a minimum threshold of 0.5 meters per second in processing meteorological data for use in AERMOD. In setting this threshold, no wind speeds lower than this value would be used for determining concentrations. This threshold was specifically applied to the 1-minute wind data. In addition, the "Ice-Free Winds Group" AERMINUTE option was selected for processing and the meteorological data was processed by applying Adjust Surface Friction Velocity (ADJ_U*).

EPA believes that the surface and upper air meteorological data selected by the Commonwealth of Kentucky for use in this modeling analysis is acceptable and was processed in a manner consistent with the SO₂ modeling TAD. EPA believes that the meteorological data shows that impacts from Century Aluminum, BREC Reid/HMP&L Station 2, and BREC Green Station are reasonably expected to most frequently occur generally northeast of each respective facility, but as shown in Figure 12 in Section 2.4.1.10, the maximum modeled concentrations occur south and west of the facilities.

2.4.1.8. Modeling Parameter: Geography, Topography (Mountain Ranges or Other Air Basin Boundaries) and Terrain

The terrain in the area of analysis is best described as gently rolling with some hills above the stack heights of the BREC and Century Aluminum facilities. To account for these terrain changes, the AERMAP (version 18081) terrain program within the AERMOD Modeling System was used to specify terrain elevations for all the receptors. The source of the elevation data incorporated into the model is from the USGS National Elevation Database (NED).

EPA agrees with the Commonwealth's use of the USGS NED database and AERMAP terrain processor for AERMOD to account for the changes in elevation of the area to obtain a more accurate modeling result.

2.4.1.9. Modeling Parameter: Background Concentrations of SO₂

The Modeling TAD offers two mechanisms for characterizing background concentrations of SO₂ that are ultimately added to the modeled design values: 1) a “tier 1” approach, based on a monitored design value, or 2) a temporally varying “tier 2” approach, based on the 99th percentile monitored concentrations by hour of day and season or month. For this area of analysis, the Commonwealth chose to use a tier 2 approach with background concentrations varying by season and by hour of day from the Evansville-Buena Vista monitor (AQS ID# 18-163-0021), located in Evansville, Indiana, approximately 40 km north of the Century Aluminum and BREC DRR facilities. The background concentrations for this area of analysis were determined by the Commonwealth to vary from 3.06 micrograms per cubic meter (µg/m³), equivalent to 1.17 ppb when expressed in three significant figures, to 17.5 µg/m³ (6.70 ppb), with an average value of 8.73 µg/m³ (3.34 ppb). Table 5 provides the complete set of season-hour of day varying background data.

The Commonwealth chose to use the Evansville-Buena Vista monitor because it is representative of the Sebree area background and accounts for potential influences of distant, large SO₂ sources in the area. The Evansville SO₂ monitor is located approximately 16 km northeast of the Vectren-A. B. Brown Generating Station. The monitor is also approximately 25 km northwest of the Vectren-F. B. Culley Generating Station, Alcoa-Vectren-Warrick Generating Station, and the Alcoa Warrick aluminum smelter operation in Newburgh, IN. The Evansville monitor is closer to these facilities than the facilities are to the Century Aluminum and BREC facilities. The Commonwealth determined that the Evansville monitor is likely impacted by the above-named facilities and that it is an appropriate and representative background monitor for the modeling analysis.

Table 5. Seasonal Hourly SO₂ Concentrations at the Evansville-Buena Vista Monitor

AERMOD ready format (MET HOUR 0 = AERMOD HOUR 1)				
Hour (Ending of Hour Period)	Winter	Spring	Summer	Fall
01:00	2.67	2.57	2.63	2.03
02:00	3.83	2.90	2.00	1.83
03:00	2.77	2.57	1.97	1.60
04:00	2.70	2.77	2.13	1.37
05:00	2.53	2.83	2.07	1.27
06:00	2.53	3.03	2.03	1.47
07:00	2.57	3.37	2.27	1.17
08:00	2.83	4.00	4.13	1.73
09:00	3.97	4.33	5.03	3.73
10:00	4.07	6.40	5.17	3.30
11:00	4.50	5.53	5.20	3.73
12:00	4.70	4.57	4.27	3.83
13:00	6.70	4.53	3.77	3.47
14:00	6.13	5.77	3.67	4.53
15:00	5.30	5.60	3.57	3.27
16:00	4.13	4.77	3.50	3.83
17:00	4.10	3.87	3.40	3.83
18:00	2.97	4.23	3.43	2.47
19:00	3.33	3.97	4.47	1.70
20:00	3.73	3.13	3.70	1.70
21:00	3.10	3.30	3.67	1.57
22:00	3.20	2.70	3.10	2.03
23:00	3.53	2.37	3.00	2.23
24:00	2.83	2.37	2.67	1.87

EPA agrees with the Commonwealth's use of a time-varying season by hour of day tier 2 approach with background concentration data from the Evansville-Buena Vista ambient SO₂ monitor. EPA also agrees with the Commonwealth's rationale for selection of the Evansville-

Buena Vista monitor as it likely accounts for potential long-range impacts for large SO₂ emissions sources located over 30 km from the Century Aluminum and BREC facilities.

2.4.1.10. *Summary of Modeling Inputs and Results*

The AERMOD modeling input parameters for the Henderson-Webster, Kentucky area of analysis are summarized below in Table 6.

Table 6. Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the Henderson-Webster, Kentucky Area

Input Parameter	Value
AERMOD Version	19191
Dispersion Characteristics	Rural
Modeled Sources	3
Modeled Stacks	28 point sources and 1 buoyant line source with 6 lines
Modeled Structures	79
Modeled Fencelines	2
Total receptors	12,160
Emissions Type	Mixed/Hybrid
Emissions Years	2017-2019 Actual Emissions from the BREC sources and the large sources at Century Aluminum. PTE for small natural-gas fired sources at Century Aluminum.
Meteorology Years	2017-2019
NWS Station for Surface Meteorology	Evansville, IN
NWS Station Upper Air Meteorology	Nashville, TN
NWS Station for Calculating Surface Characteristics	Evansville, IN
Methodology for Calculating Background SO ₂ Concentration	Tier 2, monitored concentrations varying by season and by hour of day, from the Evansville-Buena Vista monitor (AQS ID# 18-163-0021), located in Evansville, Indiana
Calculated Background SO ₂ Concentration	Varying between 1.17 ppb and 6.70 ppb

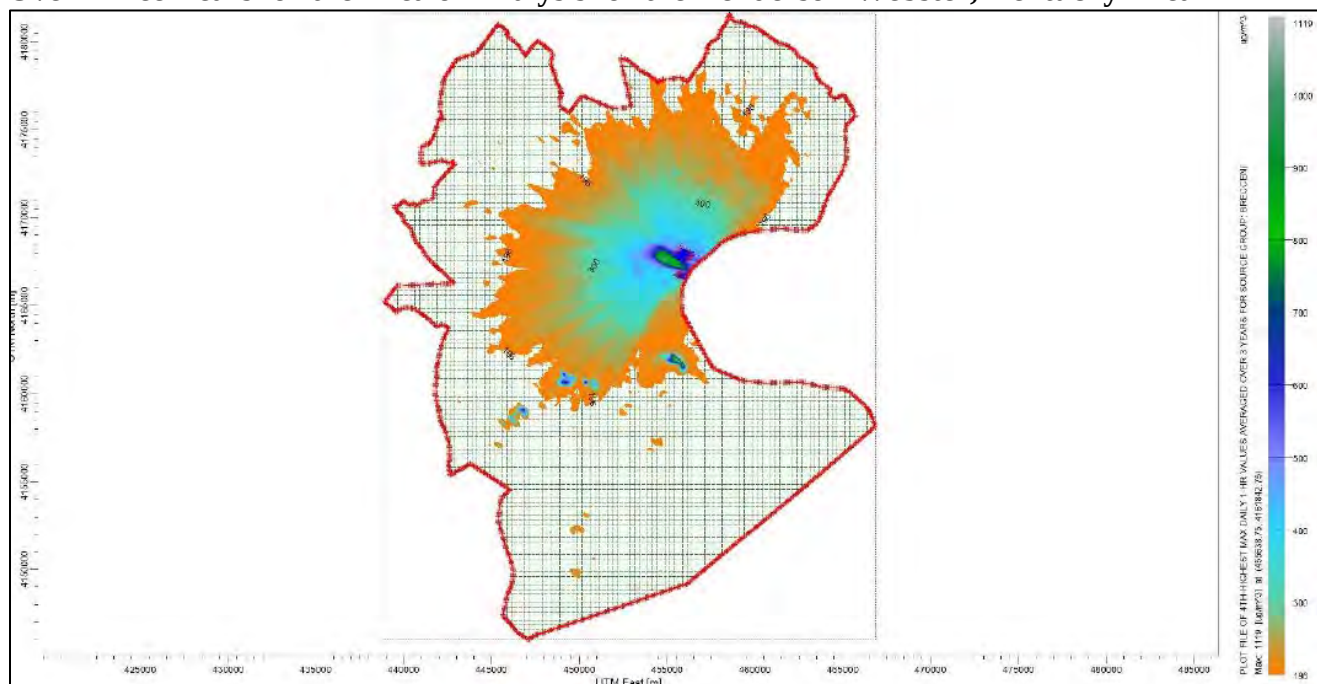
The results presented below in Table 7 and Figure 9 show the geographic extent of the predicted modeled violations based on the input parameters. The Commonwealth's receptor grid is also shown in Figure 9.

Table 7. Predicted 99th Percentile Daily Maximum 1-Hour SO₂ Concentration Averaged Over Three Years for the Area of Analysis for the Henderson-Webster, Kentucky Area

Averaging Period	Data Period	Receptor Location UTM zone 16		99 th percentile daily maximum 1-hour SO ₂ Concentration (µg/m ³)	
		UTM Easting (m)	UTM Northing (m)	Modeled concentration (including background)	NAAQS Level
99th Percentile 1-Hour Average	2017-2019	455638.75	4161842.75	1119.0	196.4*

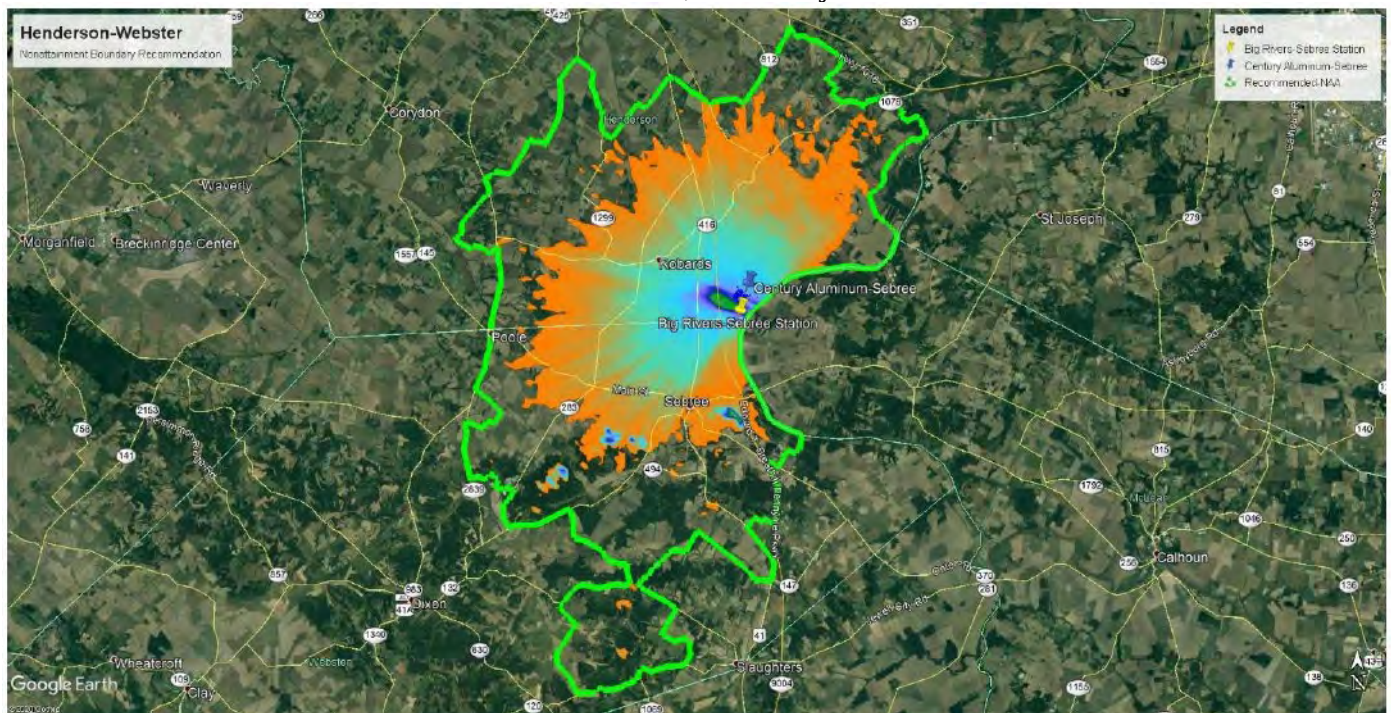
*Equivalent to the 2010 SO₂ NAAQS of 75 ppb using a 2.619 µg/m³ conversion factor

Figure 9. Predicted 99th Percentile Daily Maximum 1-Hour SO₂ Concentrations Averaged Over Three Years for the Area of Analysis for the Henderson-Webster, Kentucky Area



The modeling submitted by the Commonwealth indicates that the 1-hour SO₂ NAAQS is violated at the receptor with the highest modeled concentration. The modeling results also include the area in which a NAAQS violation was modeled, information that is relevant to the selection of the boundaries of the area that will be designated. Figure 10 was included as part of the Commonwealth's recommendation and indicates that the predicted modeled violations are fully contained within the state's recommended nonattainment area boundary.

Figure 10. Kentucky's Recommended Nonattainment Boundary Encompassing All Areas of Modeled Violations for the Henderson-Webster, Kentucky Area



The Commonwealth used roadways and landmarks to define the nonattainment boundary and provided Figure 11 and Table 8 to clearly described the boundary and identify the UTM coordinates of the vertices of the nonattainment area polygon.

Figure 11. Kentucky's Recommended Nonattainment Boundary

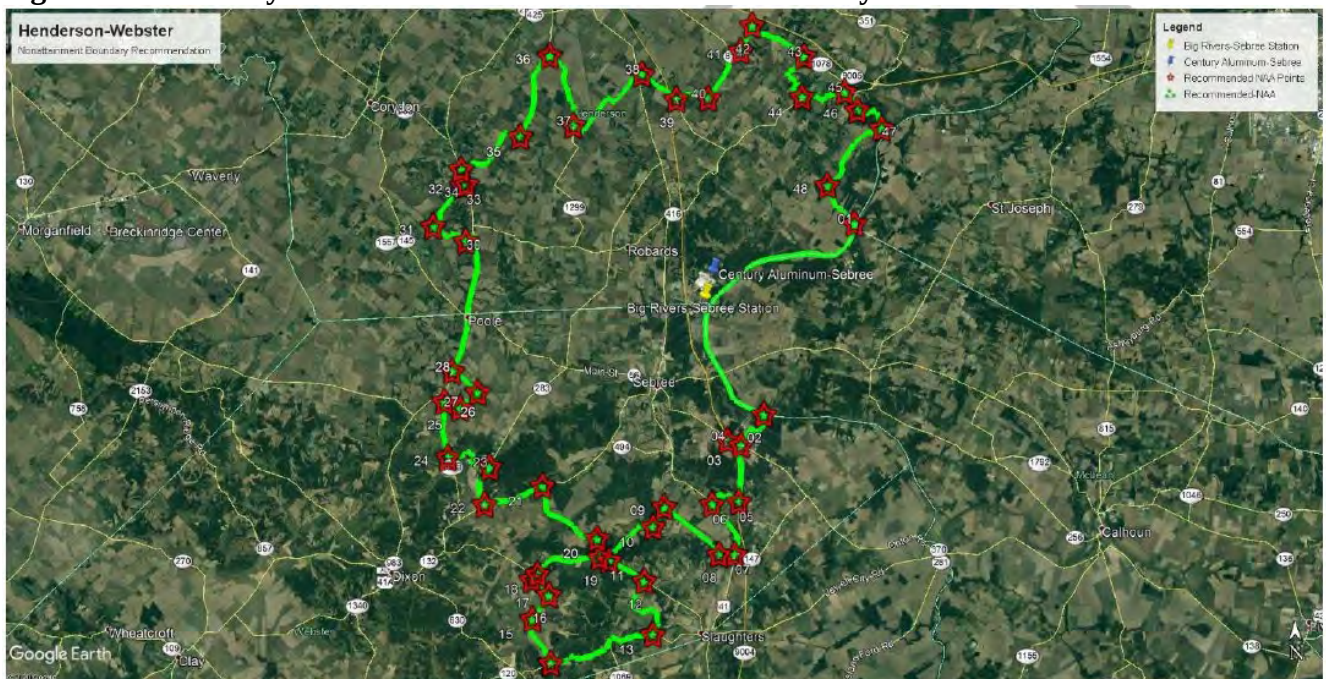


Table 8. Detailed Description of Kentucky's Recommended Nonattainment Boundary

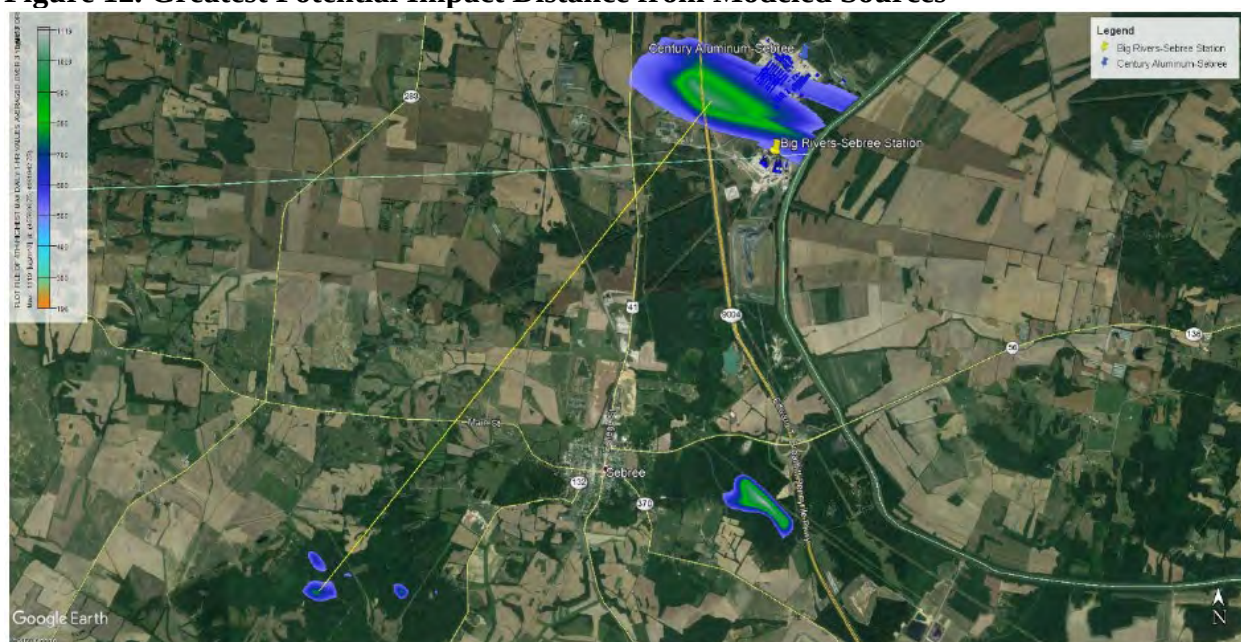
Point ID	Recommended NAA Boundary Point Pathway		X Coord. (UTM)	Y Coord. (UTM)
01	KY 520, Upper Delaware Rd	The Green River boundary	463979.00	4171000.03
02	The Green River boundary	JZ Shelton Rd	459058.03	4160832.96
03	JZ Shelton Rd	KY 370	457811.00	4159192.96
04	KY 370	Pennyrile Parkway I-69	457089.96	4159452.95
05	Pennyrile Parkway I-69	Sassafras Grove Rd	457675.35	4156244.55
06	Sassafras Grove Rd	US 41	456236.68	4156125.75
07	US 41	Slaughters Elmwood Rd	457442.82	4153425.68
08	Slaughters Elmwood Rd	Railroad Track (NW)	456589.41	4153424.43
09	Railroad Track (NW)	Breton Rd	453677.09	4155992.29
10	Breton Rd	KY 1835	453079.74	4154924.00
11	KY 1835	KY 138	450702.89	4153141.51
12	KY 138	Crowder Rd	452587.06	4152032.38
13	Crowder Rd	KY 120	453030.14	4149175.08
14	KY 120	Gooch Jones Rd	447528.25	4147663.88
15	Gooch Jones Rd	John Roach Rd	446551.75	4150042.51
16	John Roach Rd	Old Dixon Slaughters Rd	447462.17	4151329.04
17	Old Dixon Slaughters Rd	Old Dixon Rd	446532.28	4152143.23
18	Old Dixon Rd	KY 138	446849.49	4152437.09
19	KY 138	Camel Brooks Rd	450196.38	4153305.18

20	Carnel Brooks Rd	Rakestraw Bottoms Rd	450079.34	4154326.39
21	Rakestraw Bottoms Rd	KY 132	447141.40	4157145.04
22	KY 132	KY 283	444025.55	4156172.90
23	KY 283	Beckley Osbourne Rd	444300.82	4158111.35
24	Beckley Osbourne Rd	Dixon Wanamaker Rd	442067.07	4158641.90
25	Dixon Wanamaker Rd	KY 191	441887.88	4161614.33
26	KY 191	D Melton Rd	442743.25	4161250.11
27	D Melton Rd	Knoblick Creek Rd	443688.82	4162093.08
28	Knoblick Creek Rd	US 41A	442319.35	4163220.45
29	US 41A	Dixon 1 Rd	443500.62	4170518.52
30	Dixon 1 Rd	GF Sights Rd	443094.58	4170166.59
31	GF Sights Rd	Cairo Dixie Rd	441341.46	4170978.60
32	Cairo Dixie Rd	Liles Cairo Rd	442919.00	4173140.24
33	Liles Cairo Rd	US 41A	443124.23	4173204.51
34	US 41A	Cairo Hickory Grove Rd	442860.28	4174017.18
35	Cairo Hickory Grove Rd	Pruitt Agnew Rd	446056.06	4175740.98
36	Pruitt Agnew Rd	KY 1299	447662.11	4180049.93
37	KY 1299	Anthoston Frog Island Rd	448905.37	4176327.31
38	Anthoston Frog Island Rd	KY 136	452613.63	4179047.02
39	KY 136	Upper Delaware Rd	454451.59	4177687.26
40	Upper Delaware Rd	Barren Church Rd S	456153.23	4177723.20
41	Barren Church Rd S	Barren Church Rd N	457912.85	4180247.83
42	Barren Church Rd N	KY 1078	458542.52	4181615.55
43	KY 1078	Jones Brothers Rd	461322.00	4179952.85

44	Jones Brothers Rd	KY 416	461209.84	4177755.55
45	KY 416	KY 1078	463492.08	4178026.50
46	KY 1078	Onionville Rd	464177.31	4177054.13
47	Onionville Rd	Work Road	465476.34	4176076.78
48	Work Road	Upper Delaware Rd	462529.15	4173036.52

The Commonwealth also provided Figure 12, which indicates that the greatest SO₂ impacts are within 9 km of the sources under consideration.

Figure 12. Greatest Potential Impact Distance from Modeled Sources



2.4.1.11. EPA's Assessment of the Modeling Information Provided by the Commonwealth

EPA agrees with the modeling methodology used by Kentucky to characterize the area surrounding the Century Aluminum and BREC DRR facilities in the final November 12, 2020, modeling submittal. The Commonwealth performed the modeling using AERMOD version 19191, which is the current version of EPA's preferred regulatory model. The modeling was performed using default regulatory options and following the guidance provided in EPA's Modeling TAD and Guideline on Air Quality Models (40 CFR Part 51, Appendix W).

The following discussion provides a brief summary of EPA's assessment of the major components of the modeling. EPA agrees with the Commonwealth's area of analysis and source characterization components of the modeling. EPA has evaluated the need to include in the

modeling analysis any additional SO₂ emission sources within 50 km of the facilities and agrees that no additional SO₂ sources need to be included in the modeling analysis based upon the levels of emissions and distance from the DRR facilities. All other nearby sources not included in the modeling were addressed with the background concentrations used in the modeling. With regards to the background concentrations, the Commonwealth chose the Evansville-Buena Vista monitor to account for potential influences of distant, large SO₂ sources in the area that were not included in the modeling. EPA agrees with the monitor chosen for background concentrations and the 2017-2019 data period. With regards to the receptor grid, EPA believes that Kentucky's receptor grid is appropriate for the characterization of the area, considering the impacts of SO₂ emissions from the DRR facilities. The receptor grid used in Kentucky's modeling is adequate to determine the extent of the modeled violations of the 1-hour SO₂ NAAQS in the area and thus can be used to inform selection of the nonattainment boundary.

EPA also agrees with Commonwealth's selection of meteorology, terrain, and emissions data for the modeling assessment. The surface and upper air meteorological data used in the modeling analysis is appropriate for performing a valid modeling assessment. The Commonwealth appropriately used the AERMET, AERMINUTE, and AERSURFACE meteorology pre-processors to prepare the meteorological data for use in AERMOD. The Commonwealth also appropriately used the AERMAP pre-processor to account for the terrain in the modeling domain and appropriately classified the area as rural using the Auer method to evaluate land-use. The Commonwealth has addressed EPA's original comments in the 120-day intended designation letter that the modeling be revised to include the emissions from all three DRR facilities that are characterized by the Sebree SO₂ Monitor. EPA agrees with Kentucky's use of actual hourly-varying emissions from 2017-2019 for BREC Reid/HMP&L Station 2 and BREC Green Station from CEMS at the facilities. EPA also agrees with using the most recent stack test data and monthly production records to produce temporally variable actual emissions for the anode bake furnace and potlines at Century Aluminum. Additionally, EPA agrees with modeling the smaller, natural gas-fired units at Century Aluminum using potential emissions.

Considering all the data and modeling procedures described in Sections 2.4.1.1 through 2.4.1.10 of this final designations TSD, EPA agrees that Kentucky's November 12, 2020, modeling captures the geographic extent of the violations and can be used to establish the corresponding nonattainment boundary.

2.5. Emissions and Emissions-Related Data, Meteorology, Geography, and Topography for the Henderson-Webster, Kentucky Area

These factors have been incorporated into the air quality modeling efforts and results discussed above. EPA is giving consideration to these factors by considering whether they were properly incorporated and by considering the air quality concentrations predicted by the modeling.

2.6. Jurisdictional Boundaries in the Henderson-Webster, Kentucky Area

Kentucky provided an analysis of the jurisdictional boundaries to establish the geographic extent of the nonattainment area in Henderson and Webster Counties. EPA considers existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary for carrying out the air quality planning and enforcement functions for the area. Our goal is to base designations on clearly defined legal boundaries that align with existing administrative boundaries when reasonable. Existing jurisdictional boundaries used to define a nonattainment area must encompass the area that has been identified as meeting the nonattainment definition.

After assessing the five factors outlined above, the Commonwealth recommended the nonattainment boundary illustrated in Figure 11 above, which utilizes permanent and readily identifiable jurisdictional boundaries, roadways, and geographical landmarks to inform the Henderson-Webster partial nonattainment boundary. The Commonwealth's November 12, 2020, nonattainment boundary includes those undesignated portions of Henderson and Webster Counties encompassed by the polygon bounded by 48 vertices using UTM coordinates as described in Table 8 above. Kentucky's boundary includes the violating DRR monitor and all three DRR sources: Century Aluminum, BREC Reid/HMP&L Station 2 and Robert D. Green Station. Table 8 above provides a description of the vertices (*i.e.*, UTM geographic coordinates) and the identifiable roadways and physical landmarks that define the geographical extent of the partial nonattainment boundary. EPA believes the Commonwealth's boundary recommendation provides for a clear, legally defined boundary and encompasses an area identified as meeting the nonattainment definition. The Commonwealth also recommends attainment/unclassifiable for the remaining undesignated areas in Henderson and Webster County not included in the Commonwealth's nonattainment boundary described above. See Figure 13.

2.7. Other Information Relevant to the Designation of the Henderson-Webster, Kentucky Area

Kentucky's November 12, 2020, response to EPA's August 13, 2020, intended designations includes an updated nonattainment boundary recommendation based on a modeling analysis for the undesignated portions of Henderson-Webster Area. EPA's assessment of the Commonwealth's modeling analysis and updated nonattainment boundary recommendation is provided in sections 2.4.1, 2.5 and 2.6 above. EPA received comments from the Sierra Club regarding the intended designation for the Henderson-Webster area. These comments are addressed in the Response to Comments document associated with this final action.

2.8. EPA's Assessment of the Available Information for the Henderson-Webster, Kentucky Area

A monitor in the Henderson-Webster area is violating the NAAQS based on the 2017-2019 design value. Kentucky submitted air dispersion modeling to demonstrate the extent of the NAAQS violations and to establish a nonattainment boundary.

Kentucky submitted additional air dispersion modeling on November 12, 2020, superseding an October 16, 2020, submission to define the extent of the nonattainment area for the Henderson-Webster Area. The Commonwealth's modeling supports the Commonwealth's updated nonattainment boundary recommendation of a nonattainment boundary that includes undesignated portions of Henderson and Webster Counties. EPA believes Kentucky's air dispersion modeling accurately characterizes the extent of the nonattainment boundary based on more recent emissions from both power plants (Robert Reid Station/Henderson Municipal Power and Light (HMP&L) Station 2, and Robert D. Green Station) and the aluminum plant (Century Aluminum), and considered the most recent meteorology data, current background concentrations from nearby monitors, and the current version of AERMOD.⁴

EPA believes that this updated modeling is more representative of the area than the modeling used to site the monitor that was used to develop the intended nonattainment boundary and it accounts for all modeled impacts above the SO₂ standard. EPA believes that our final nonattainment area, bounded by the UTM coordinates listed in Table 8 above, will have clearly defined legal boundaries, and we find these boundaries to be a suitable basis for defining our final nonattainment area.

EPA has no evidence to suggest that violations are occurring in the remainder of Henderson or Webster Counties or that there are sources outside the nonattainment area that are contributing to the violations in the nonattainment area. Specifically, the remainder of Henderson and Webster counties do not contain any sources that emitted greater than 2,000 tpy of SO₂ in 2017 - 2019. For these reasons, EPA is designating the remainder of Henderson and Webster Counties as attainment/unclassifiable.

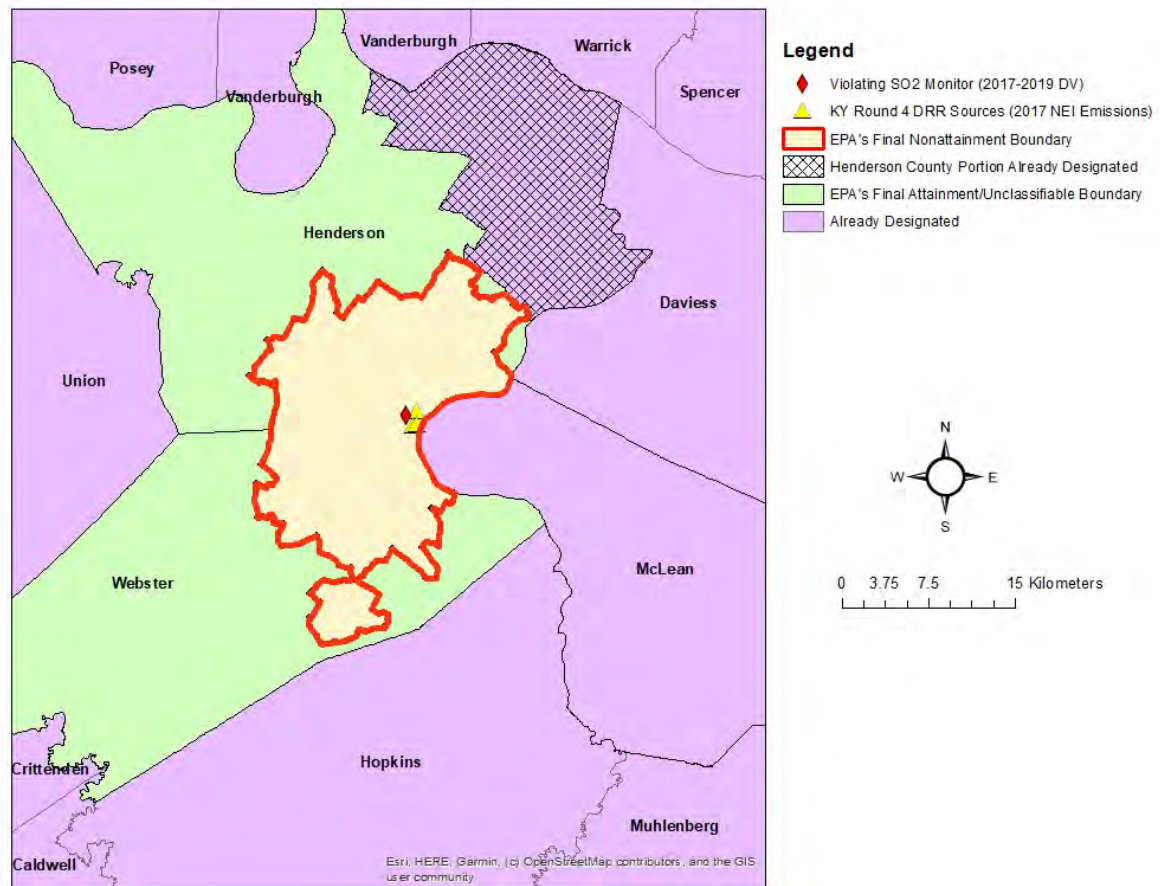
2.9. Summary of EPA's Final Designation for the Henderson-Webster, Kentucky Area

After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, EPA is designating a portion of the Henderson-Webster, Kentucky area as nonattainment for the 2010 SO₂ NAAQS. Specifically, the boundaries are comprised of the portions of Henderson County and Webster County contained within the area bounded by the UTM coordinates listed in Table 8 above.

Additionally, EPA is designating the remainder of Henderson County and Webster County as attainment/unclassifiable. Figure 13 shows the boundary of this final designated area.

⁴ EPA's assessment of the modeling for the Henderson-Webster area to inform our nonattainment boundary for 2010 SO₂ NAAQS designations does not imply that the modeling is appropriate for other purposes, such as new source review, interstate transport, or state implementation plan demonstrations.

Figure 13. Boundary of the Final Henderson-Webster Nonattainment Area



APPENDIX C

Nonattainment Area Monitoring Data

User ID: JNALL

DESIGN VALUE REPORT

Report Request ID: 2395383

Report Code: AMP480

Jul. 13, 2026

GEOGRAPHIC SELECTIONS													
Tribal Code	State	County	Site	Parameter	POC	City	AQCR	UAR	CBSA	CSA	EPA Region		
	21	101											

PROTOCOL SELECTIONS			
Parameter Classification	Parameter	Method	Duration
DESIGN VALUE	42401		

AGENCY SELECTIONS
Kentucky Division For Air Quality

SELECTED OPTIONS	
Option Type	Option Value
SINGLE EVENT PROCESSING	EXCLUDE REGIONALLY CONCURRED EVENTS
MERGE PDF FILES	YES
AGENCY ROLE	PQA0
USER SITE METADATA	STREET ADDRESS
QUARTERLY DATA IN WORKFILE	NO
WORKFILE DELIMITER	,
USE LINKED SITES	YES

DATE CRITERIA	
Start Date	End Date
2017	2025

APPLICABLE STANDARDS
Standard Description
S02 1-hour 2010

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

- Notes:**
1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
 2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
 3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)

Standard Units: Parts per billion(008)

NAAQS Standard: SO2 1-hour 2010

Statistic: Annual 99th Percentile **Level:** 75

Design Value Year: 2017

REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.

State Name: Kentucky

Site ID	STREET ADDRESS	2017			2016			2015			3-Year	
		Comp. Qtrs	99th Percentile	Cert& Eval	Comp. Qtrs	99th Percentile	Cert& Eval	Comp. Qtrs	99th Percentile	Cert& Eval	Design Value	Valid Ind.
21-101-0014	BASKETT FIRE DEPARTMENT, 74	4	10.0	Y	4	14.0	Y	4	19.0	Y	14	Y
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	94.0	Y							94	N

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)
Standard Units: Parts per billion(008)
NAAQS Standard: SO2 Annual 2024
Statistic: Annual Mean

Design Value Year: 2017
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
Level: 75
State Name: Kentucky

Site ID	STREET ADDRESS	2017			2016			2015			3-Year	
		Comp. Qtrrs	99th Percentile	Cert& Eval	Comp. Qtrrs	99th Percentile	Cert& Eval	Comp. Qtrrs	99th Percentile	Cert& Eval	Design Value	Valid Ind.
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	2.3	Y							2	N
21-101-0014	BASKETT FIRE DEPARTMENT, 74	4	1.0	Y	4	1.7	Y	4	.6	Y	1	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)

Standard Units: Parts per billion(008)

NAAQS Standard: SO2 1-hour 2010

Statistic: Annual 99th Percentile **Level:** 75

Design Value Year: 2018

REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.

State Name: Kentucky

Site ID	STREET ADDRESS	2018			2017			2016			3-Year	
		Comp. Qtrs	99th Percentile	Cert& Eval	Comp. Qtrs	99th Percentile	Cert& Eval	Comp. Qtrs	99th Percentile	Cert& Eval	Design Value	Valid Ind.
21-101-0014	BASKETT FIRE DEPARTMENT, 74	4	13.0	M	4	10.0	Y	4	14.0	Y	12	Y
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	102.0	M	4	94.0	Y				98	N

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
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3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)
Standard Units: Parts per billion(008)
NAAQS Standard: SO2 Annual 2024
Statistic: Annual Mean

Design Value Year: 2018
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
Level: 75
State Name: Kentucky

Site ID	STREET ADDRESS	2018			2017			2016			3-Year	
		Comp. Qtrs	99th Percentile	Cert& Eval	Comp. Qtrs	99th Percentile	Cert& Eval	Comp. Qtrs	99th Percentile	Cert& Eval	Design Value	Valid Ind.
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	2.6	M	4	2.3	Y				2	N
21-101-0014	BASKETT FIRE DEPARTMENT, 74	4	.6	M	4	1.0	Y	4	1.7	Y	1	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)
Standard Units: Parts per billion(008)
NAAQS Standard: SO2 1-hour 2010
Statistic: Annual 99th Percentile **Level:** 75

Design Value Year: 2019
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
State Name: Kentucky

Site ID	STREET ADDRESS	2019			2018			2017			3-Year	
		Comp. Qtrs	99th Percentile	Cert& Eval	Comp. Qtrs	99th Percentile	Cert& Eval	Comp. Qtrs	99th Percentile	Cert& Eval	Design Value	Valid Ind.
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	99.0	Y	4	102.0	M	4	94.0	Y	98	Y
21-101-0014	BASKETT FIRE DEPARTMENT, 74	0	12.0 *	N	4	13.0	M	4	10.0	Y	12	N

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)
Standard Units: Parts per billion(008)
NAAQS Standard: SO2 Annual 2024
Statistic: Annual Mean

Design Value Year: 2019
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
Level: 75
State Name: Kentucky

Site ID	STREET ADDRESS	2019			2018			2017			3-Year	
		Comp. Qtrrs	99th Percentile	Cert& Eval	Comp. Qtrrs	99th Percentile	Cert& Eval	Comp. Qtrrs	99th Percentile	Cert& Eval	Design Value	Valid Ind.
21-101-0014	BASKETT FIRE DEPARTMENT, 74	0	.9 *	N	4	.6	M	4	1.0	Y	1	N
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	1.8	Y	4	2.6	M	4	2.3	Y	2	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)
Standard Units: Parts per billion(008)
NAAQS Standard: SO2 1-hour 2010
Statistic: Annual 99th Percentile **Level:** 75

Design Value Year: 2020
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
State Name: Kentucky

<u>Site ID</u>	<u>STREET ADDRESS</u>	2020			2019			2018			3-Year	
		<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Design</u>	<u>Valid</u>
		<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Value</u>	<u>Ind.</u>
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	73.0	Y	4	99.0	Y	4	102.0	M	91	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)
Standard Units: Parts per billion(008)
NAAQS Standard: SO2 Annual 2024
Statistic: Annual Mean

Design Value Year: 2020
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
Level: 75
State Name: Kentucky

Site ID	STREET ADDRESS	2020			2019			2018			3-Year	
		Comp. Qtrrs	99th Percentile	Cert& Eval	Comp. Qtrrs	99th Percentile	Cert& Eval	Comp. Qtrrs	99th Percentile	Cert& Eval	Design Value	Valid Ind.
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	1.5	Y	4	1.8	Y	4	2.6	M	2	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)
Standard Units: Parts per billion(008)
NAAQS Standard: SO2 1-hour 2010
Statistic: Annual 99th Percentile **Level:** 75

Design Value Year: 2021
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
State Name: Kentucky

<u>Site ID</u>	<u>STREET ADDRESS</u>	2021			2020			2019			3-Year	
		<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Design</u>	<u>Valid</u>
		<u>Qtrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Qtrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Qtrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Value</u>	<u>Ind.</u>
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	68.0	Y	4	73.0	Y	4	99.0	Y	80	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)
Standard Units: Parts per billion(008)
NAAQS Standard: SO2 Annual 2024
Statistic: Annual Mean

Design Value Year: 2021
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.

Level: 75
State Name: Kentucky

Site ID	STREET ADDRESS	2021			2020			2019			3-Year	
		Comp. Qtrts	99th Percentile	Cert& Eval	Comp. Qtrts	99th Percentile	Cert& Eval	Comp. Qtrts	99th Percentile	Cert& Eval	Design Value	Valid Ind.
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	1.3	Y	4	1.5	Y	4	1.8	Y	1	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)
Standard Units: Parts per billion(008)
NAAQS Standard: SO2 1-hour 2010
Statistic: Annual 99th Percentile

Design Value Year: 2022
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
Level: 75
State Name: Kentucky

<u>Site ID</u>	<u>STREET ADDRESS</u>	2022			2021			2020			3-Year	
		<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Design</u>	<u>Valid</u>
		<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Value</u>	<u>Ind.</u>
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	72.6	Y	4	68.0	Y	4	73.0	Y	71	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)
Standard Units: Parts per billion(008)
NAAQS Standard: SO2 Annual 2024
Statistic: Annual Mean

Design Value Year: 2022
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
Level: 75
State Name: Kentucky

Site ID	STREET ADDRESS	2022			2021			2020			3-Year	
		Comp. Qtrrs	99th Percentile	Cert& Eval	Comp. Qtrrs	99th Percentile	Cert& Eval	Comp. Qtrrs	99th Percentile	Cert& Eval	Design Value	Valid Ind.
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	1.3	Y	4	1.3	Y	4	1.5	Y	1	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)

Standard Units: Parts per billion(008)

NAAQS Standard: SO2 1-hour 2010

Statistic: Annual 99th Percentile

Design Value Year: 2023

REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.

State Name: Kentucky

Level: 75

<u>Site ID</u>	<u>STREET ADDRESS</u>	2023			2022			2021			3-Year	
		<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Design</u>	<u>Valid</u>
		<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Value</u>	<u>Ind.</u>
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	94.3	Y	4	72.6	Y	4	68.0	Y	78	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)
Standard Units: Parts per billion(008)
NAAQS Standard: SO2 Annual 2024
Statistic: Annual Mean

Design Value Year: 2023
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
Level: 75
State Name: Kentucky

Site ID	STREET ADDRESS	2023			2022			2021			3-Year	
		Comp. Qtrs	99th Percentile	Cert& Eval	Comp. Qtrs	99th Percentile	Cert& Eval	Comp. Qtrs	99th Percentile	Cert& Eval	Design Value	Valid Ind.
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	2.4	Y	4	1.3	Y	4	1.3	Y	2	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)
Standard Units: Parts per billion(008)
NAAQS Standard: SO2 1-hour 2010
Statistic: Annual 99th Percentile **Level:** 75

Design Value Year: 2024
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
State Name: Kentucky

<u>Site ID</u>	<u>STREET ADDRESS</u>	2024			2023			2022			3-Year	
		<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Design</u>	<u>Valid</u>
		<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Value</u>	<u>Ind.</u>
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	78.7	Y	4	94.3	Y	4	72.6	Y	82	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)
Standard Units: Parts per billion(008)
NAAQS Standard: SO2 Annual 2024
Statistic: Annual Mean

Design Value Year: 2024
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
Level: 75
State Name: Kentucky

<u>Site ID</u>	<u>STREET ADDRESS</u>	2024			2023			2022			3-Year	
		<u>Comp.</u> <u>Qtrs</u>	<u>99th</u> <u>Percentile</u>	<u>Cert&</u> <u>Eval</u>	<u>Comp.</u> <u>Qtrs</u>	<u>99th</u> <u>Percentile</u>	<u>Cert&</u> <u>Eval</u>	<u>Comp.</u> <u>Qtrs</u>	<u>99th</u> <u>Percentile</u>	<u>Cert&</u> <u>Eval</u>	<u>Design</u> <u>Value</u>	<u>Valid</u> <u>Ind.</u>
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	2.4	Y	4	2.4	Y	4	1.3	Y	2	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)

Standard Units: Parts per billion(008)

NAAQS Standard: SO2 1-hour 2010

Statistic: Annual 99th Percentile **Level:** 75

Design Value Year: 2025

REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.

State Name: Kentucky

<u>Site ID</u>	<u>STREET ADDRESS</u>	2025			2024			2023			3-Year	
		<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Comp.</u>	<u>99th</u>	<u>Cert&</u>	<u>Design</u>	<u>Valid</u>
		<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Qtrrs</u>	<u>Percentile</u>	<u>Eval</u>	<u>Value</u>	<u>Ind.</u>
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	71.2	Y	4	78.7	Y	4	94.3	Y	81	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

Pollutant: Sulfur dioxide(SO2 1-hour 2010)

Standard Units: Parts per billion(008)

NAAQS Standard: SO2 Annual 2024

Statistic: Annual Mean

Design Value Year: 2025

REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.

Level: 75

State Name: Kentucky

Site ID	STREET ADDRESS	2025			2024			2023			3-Year	
		Comp. Qtrts	99th Percentile	Cert& Eval	Comp. Qtrts	99th Percentile	Cert& Eval	Comp. Qtrts	99th Percentile	Cert& Eval	Design Value	Valid Ind.
21-101-1011	Alcan Aluminum Road, 1.0 Mi	4	1.6	Y	4	2.4	Y	4	2.4	Y	2	Y

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Jul. 13, 2026

CERTIFICATION EVALUATION AND CONCURRENCE FLAG MEANINGS

FLAG	MEANING
M	The monitoring organization has revised data from this monitor since the most recent certification letter received from the state.
N	The certifying agency has submitted the certification letter and required summary reports, but the certifying agency and/or EPA has determined that issues regarding the quality of the ambient concentration data cannot be resolved due to data completeness, the lack of performed quality assurance checks or the results of uncertainty statistics shown in the AMP255 report or the certification and quality assurance report.
S	The certifying agency has submitted the certification letter and required summary reports. A value of "S" conveys no Regional assessment regarding data quality per se. This flag will remain until the Region provides an "N" or "Y" concurrence flag.
U	Uncertified. The certifying agency did not submit a required certification letter and summary reports for this monitor even though the due date has passed, or the state's certification letter specifically did not apply the certification to this monitor.
X	Certification is not required by 40 CFR 58.15 and no conditions apply to be the basis for assigning another flag value
Y	The certifying agency has submitted a certification letter, and EPA has no unresolved reservations about data quality (after reviewing the letter, the attached summary reports, the amount of quality assurance data submitted to AQS, the quality statistics, and the highest reported concentrations).

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

APPENDIX D

Attainment Year Emissions Inventory

Please see attached spreadsheet:
“2024-08-13 Henderson_Webster-
Attainment Demo_Emissions Inventory”

APPENDIX E

**BREC-Green Station Natural
Gas Conversion Letter;**

**BREC-HMP&L Station 2
Retirement Letter**

**BREC-Green Permit (For
informational purposes only)**



Sebree Station
9000 Highway 2096
Robards, KY 42452
www.bigrivers.com

July 29, 2022

Kentucky Division for Air Quality
Department of Environmental Protection
300 Sower Boulevard
Second Floor
Frankfort, KY 40601

Re: Green Station (AI 44411), Unit 1 - Quarterly Reporting for the 2nd Quarter of 2022.

To Whom It May Concern:

Green Station, Unit One is owned and operated by Big Rivers Electric Corporation. This electric generating unit converted from coal-fired to natural gas-fired on May 26, 2022.

Please find enclosed the following quarterly reports for Green Unit 1:

- Excess Emissions and Continuous Monitoring System (CMS) Downtime Summary Reports
- SO₂ and NO_x Hourly Emission Rate Report
- Opacity Excess Emissions Report

I certify that, based on the information and belief formed after reasonable inquiry, the statements and information contained in the documents referenced above are true, accurate, and complete.

Please contact Mark Bertram at (270) 844-5708 if you have any questions or require further information.

Sincerely,

Heather Todd
Plant Manager

Commonwealth of Kentucky
Natural Resources & Environmental Protection Cabinet
Department for Environmental Protection
DIVISION FOR AIR QUALITY

Pollutant: (SO2) NOX TRS H2S CO OPACITY
(circle one)

*FOR OPACITY-RECORD ALL TIMES IN MINUTES. FOR GASES-RECORD ALL TIMES IN HOURS.

(Type or Print Legibly)

Reporting Period Date: From: 4/1/2022 To: 6/30/2022
Emission Limitation: > 0.8 lbs/mmBtu - 3 Hour Average
Company Name: Big Rivers Electric Corp.
Address: 201 3rd St., P.O. Box 24
Henderson, Kentucky 42419-0024
Monitor Manufacture: Thermo Electron Model #: 43I
Date of Latest: CMS CERTIFICATION: 6/7/22 CMS AUDIT:
Process Unit(s) Description: Green Station Unit 1 - Natural Gas Fired Power Plant

Total Source Operating Time In Reporting Period?* 540 HOURS

EMISSION DATA SUMMARY*

(HOURS)

1. Duration of Excess Emission Report Period Due to:

A. Startup/Shutdown: 0
B. Control Equipment Problems: 0
C. Process Problems: 0
D. Other Known Causes: 0
E. Unknown Causes: 0

2. Total Duration of Excess Emission: 0

3. (Total Duration of Excess Emissions)
(Total Source Operating Time) X 100 = 0.00%

CMS PERFORMANCE SUMMARY*

(HOURS)

1. CMS Downtime in Reporting Due to:

A. Monitor Equipment Malfunctions: 0
B. Non-Monitor Equipment Malf: 0
C. Quality Assurance Calibration: 0
D. Other Known Causes: 0
E. Unknown Causes: 0

2. Total CMS Downtime: 0

3. (Total CMS downtime)
(Total Source On Time) X 100 = 0.00%

Describe any changes which have occurred since the last quarterly submittal concerning CMS, PROCESS, or CONTROL: G-1 stopped operating on coal as of 4/4/22 and began operating on natural gas as of 5/26/22.

I CERTIFY THAT THE INFORMATION CONTAINED IN THIS REPORT IS TRUE, ACCURATE, AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

NAME: Heather Todd

TITLE: Plant Manager

SIGNATURE: Heather Todd

DATE: 7-29-22

Commonwealth of Kentucky
Natural Resources & Environmental Protection Cabinet
Department for Environmental Protection
DIVISION FOR AIR QUALITY

Pollutant: SO2 **NOX** TRS H2S CO OPACITY
(circle one)

*FOR OPACITY-RECORD ALL TIMES IN MINUTES. FOR GASES-RECORD ALL TIMES IN HOURS.

(Type or Print Legibly)

Reporting Period Date: From: 4/1/2022 To: 6/30/2022
Emission Limitation: > 0.20 lbs/mmBtu - 3-Hour Ave
Company Name: Big Rivers Electric Corp.
Address: 201 3rd St., P.O. Box 24
Henderson, Kentucky 42419-0024
Monitor Manufacture: Thermo Electron Model #: 4210-ABANN
Date of Latest: CMS CERTIFICATION: 06/07/22 CMS AUDIT: 06/07/22
Process Unit(s) Description: Green Station Unit 1 - Natural Gas Fired Power Plant
Total Source Operating Time In Reporting Period? 540 HOURS

EMISSION DATA SUMMARY*

(HOURS)

1. Duration of Excess Emission Report Period Due to:

A. Startup/Shutdown: 0
B. Control Equipment Problems: 0
C. Process Problems: 0
D. Other Known Causes: 0
E. Unknown Causes: 0

2. Total Duration of Excess Emission: 0

3. (Total Duration of Excess Emissions)
(Total Source Operating Time) X 100 = 0.00%

CMS PERFORMANCE SUMMARY*

(HOURS)

1. CMS Downtime in Reporting Due to:

A. Monitor Equipment Malfunctions: 0
B. Non-Monitor Equipment Malf: 0
C. Quality Assurance Calibration: 4
D. Other Known Causes: 9
E. Unknown Causes: 0

2. Total CMS Downtime: 13

3. (Total CMS downtime)
(Total Source On Time) X 100 = 2.41%

Describe any changes which have occurred since the last quarterly submittal concerning CMS, PROCESS, or CONTROL: G-1 stopped operating on coal as of 4/4/22 and began operating on natural gas as of 5/26/22. A new NOx CEMS was certified on 6/7/22.

I CERTIFY THAT THE INFORMATION CONTAINED IN THIS REPORT IS TRUE, ACCURATE, AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

NAME: Heather Todd

TITLE: Plant Manager

SIGNATURE: Heather Todd

DATE: 7-29-22

Commonwealth of Kentucky
Natural Resources & Environmental Protection Cabinet
Department for Environmental Protection
DIVISION FOR AIR QUALITY

Pollutant: SO2 NOX TRS H2S CO **OPACITY**
(circle one)

*FOR OPACITY-RECORD ALL TIMES IN MINUTES. FOR GASES-RECORD ALL TIMES IN HOURS.

(Type or Print Legibly)

Reporting Period Date: From: 4/1/2022 To: 6/30/2022
Emission Limitation: > 20% Opacity - Allowed One Exceedence per Hour (Up to 27%)
Company Name: Big Rivers Electric Corp.
Address: 201 3rd St., P.O. Box 24
Henderson, Kentucky 42419-0024
Monitor Manufacture: Spectrum Systems Model #: SP41
Date of Latest: CMS CERTIFICATION: 3/10/2000 CMS AUDIT: 12/09/21
Process Unit(s) Description: Green Station Unit 1 - Coal Fired Power Plant
Total Source Operating Time In Reporting Period? 32400 MINUTES

EMISSION DATA SUMMARY*

(MINUTES)

1. Duration of Excess Emission Report Period Due to:

A. Startup/Shutdown: 0
B. Control Equipment Problems: 0
C. Process Problems: 0
D. Other Known Causes: 0
E. Unknown Causes: 0

2. Total Duration of Excess Emission: 0

3. (Total Duration of Excess Emissions)
(Total Source Operating Time) X 100 = 0.00%

CMS PERFORMANCE SUMMARY*

(MINUTES)

1. CMS Downtime in Reporting Due to:

A. Monitor Equipment Malfunctions: 0
B. Non-Monitor Equipment Malf: 0
C. Quality Assurance Calibration: 198
D. Other Known Causes: 0
E. Unknown Causes: 0

2. Total CMS Downtime: 198

3. (Total CMS downtime)
(Total Source Time) X 100 = 0.61%

Describe any changes which have occurred since the last quarterly submittal concerning CMS, PROCESS, or CONTROL: G-1 stopped operating on coal as of 4/4/22 and began operating on natural gas as of 5/26/22.

I CERTIFY THAT THE INFORMATION CONTAINED IN THIS REPORT IS TRUE, ACCURATE, AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

NAME: Heather Todd

TITLE: Plant Manager

SIGNATURE: Heather Todd

DATE: 7-29-22



EXCESS OPACITY EMISSIONS REPORT
GREEN STATION 1 1st QUARTER 2022

Date	Time	Reading	Code	Comments
				No Opacity Exceedances

VIA E-MAIL: Melissa.duff@ky.gov

December 28, 2018

Ms. Melissa Duff, Director
Kentucky Division for Air Quality
300 Sower Boulevard, 2nd Floor
Frankfort, Kentucky 40601

Re: Henderson Station II Generating Station Title V Permit; Source I.D. #21-233-00001; Permit #V-11-003 R1; Agency Interest #4196

Dear Ms. Duff:

Henderson Municipal Power & Light (HMP&L) currently owns Henderson Station II, which is located in Henderson County, Kentucky and regulated under Title V permit #V-11-003 R1. The Title V permit was issued by the Kentucky Division for Air Quality on September 28, 2011 and last revised June 15, 2015.

Henderson Station II is scheduled to be retired effective February 1, 2019. The ownership of the station after January 31, 2019 is in dispute. Nevertheless, both parties intend to cease operations at the plant. The conditions of the Title V permit related to Emission Unit 02 (referred to as Henderson Station Unit 1) and Emission Unit 03 (referred to as Henderson Station Unit 2) will no longer be applicable upon the retirement of this electric generating station. This includes all secondary emission units within the Title V permit (i.e. Emission Unit 4-Coal Handling Operation, Emission Unit 5-Cooling Towers, and Emission Unit 07-08 Emergency Generator and Fire Pump).

Sincerely,



Chris Heimgartner
General Manager
Henderson Municipal Power & Light



Bob Berry
CEO
Big Rivers Electric Cooperative

cc: Mac Cann, KDAQ-Owensboro (mac.cann@ky.gov)
Rick Shewekah, KDAQ-Frankfort (rick.shewekah@ky.gov)
Michael Kennedy, KDAQ-Frankfort (michael.kennedy@ky.gov)
Ken Brooks, HMP&L (kbrooks@hmpl.net)
Mike Pullen, BREC (mike.pullen@bigrivers.com)

**Commonwealth of Kentucky
Energy and Environment Cabinet
Department for Environmental Protection
Division for Air Quality
300 Sower Boulevard, 2nd Floor
Frankfort, Kentucky 40601
(502) 564-3999**

Final

**AIR QUALITY PERMIT
Issued under 401 KAR 52:020**

Permittee Name: Big Rivers Electric Corporation
Mailing Address: P.O. Box 24, Henderson, KY 42419

Source Name: Big Rivers Electric Corp – R.D. Green Station
Mailing Address: 9000 KY 2096, Robards, KY 42452

Source Location: Same as Above

Permit: V-19-020 R2
Agency Interest: 44411
Activity: APE20210001
Review Type: Title V/Synthetic Minor, Construction/Operating
Source ID: 21-233-00052

Regional Office: Owensboro Regional Office
3032 Alvey Park Dr. W., Suite 700
Owensboro, KY 42303
(270) 687-7304

County: Webster

Application
Complete Date: February 23, 2012
Issuance Date: July 12, 2020
Revision Date: January 17, 2022
Expiration Date: July 12, 2025

Rick Shewekah

For **Melissa Duff, Director**
Division for Air Quality

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Permit Type	Activity #	Complete Date	Issuance Date	Summary of Action
V-19-020 Permit Renewal	APE20110001	02/23/2012	7/12/2020	Title V, Acid Rain, CAIR Renewal
	APE20130002	12/13/2013		Title V, Previously Unidentified Emission Points Added
	APE20180002	6/10/2019		Addition of Transfer Point not previously identified. Cooling tower update.
V-19-020 R1	APE20200001	9/17/2020	9/18/2020	Administrative Amendment
V-19-020 R2	APE20210001	8/11/2021	1/17/2022	Title V Significant Revision, Natural Gas conversion

SECTION A - PERMIT AUTHORIZATION

Pursuant to a duly submitted application the Kentucky Energy and Environment Cabinet (Cabinet) hereby authorizes the operation of the equipment described herein in accordance with the terms and conditions of this permit. This permit was issued under the provisions of Kentucky Revised Statutes (KRS) Chapter 224 and regulations promulgated pursuant thereto.

The permittee shall not construct, reconstruct, or modify any affected facilities without first submitting a complete application and receiving a permit for the planned activity from the permitting authority, except as provided in this permit or in 401 KAR 52:020, Title V Permits.

Issuance of this permit does not relieve the permittee from the responsibility of obtaining any other permits, licenses, or approvals required by the Cabinet or any other federal, state, or local agency.

The Division for Air Quality has determined that the Big Rivers Electric Corporation – Green Station and the Big Rivers Electric Corporation – Reid Station are one source as defined in 401 KAR 52:001 and Regulation 401 KAR 51:017, Prevention of Significant Deterioration of Air Quality. This permit contains requirements for both Big Rivers Electric Corporation – Green Station and Big Rivers Electric Corporation – Reid Station.

SECTION B - EMISSION POINTS, EMISSION UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS**Emissions Units 1 and 2: Identical Natural Gas-fired, Dry Bottom, Wall-fired Boilers****Description:**

Natural gas-fired

Construction Commenced: June 1976

Commercial Operation: December 1979 (EU 1) January 1981 (EU 2)

Fuel Conversion Project: September 2021

Monitoring Equipment: Continuous Emissions Monitoring (CEMS) Nitrogen Oxides (NO_x), Carbon Dioxide (CO₂)

Maximum Continuous Rating: 2,453 MMBtu/hour, each

APPLICABLE REGULATIONS:

401 KAR 51:160, *NO_x requirements for large utility and industrial boilers.*

401 KAR 51:210, *CAIR NO_x annual trading program.*

401 KAR 51:220, *CAIR NO_x ozone season trading program.*

401 KAR 51:230, *CAIR SO₂ trading program.*

401 KAR 51:240, *Cross-State Air Pollution Rule (CSAPR) NO_x annual trading program.*

401 KAR 51: 260, *Cross-State Air Pollution Rule (CSAPR) SO₂ group 1 trading program*

401 KAR 52:060, *Acid rain permits*

401 KAR 59:015, *New indirect heat exchangers*

401 KAR 60:005, Section 2(2)(a), 40 C.F.R. 60.40 through 60.46, **(Subpart D)**, *Standards of Performance for Fossil-Fuel-Fired Steam Generators*

401 KAR 63:002, Section 2(4)(iii), 40 C.F.R 63.7480 through 63.7575, Tables 1 to 13, **(Subpart DDDDD)**, *National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters*

40 CFR Part 75, *Continuous Emissions Monitoring (CEM)*

40 CFR 97, Subpart GGGGG, *CSAPR NO_x Ozone Season Group 3 Trading Program*

1. Operating Limitations:

- a. Once the Gas Conversion Project is completed or by September 1, 2022, whichever is sooner, Emission Units 1 and 2 shall no longer utilize coal, petroleum coke, or No. 2 fuel oil and shall only utilize natural gas as a fuel. [401 KAR 52:020, Section 10, to preclude 401 KAR 51:017]
- b. The permittee shall limit the fuel heat input to Emission Units 1 and 2 to no more than 40,410,722 MMBtu/yr on a 12 month rolling total basis. [401 KAR 52:020, Section 10, to preclude 401 KAR 51:017]

Compliance Demonstration: The permittee shall demonstrate compliance according to **4. Specific Monitoring Requirements d.** and **5. Specific Recordkeeping Requirements e.**

- c. The permittee shall meet the work practice standards established in 40 CFR Part 63, Table 3 to Subpart DDDDD, as established in 401 KAR 63:002, Section 2(4)(iii) [401 KAR 59:015, Section 7 and 401 KAR 59:015, Section 7(2)(a)].

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- d. At all times, the permittee shall operate and maintain any affected source (as defined in 40 CFR 63.7490), including associated air pollution control equipment and monitoring equipment, in a manner consistent with safety and good air pollution control practices for minimizing emissions. Determination of whether such operation and maintenance procedures are being used will be based on information available to the Administrator that may include, but is not limited to, monitoring results, review of operation and maintenance procedures, review of operation and maintenance records, and inspection of the source. [40 CFR 63.7500(a)(3)]
- e. The permittee shall meet the requirements in 40 CFR 63.7500(a)(1) through (3), except as provided in 40 CFR 63.7500(b) through (e). The permittee shall meet these requirements at all times the affected unit is operating, except as provided in 40 CFR 63.7500(f). The permittee shall meet each emission limit and work practice standard in 40 CFR 63, Subpart DDDDD Tables 1 through 3, and 11 through 13 that applies to the boiler or process heater, for each boiler or process heater at the source, except as provided under 40 CFR 63.7522. [40 CFR 63.7500(a) and (a)(1)]
- f. For an existing EGU that becomes subject after January 31, 2016, the permittee shall demonstrate compliance within 180 days after becoming an affected source [40 CFR 7510(i)]
- g. The permittee shall conduct a 5-year performance tune-up according to 40 CFR 63.7540(a)(12). Each 5-year tune-up specified in 40 CFR 63.7540(a)(12) shall be conducted no more than 61 months after the previous tune-up. [40 CFR 63.7515(d)]
- h. The permittee shall conduct a tune-up of the boiler every 5 years as specified in 40 CFR 63.7540(a)(10)(i) through (vi) to demonstrate continuous compliance. The permittee may delay the burner inspection specified in 40 CFR 63.7540(a)(10)(i) until the next scheduled or unscheduled unit shutdown, but shall inspect each burner at least once every 72 months. [40 CFR 63.7540(a)(12)]
 - i. As applicable, inspect the burner, and clean or replace any components of the burner as necessary (you may perform the burner inspection any time prior to the tune-up or delay the burner inspection until next scheduled unit shutdown). At units where entry into a piece of process equipment or into a storage vessel is required to complete the tune-up inspections, inspections are required only during planned entries into the storage vessel or process equipment [40 CFR 63.7540(a)(10)(i)];
 - ii. Inspect the flame pattern, as applicable, and adjust the burner as necessary to optimize the flame pattern. The adjustment should be consistent with the manufacturer's specifications, if available [40 CFR 63.7540(a)(10)(ii)];
 - iii. Inspect the system controlling the air-to-fuel ratio, as applicable, and ensure that it is correctly calibrated and functioning properly (you may delay the inspection until the next scheduled unit shutdown) [40 CFR 63.7540(a)(10)(iii)];

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- iv. Optimize total emissions of CO. This optimization should be consistent with the manufacturer's specifications, if available, and with any NO_x requirement to which the units are subject [40 CFR 63.7540(a)(10)(iv)];
- v. Measure the concentrations in the effluent stream of CO in parts per million, by volume, and oxygen in volume percent, before and after the adjustments are made (measurements may be either on a dry or wet basis, as long as it is the same basis before and after the adjustments are made). Measurements may be taken using a portable CO analyzer; and [40 CFR 63.7540(a)(10)(v)]
- vi. Maintain on-site and submit, if requested by the Administrator, a report containing the information in 40 CFR 63.7540(a)(10)(vi)(A) through (C) [40 CFR 63.7540(a)(10)(vi)],
 - 1. The concentrations of CO in the effluent stream in parts per million by volume, and oxygen in volume percent, measured at high fire or typical operating load, before and after the tune-up of the boiler or process heater [40 CFR 63.7540(a)(10)(vi)(A)];
 - 2. A description of any corrective actions taken as part of the tune-up; and [40 CFR 63.7540(a)(10)(vi)(B)]
 - 3. The type and amount of fuel used over the 12 months prior to the tune-up, but only if the unit was physically and legally capable of using more than one type of fuel during that period. Units sharing a fuel meter may estimate the fuel used by each unit [40 CFR 63.7540(a)(10)(vi)(C)].
- i. If the unit is not operating on the required date for a tune-up, the tune-up shall be conducted within 30 calendar days of startup. [40 CFR 63.7540(a)(13)]
- j. The permittee shall have a one-time energy assessment performed by a qualified energy assessor. An energy assessment completed on or after January 1, 2008, that meets or is amended to meet the energy assessment requirements in 40 CFR 63, Table 3, satisfies the energy assessment requirement. A facility that operated under an energy management program developed according to the ENERGY STAR guidelines for energy management or compatible with ISO 50001 for at least one year between January 1, 2008 and the compliance date specified in 40 CFR 63.7495 that includes the affected units also satisfies the energy assessment requirement. The energy assessment shall include the following with extent of the evaluation for 40 CFR 63, Table 3 4. a. through e. appropriate for the on-site technical hours listed in 40 CFR 63.7575 [40 CFR 63, Subpart DDDDD, Table 3 4.];
 - i. A visual inspection of the boiler or process heater system [40 CFR 63, Subpart DDDDD, Table 3 4. a.].
 - ii. An evaluation of operating characteristics of the boiler or process heater systems, specifications of energy using systems, operating, and maintenance procedures, and unusual operating constraints [40 CFR 63, Subpart DDDDD, Table 3 4. b.].

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- iii. An inventory of major energy use systems consuming energy from affected boilers and process heaters and which are under the control of the permittee [40 CFR 63, Subpart DDDDD, Table 3 4. c.].
- iv. A review of available architectural and engineering plans, facility operation, and maintenance procedures and logs, and fuel usage [40 CFR 63, Subpart DDDDD, Table 3 4. d.].
- v. A review of the facility energy management program and provide recommendations for improvements consistent with the definition of energy management program, if identified [40 CFR 63, Subpart DDDDD, Table 3 4. e.].
- vi. A list of cost-effective energy conservation measures that are within the facility's control [40 CFR 63, Subpart DDDDD, Table 3 4. f.].
- vii. A list of the energy savings potential of the energy conservation measures identified [40 CFR 63, Subpart DDDDD, Table 3 4. g.].
- viii. A comprehensive report detailing the ways to improve efficiency, the cost of specific improvements, benefits, and the time frame for recouping those investments [40 CFR 63, Subpart DDDDD, Table 3 4. h.].

2. Emission Limitations:

- a. Particulate matter (PM) emissions from each stack shall not exceed 0.10 lb/MMBtu actual heat input. [401 KAR 59:015, Section 4(1)(b)]
- b. Visible emissions from each stack shall not exceed 20% opacity, except: [401 KAR 59:015, Section 4(2)]
 - i. That a maximum of 27% opacity shall be allowed for one six-minute period in any 60 consecutive minutes. [401 KAR 59:015, Section 4(2)(a)]
 - ii. For emissions from an affected facility caused by building a new fire, emissions during the period required to bring the boiler up to operating conditions shall be allowed, if the method used is recommended by the manufacturer and the time does not exceed the manufacturer's recommendations. [401 KAR 59:015, Section 4(2)(c)]
- c. Sulfur Dioxide (SO₂) emissions from each stack shall not exceed 0.8 lb/MMBtu actual heat input. [401 KAR 59:015, Section 5(1)(b)1.]

Compliance Demonstration: The permittee is assumed to be in compliance with the applicable 401 KAR 59:015 PM, opacity, and SO₂ standards.

- d. Nitrogen oxides (NO_x) emissions from each stack shall not exceed 0.20 lb/MMBtu (86 ng/J). [40 CFR 60.44(a)(1)]

Compliance Demonstration: The permittee shall demonstrate compliance according to **3. Testing Requirements** a. and **4. Specific Monitoring Requirements** a.

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

e. See **Section D – Source Emission Limitations and Testing Requirements.**

3. Testing Requirements:

- a. In conducting the performance tests required in 40 CFR 60.8 and subsequent performance tests as requested by the EPA Administrator, the permittee shall use as reference methods and procedures the test methods in 40 CFR Part 60, Appendix A or other methods and procedures as specified in this section, except as provided in 40 CFR 60.8(b). Acceptable alternative methods and procedures are given in 40 CFR 60.46(d). The permittee shall determine compliance with the NO_x standard in 40 CFR 60.44 according to 40 CFR 60.46(b). [40 CFR 60.46(a) and (b)]
- b. Testing shall be conducted at such times as may be requested by the cabinet in accordance with 401 KAR 59:005, Section 2(2) and 401 KAR 50:045, Section 1.

4. Specific Monitoring Requirements:

- a. Continuous emission monitoring systems (CEMS) shall be installed, calibrated, maintained, and operated for, NO_x emissions and carbon dioxide (CO₂) emissions [40 CFR 60.45(a), 401 KAR 52:020, Section 10].
- b. Notwithstanding 40 CFR 60.13(b), installation of a CEMS for NO_x may be delayed until after the initial performance tests under 40 CFR 60.8 have been conducted. If the permittee demonstrates during the performance test that emissions of NO_x are less than 70 percent of the applicable standards in 40 CFR 60.44, a CEMS for measuring NO_x emissions is not required. If the initial performance test results show that NO_x emissions are greater than 70 percent of the applicable standard, the permittee shall install a CEMS for NO_x within one year after the date of the initial performance tests under 40 CFR 60.8 and comply with all other applicable monitoring requirements under 40 CFR Part 60. If the permittee is not required to and elects not to install any CEMS for NO_x, a CEMS for measuring either O₂ or CO₂ is not required. [40 CFR 60.45(b)(3) and (b)(4)]
- c. For performance evaluations under 40 CFR 60.13(c) and calibration checks under 40 CFR 60.13(d), the applicable procedures of 40 CFR 60.45(c) shall be used. For CEMS installed under 40 CFR 60.45(a), the conversion procedures of 40 CFR 60.45(e) shall be used to convert the continuous monitoring data into units of the applicable standards (ng/J, lb/MMBtu). The values used in the equations under 40 CFR 60.45(e)(1) and (2) are derived according to 40 CFR 60.45(f) [40 CFR 60.45(c), (e), and (f)]
- d. The permittee shall monitor the monthly and the 12 month rolling total fuel heat input (MMBtu) and natural gas usage (MMscf). [401 KAR 52:010, Section 10]

5. Specific Recordkeeping Requirements:

- a. The permittee shall keep records according to 40 CFR 63.7555(a)(1) and (2). [40 CFR 63.7555(a)]
 - i. A copy of each notification and report that was submitted to comply with 40 CFR 63, Subpart DDDDD, including all documentation supporting any Initial Notification of Compliance Status or semiannual compliance report submitted, according to the requirements in 40 CFR 63.10(b)(2)(xiv). [40 CFR 63.7555(a)(1)]

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- ii. Records of performance tests, fuel analyses, or other compliance demonstrations and performance evaluations as required in 40 CFR 63.10(b)(2)(viii). [40 CFR 63.7555(a)(2)]
- b. Records shall be in a form suitable and readily available for expeditious review, according to 40 CFR 63.10(b)(1). [40 CFR 63.7560(a)]
- c. As specified in 40 CFR 63.10(b)(1), the permittee shall keep each record for 5 years following the date of each occurrence, measurement, maintenance, corrective action, report, or record. [40 CFR 63.7560(b)]
- d. The permittee shall keep each record on site, or they shall be accessible from on site (for example, through a computer network), for at least 2 years after the date of each occurrence, measurement, maintenance, corrective action, report, or record, according to 40 CFR 63.10(b)(1). The permittee can keep the records off site for the remaining 3 years. [40 CFR 63.7560(c)]
- e. The permittee shall maintain records of the monthly and 12 month rolling total fuel heat input (MMBtu) and natural gas usage (MMscf). [401 KAR 52:020, Section 10]

6. Specific Reporting Requirements:

- a. Excess emission and monitoring system performance reports shall be submitted to the Administrator semiannually for each six-month period. Each excess emission and MSP report shall include the information required in 40 CFR 60.7(c). Periods of excess emissions and monitoring systems (MS) downtime that shall be reported are defined as follows: Excess emissions for affected facilities using a CEMS for measuring NO_x are defined as: [40 CFR 60.45(g) and (g)(3)]
 - i. For affected facilities electing not to comply with 40 CFR 60.44(e), any three-hour period during which the average emissions (arithmetic average of three contiguous one-hour periods) exceed the applicable standards in 40 CFR 60.44, or [40 CFR 60.45(g)(3)(i)]
 - ii. For affected facilities electing to comply with 40 CFR 60.44(e), any 30 operating day period during which the average emissions (arithmetic average of all one-hour periods) during the 30 operating days) of NO_x as measured by a CEMS exceed the applicable standard in 40 CFR 60.44. Facilities complying with the 30-day NO_x standard shall use the most current associated NO_x compliance and monitoring requirements in 40 CFR 60.48Da and 60.49Da. [40 CFR 60.45(g)(3)(ii)]
- b. The permittee shall submit to the Administrator all of the notifications in 40 CFR 63.7(b) and (c), 63.8(e), (f)(4) and (6), and 63.9(b) through (h) that apply by the dates specified. [40 CFR 63.7545(a)]
- c. As specified in 40 CFR 63.9(b)(2), for startup of an affected source before January 31, 2013, the permittee shall submit an Initial Notification not later than 120 days after January 31, 2013, or no later than 120 days after the source becomes subject to 40 CFR 63, Subpart DDDDD, whichever is later. [40 CFR 63.7545(b)]

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- d. The permittee shall submit a Notification of Compliance Status according to 40 CFR 63.9(h)(2)(ii). For the initial compliance demonstration for each boiler or process heater, the permittee shall submit the Notification of Compliance Status, including all performance test results and fuel analyses, before the close of business on the 60th day following the completion of all performance test and/or other initial compliance demonstrations for all boiler or process heaters at the facility according to 40 CFR 63.10(d)(2). The Notification of Compliance Status report shall contain all the information specified in 40 CFR 63.7545(e)(1) through (8), as applicable. If an initial compliance demonstration as specified in 40 CFR 63.7530(a) is not required, the Notification of Compliance Status shall only contain the information in 40 CFR 63.7545(e)(1) and (8) and shall be submitted within 60 days of the compliance date specified at 40 CFR 63.7495(b). [40 CFR 63.7545(e)]
 - i. A description of the affected unit(s) including identification of which subcategories the unit is in, the design heat input capacity of the unit, a description of the add-on controls used on the unit to comply with 40 CFR 63, Subpart DDDDD, description of the fuel(s) burned, including whether the fuel(s) were a secondary material determined by the permittee or EPA through a petition process to be non-waste under 40 CFR 241.3, whether the fuel(s) were a secondary material processed from discarded non-hazardous secondary materials within the meaning of 40 CFR 241.3, and justification for the selection of fuel(s) burned during the compliance demonstration. [40 CFR 63.7545(e)(1)]
 - ii. In addition to the information required in 40 CFR 63.9(h)(2), the notification of compliance status shall include the following certification(s) of compliance, as applicable, and signed by a responsible official: [40 CFR 63.7545(e)(8)]
 - 1. "This facility completed the required initial tune-up for all the boilers and process heaters covered by 40 CFR Part 63 Subpart DDDDD at this site according to the procedures in 40 CFR 63.7540(a)(10)(i) through (vi)." [40 CFR 63.7545(e)(8)(i)]
 - 2. "This facility has had an energy assessment performed according to 40 CFR 63.7530(e)." [40 CFR 63.7545(e)(8)(ii)]
- e. The permittee shall submit each report in 40 CFR 63, Subpart DDDDD, Table 9 that applies. [40 CFR 63.7550(a)]
- f. Unless the EPA Administrator has approved a different schedule for submission of reports under 40 CFR 63.10(a), the permittee shall submit each report, according to 40 CFR 63.7550(h), by the date in 40 CFR 63, Subpart DDDDD, Table 9 and according to the requirements in 40 CFR 63.7550(b)(1) through (4). For units that are subject only to a requirement to conduct subsequent annual, biennial, or 5-year tune-up according to 40 CFR 63.7540(a)(10), (11), or (12), respectively, and not subject to emission limits or 40 CFR 63, Subpart DDDDD, Table 4 operating limits, the permittee may submit only annual, biennial, or 5-year compliance report, as applicable, as specified in 40 CFR 63.7550(b)(1) through (4), instead of a semi-annual compliance report. For each affected source that is subject to permitting regulations pursuant to 40 CFR Part 70 or Part 71, and if the permitting authority has established dates for submitting semiannual reports pursuant to 40 CFR 70.6(a)(3)(iii)(A) or 71.6(a)(3)(iii)(A), the permittee may submit the

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

first and subsequent compliance reports according to the dates the permitting authority has established in the permit instead of according to the dates in 40 CFR 63.7550(b)(1) through (4). [40 CFR 63.7550(b) and (b)(5)]

- g. A compliance report shall contain the following information depending on how the facility chooses to comply with the limits set in this rule. If the facility is subject to the requirements of a tune up, the permittee shall submit a compliance report with the information in 40 CFR 63.7550(c)(5)(i) through (iii), (xiv), and (xvii). [40 CFR 63.7550(c) and (c)(1)]
 - i. Company and Facility name and address. [40 CFR 63.7550(c)(5)(i)]
 - ii. Process unit information, emissions limitations, and operating parameter limitations. [40 CFR 63.7550(c)(5)(ii)]
 - iii. Date of report and beginning and ending dates of the reporting period. [40 CFR 63.7550(c)(5)(iii)]
 - iv. Include the date of the most recent tune-up for each unit subject to only the requirement to conduct an annual, biennial, or 5-year tune-up according to 40 CFR 63.7540(a)(10), (11), or (12) respectively. Include the date of the most recent burner inspection if it was not done annually, biennially, or on a 5-year period and was delayed until the next scheduled or unscheduled unit shutdown. [40 CFR 63.7550(c)(5)(xiv)]
 - v. Statement by a responsible official with that official's name, title, and signature, certifying the truth, accuracy, and completeness of the content of the report. [40 CFR 63.7550(c)(5)(xvii)]
- h. The permittee shall submit the reports according to the procedures specified in 40 CFR 63.7550(h)(1) through (3). The permittee shall submit all reports required by 40 CFR 63, Subpart DDDDD, Table 9 electronically to the EPA via the CEDRI. (CEDRI can be accessed through the EPA's CDX.) The permittee shall use the appropriate electronic report in CEDRI for 40 CFR 63, Subpart DDDDD. Instead of using the electronic report in CEDRI for 40 CFR 63, Subpart DDDDD, the permittee may submit an alternate electronic file consistent with the XML schema listed on the CEDRI Web site (<http://www.epa.gov/ttn/chief/cedri/index.html>) , once the XML schema is available. If the reporting form specific to 40 CFR 63, Subpart DDDDD is not available in CEDRI at the time that the report is due, the permittee shall submit the report to the Administrator at the appropriate address listed in 40 CFR 63.13. The permittee shall begin submitting reports via CEDRI no later than 90 days after the form becomes available in CEDRI. [40 CFR 63.7550(h) and (h)(3)]
- i. See **Section F – Monitoring, Recordkeeping, and Reporting Requirements.**

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

Emission Unit 03: Coal and Pet Coke Hauling and Storage Operations

Description:

Emission Unit	Description	Maximum Rated Capacity	Controls	Commenced Construction
EU03(1)	Coal and Pet Coke Storage Piles	800 tons/hr	Wet Material, Compaction, Telescopic Chute	1975
EU03(2)	Haul Trucks on Unpaved Roads to Stockpiles	400 tons/hr	Wet Material, Water Suppression	1975
EU03(3)	Haul Trucks on Paved Road to Coal Pile or Receiving Hoppers (Coal)	400 tons/hr	Wet Material, Water Suppression	1975

APPLICABLE REGULATIONS:

401 KAR 63:010, Fugitive Emissions

40 CFR 52.21, (a) through (i) and (s) through (w), Prevention of Significant Deterioration of Air Quality applicable to major construction or modification commenced before August 7, 1979

1. Operating Limitations:

- a) Reasonable precautions shall be taken to prevent particulate matter from becoming airborne. Such reasonable precautions shall include, when applicable, but not be limited to the following [401 KAR 63:010, Section 3]:
 - i) Use, where possible, of water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land [401 KAR 63:010, Section 3(a)];
 - ii) Application and maintenance of asphalt, water, or suitable chemicals on roads, material stockpiles, and other surfaces, which can create airborne dusts [401 KAR 63:010, Section 3(1)(b)];
 - iii) Covering, at all times when in motion, open bodied trucks transporting materials likely to become airborne [401 KAR 63:010, Section 3(1)(d)];
 - iv) The maintenance of paved roadways in a clean condition [401 KAR 63:010, Section 3(1)(e)]; and
 - v) The prompt removal of earth or other material from a paved street which earth or other material has been transported thereto by trucking or earth moving equipment or erosion by water [401 KAR 63:010, Section 3(1)(f)].
- b) Additional Requirements, in addition to the requirements of Section 3 of this regulation, the following shall apply [401 KAR 63:010, Section 4]:
 - i) Open bodied trucks, operating outside company property, transporting materials likely to become airborne shall be covered at all times when in motion [401 KAR 63:010, Section 4(1)];
 - ii) The provisions of 401 KAR 63:010, Section 3(1) and (2) shall not be applicable to temporary blasting or construction operations [401 KAR 63:010, Section 4(3)]; and
 - iii) No one shall allow earth or other material being transported by truck or earth moving equipment to be deposited onto a paved street or roadway [401 KAR 63:010, Section 4(4)].

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- c) Once the Gas Conversion Project is completed or by September 1, 2022, whichever is sooner, Emission Unit 03 shall cease operation. [401 KAR 52:020, Section 10, to preclude 401 KAR 51:017]

2. Emission Limitations:

Discharge of visible fugitive dust emissions beyond the property line is prohibited [401 KAR 63:010, Section 3(2)].

Compliance Demonstration: See 4. **Specific Monitoring Requirements: (b).**

3. Testing Requirements:

N/A

4. Specific Monitoring Requirements:

- a) The permittee shall monitor the amount of coal and pet coke received and processed in tons on a weekly basis [401 KAR 52:020, Section 10].
- b) Visual observations shall be made on a daily basis during operation, to ensure that the fugitive air emissions are not being generated in such a manner as to cause a nuisance or to cross the property line. If such a condition develops, water or another wetting agent shall be applied to suppress the fugitive air emissions so as to comply with applicable requirements of 401 KAR 63:010 [401 KAR 52:020, Section 10].

5. Specific Recordkeeping Requirements:

- a) The permittee shall maintain the records of amount of coal and pet coke received and processed in tons on a weekly basis [401 KAR 52:020, Section 10].
- b) The permittee shall maintain records of the daily visual observations performed and, if applicable, records of when water or other wetting agents were used to suppress fugitive emissions as noted in 4. **Specific Monitoring Requirements: (b)** [401 KAR 52:020, Section 10].

6. Specific Reporting Requirements:

See **Section F - Monitoring, Recordkeeping, and Reporting Requirements** for further requirements.

7. Specific Control Equipment Operating Conditions:

- a) Water suppression and compaction shall be operated to maintain compliance with applicable requirements, consistent with manufacturer's specifications and standard operating practices [401 KAR 50:055].
- b) See **Section E – Source Control Equipment Requirements** for additional requirements.

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

Emission Unit 04A: Coal and Pet Coke Crushing and Processing Equipment

Description:

Emission Unit	Description	Maximum Rated Capacity	Controls	Commenced Construction
EU04(1)	Receiving Hoppers (Coal) from Haul Trucks to Underground A1 Conveyor	400 tons/hr	Wet Material, Partial Enclosure	1975
EU04(2)	Coal Conveyor & Transfer Points (30" x 350')(A1 Conveyor)(From A1 to A Conveyors)	400 tons/hr	Partial Enclosure	1975
EU04(4)	Coal and Pet Coke from Green Barge Unloading	1,500 tons/hr	Baghouse	1975
EU04(5)	Coal and Pet Coke from Green Barge Transfer onto B1 Conveyors	1,500 tons/hr	Baghouse (Share with EU04 (4))	1975
EU04(6)	Coal and Pet Coke Conveyor & Transfer Points (54" x 542') (B1 Conveyor)	1,500 tons/hr	Bin Vent Filters	1975
EU04(8)	Coal/Pet Coke Conveyor & Transfer Points (2 at 30" x 1686')(1C & 2C Conveyors) (From 1C & 2C to Crusher)	800 tons/hr	Wet Material, Partial Enclosure	1975
EU04(9)	Crusher House Feeders (400 tons/hr per Crusher)	800 tons/hr	Wet Material, Complete Enclosure	1975
EU04(10)	Coal/Pet Coke Conveyor & Transfer Points (Crusher House)(From Crusher House to 2D Conveyor)	400 tons/hr	Bin Vent Filters	1975
EU04(11)	Coal/Pet Coke Conveyor & Transfer Points (Crusher House)(From Crusher House to 1D Conveyor)	400 tons/hr	Bin Vent Filters	1975
EU04(12)	Coal/Pet Coke Conveyor & Transfer Points (2 at 30" x 1014')(1D & 2D Conveyors)(From 1D & 2D Conveyors to Tripper Room)	800 tons/hr	Baghouse	1975
EU04(16)	Coal Conveyor & Transfer Points (42" x 843')(Stack-Out Conveyor)(From Stack-Out Conveyor to Radial Stacker)	400 tons/hr	Wet Material, Partial Enclosures	2000

Applicable Regulations:

401 KAR 59:010, New Process Operations

401 KAR 60:005, Section 2(2)(gg), 40 C.F.R. 60.250 to 60.258, (**Subpart Y**), *Standards of Performance for Coal Preparation Plants*.

40 CFR 52.21, (a) through (i) and (s) through (w), Prevention of Significant Deterioration of Air Quality applicable to major construction or modification commenced before August 7, 1979

1. Operating Limitations:

Once the Gas Conversion Project is completed or by September 1, 2022, whichever is sooner, Emission Unit 04A shall cease operation. [401 KAR 52:020, Section 10, to preclude 401 KAR 51:017]

2. Emission Limitations:

a) Particulate matter emissions into the open air from shall not exceed:

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- i) $[3.59(P)^{0.62}]$ lbs/hr, where P is the processing rate in tons per hour, for $P < 30$ tons/hr [401 KAR 59:010, Section 3(2)].
- ii) $[17.31(P)^{0.16}]$ lbs/hr, where P is the processing rate in tons per hour, for $P > 30$ tons/hr [401 KAR 59:010, Section 3(2)].

Compliance Demonstration: These units are assumed to be in compliance with the particulate emission limit based on the AP-42 particulate matter emission factor.

- b) Visible emissions shall not equal or exceed twenty 20% based on a six-minute average [401 KAR 59:010, Section 3(1)(a)].

Compliance Demonstration: See 4. Specific Monitoring Requirements: (b).

- c) On and after the date on which the performance test is conducted or required to be completed under 40 CFR 60.8, whichever date comes first, the permittee shall not cause to be discharged into the atmosphere from any coal processing and conveying equipment, coal storage system, or coal transfer and loading system processing coal constructed, reconstructed, or modified on or before April 28, 2008, gases which exhibit 20% opacity or greater [40 CFR 60.254(a)].

Compliance Demonstration: See 3. Testing Requirements: (b) and 4. Specific Monitoring Requirements: (b).

3. Testing Requirements:

- a) Testing shall be conducted at such times as may be requested by the cabinet in accordance with 401 KAR 59:005, Section 2(2) and 401 KAR 50:045, Section 4.
- b) The permittee shall conduct opacity testing according to 40 CFR 60.257(a) by performing a U.S. EPA Reference Method 9 of Appendix A-4 of 40 CFR part 60, and shall follow the procedures as described in 40 CFR 60.11 when visible emissions are observed [40 CFR 60.257(a)].

4. Specific Monitoring Requirements:

- a) The permittee shall monitor the amount of coal and pet coke received and processed in tons on a weekly basis [401 KAR 52:020, Section 10].
- b) The permittee shall perform a qualitative visible observation of the opacity from stacks on a daily basis and maintain a log of the observation. If visible emission from a stack are seen, then the opacity shall be determined by U.S. EPA Reference Method 9 and the permittee shall initiate an inspection of the control equipment for any necessary repairs. [401 KAR 52:020, Section 10]

5. Specific Recordkeeping Requirements:

- a) The permittee shall monitor the amount of coal and pet coke received and processed in tons on a weekly basis [401 KAR 52:020, Section 10].
- b) The permittee shall record and maintain a log of any U.S. EPA Reference Method 9 opacity observations made recording the date, time, and opacity reading. The permittee shall also document inspections and any repairs made [401 KAR 52:020, Section 10].

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

6. Specific Reporting Requirements:

See **Section F - Monitoring, Recordkeeping, and Reporting Requirements** for further requirements.

7. Specific Control Equipment Operating Conditions:

- a) The enclosure and baghouse at Green Station barge unloading, bin vent filters on the B1 Conveyor transfer point, enclosure on the Crusher House, bin vent filters on the crusher house to 2D conveyor transfer point, bin vent filters on the crusher house to 1D conveyor transfer point, baghouse on the tripper room and conveyor transfer points shall be operated to maintain compliance with permitted emission limitations, consistent with manufacturer's specifications and standard operating practices [401 KAR 50:055].
- b) Records regarding the maintenance of the control equipment shall be maintained [401 KAR 52:020 Section 10].
- c) See **Section E – Source Control Equipment Requirement**

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

Emission Unit 04B: Coal and Pet Coke Crushing and Processing Equipment

Description:

Emission Unit	Description	Maximum Rated Capacity	Controls	Commenced Construction
EU04(3)	Coal Conveyor & Transfer Points (30" x 350")(A Conveyor)(From A Conveyor to Coal Stockpile)	400 tons/hr	Wet Material, Telescopic Chute	1975
EU04(7)	Coal / Pet Coke Conveyor & Transfer Point (54" x 1078")(B2 Conveyor)(From B2 Conveyor to Coal/Pet Coke Pile)	1,500 tons/hr	Wet Material, Telescopic Chute	1975
EU04(13)	Coal from Reid Barge Unloader	800 tons/hr	Partial Enclosure & Wet Material	1963
EU04(14)	Coal Conveyor & Transfer Points (Barge Unloader)(From Unloader to #1 River Conveyor)	800 tons/hr	Partial Enclosure & Wet Material	1963
EU04(15)	Coal Conveyor & Transfer Points (42" x 1318')(Transfer House)(From #1 River to Stack-Out Conveyors)	800 tons/hr	Wet Material, Partial Enclosure	1963
EU04(17)	Coal Conveyor & Transfer Points (36" x 400')(Radial Stacker)(From Radial Stacker to Coal Pile)	400 tons/hr	Wet Material	2000

Applicable Regulations:

401 KAR 63:010, Fugitive Emissions

40 CFR 52.21, (a) through (i) and (s) through (w), Prevention of Significant Deterioration of Air Quality applicable to major construction or modification commenced before August 7, 1979

1. Operating Limitations:

- a) Reasonable precautions shall be taken to prevent particulate matter from becoming airborne. Such reasonable precautions shall include, when applicable, but not be limited to the following [401 KAR 63:010, Section 3(1)]:
 - i) Installation and use of hoods, fans, and enclosures to vent the handling of dusty materials, or the use of water sprays or other measures to suppress the dust emissions during handling; and/or
 - ii) Application and maintenance of asphalt, oil, water, or suitable chemicals on roads, materials stockpiles, and other surfaces, which can create airborne dusts.
- b) Once the Gas Conversion Project is completed or by September 1, 2022, whichever is sooner, Emission Unit 04B shall cease operation. [401 KAR 52:020, Section 10, to preclude 401 KAR 51:017]

2. Emission Limitations:

No person shall cause or permit the discharge of visible fugitive dust emissions beyond the lot line of the property on which the emissions originate [401 KAR 63:010, Section 3(2)].

Compliance Demonstration: See **4. Specific Monitoring Requirements: (b).**

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

3. Testing Requirements:

N/A

4. Specific Monitoring Requirements:

- a) The permittee shall monitor the amount of coal and pet coke received and processed in tons on a weekly basis [401 KAR 52:020, Section 10].
- b) Visual observations shall be made on a daily basis during operation, to ensure that the fugitive air emissions are not being generated in such a manner as to cause a nuisance or to cross the property line. If such a condition develops, water or another wetting agent shall be applied to suppress the fugitive air emissions so as to comply with applicable requirements of 401 KAR 63:010. [401 KAR 52:020, Section 10]

5. Specific Recordkeeping Requirements:

- a) The permittee shall keep records of the amount of coal and pet coke received and processed in tons on a weekly basis [401 KAR 52:020, Section 10].
- b) The permittee shall maintain records of the daily visual observations and, if applicable, records of when water or other wetting agents were used to suppress fugitive emissions as noted in 4. **Specific Monitoring Requirements: (b)** [401 KAR 52:020, Section 10].

6. Specific Reporting Requirements:

See Section F – Monitoring Recordkeeping and Reporting Requirements.

7. Specific Control Equipment Operating Conditions:

- a) The partial enclosures on the conveyor transfer points, wetting, and telescopic chutes shall be operated to maintain compliance with permitted emission limitations, consistent with manufacturer's specifications and standard operating practices [401 KAR 50:055].
- b) See Section E-Source Control Equipment Requirements.

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

Emission Unit 05: Lime Conveying and Storage Operations

Description:

Emission Unit	Description	Maximum Rated Capacity	Controls	Commenced Construction
EU05(1)	Lime Conveyor & Transfer Points (30" x 2450')(L1 Conveyor)(From L1 Conveyor to Lime Tower)	400 tons/hr	Baghouse	1975
EU05(2)	Lime Silos (Four (4) Silos with East & West Screw Conveyors)	400 tons/hr	Baghouse	1975
EU05(3)	Lime From Green Barge Unloading	400 tons/hr	Baghouse	1975
EU05(4)	Lime from Green Barge Unloading Transfer onto L1 Conveyor	400 tons/hr	Baghouse	1975

APPLICABLE REGULATIONS:

401 KAR 59:010, New Process Operations

40 CFR 52.21, (a) through (i) and (s) through (w), Prevention of Significant Deterioration of Air Quality applicable to major construction or modification commenced before August 7, 1979

1. Operating Limitations:

Once the Gas Conversion Project is completed or by September 1, 2022, whichever is sooner, Emission Unit 05 shall cease operation. [401 KAR 52:020, Section 10, to preclude 401 KAR 51:017]

2. Emission Limitations:

a) Particulate matter emissions into the open air from shall not exceed:

- i) $[3.59(P)^{0.62}]$ lbs/hr, where P is the processing rate in tons per hour, for $P < 30$ tons/hr [401 KAR 59:010, Section 3(2)].
- ii) $[17.31(P)^{0.16}]$ lbs/hr, where P is the processing rate in tons per hour, for $P > 30$ tons/hr [401 KAR 59:010, Section 3(2)].

Compliance Demonstration: These units are assumed to be in compliance with the particulate emission limit based on the AP-42 particulate matter emission factor and the proper operation of the baghouse and dust collectors.

b) Visible emissions shall not equal or exceed twenty 20% based on a six-minute average [401 KAR 59:010, Section 3(1)(a)].

Compliance Demonstration: See 4. **Specific Monitoring Requirements:** (a).

3. Testing Requirements:

N/A

4. Specific Monitoring Requirements:

a) The permittee shall perform a qualitative visual observation of the opacity from each stack on a daily basis and maintain a log of the observations. If visible emissions from any stack are seen, the permittee shall determine the opacity by U.S. EPA Reference Method 9 and the permittee shall initiate an inspection of the control equipment for any necessary repairs. [401 KAR 52:020, Section 10]

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- b) The permittee shall monitor the amount of lime received and conveyed on a weekly basis [401 KAR 52:020, Section 10].

5. Specific Recordkeeping Requirements:

- a) The permittee shall keep records of the amount of lime received and conveyed on a weekly basis [401 KAR 52:020, Section 10].
- b) The permittee shall record and maintain a log of U.S. EPA Reference Method 9 opacity observations made recording the date, time, and opacity reading. The permittee shall also document inspections and any repairs made. [401 KAR 52:020, Section 10]

6. Specific Reporting Requirements:

See **Section F - Monitoring, Recordkeeping, and Reporting Requirements** for further requirements.

7. Specific Control Equipment Operating Conditions:

- a) The baghouses and dust collectors at storage silos and conveyor transfer points shall be operated to maintain compliance with applicable requirements, consistent with manufacturer's specifications and standard operating practices [401 KAR 50:055].
- b) Records regarding the maintenance of the control equipment shall be maintained [401 KAR 52:020 Section 10].
- c) See **Section E - Source Control Equipment Requirements**.

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)**Emission Unit 06: Lime Handling and Processing Operations****Description:**

Emission Unit	Description	Maximum Rated Capacity	Controls	Commenced Construction
EU06	Lime Slurry Slaker System	400 tons/hr	Enclosed	1975

APPLICABLE REGULATIONS:**401 KAR 63:010, Fugitive Emissions**

40 CFR 52.21, (a) through (i) and (s) through (w), Prevention of Significant Deterioration of Air Quality applicable to major construction or modification commenced before August 7, 1979

1. Operating Limitations:

- a) Reasonable precautions shall be taken to prevent particulate matter from becoming airborne. Such reasonable precautions shall include, when applicable, but not be limited to the installation and use of hoods, fans, and enclosure to enclose and vent the handling of dusty materials, or the use of water sprays or other measures to suppress the dust emissions during handling [401 KAR 63:010, Section 3(1)(c)].
- b) Once the Gas Conversion Project is completed or by September 1, 2022, whichever is sooner, Emission Unit 06 shall cease operation. [401 KAR 52:020, Section 10, to preclude 401 KAR 51:017]

2. Emission Limitations:

- a) No person shall cause or permit the discharge of visible fugitive dust emissions beyond the property line on which the emissions originate [401 KAR 63:010, Section 3(2)].
- b) When dust, fumes, gases, mist, odorous matter, vapors, or any combination thereof escape from a building or equipment in such a manner and amount as to cause a nuisance or to violate any administrative regulation, the Secretary may order that the building or equipment in which processing, handling and storage are done be tightly closed and ventilated in such a way that all air and gases and air or gasborne material leaving the building or equipment are treated by removal or destruction of air contaminants before discharge to the open air [401 KAR 63:010, Section 3(3)].

Compliance Demonstration: See 4. **Specific Monitoring Requirements.**

3. Testing Requirements:

N/A

4. Specific Monitoring Requirements:

Visual observations shall be made on a daily basis each day of operation, to ensure the control equipment is functioning while the associated equipment is in operation and to determine if any fugitive air emissions are being generated in such a manner as to cause a nuisance or to cross the property line. If such a condition develops, water or another wetting agent shall be applied to suppress the fugitive air emissions so as to comply with applicable requirements of 401 KAR 63:010 [401 KAR 52:020, Section 10].

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

5. Specific Recordkeeping Requirements:

The permittee shall maintain records of the daily visual observations and, if applicable, records of when water or other wetting agents were used to suppress fugitive emissions as noted in **4. Specific Monitoring Requirements: (b)** [401 KAR 52:020, Section 10].

6. Specific Reporting Requirements:

See **Sections F – Monitoring Recordkeeping and Reporting Requirements.**

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

Emission Unit 07A: Ash and Sludge Handling Operations

Description:

Emission Unit	Description	Maximum Rated Capacity	Controls	Commenced Construction
EU07(1)	Ash Truck Loadout Stations	200 tons/hr	N/A	1975
EU07(4)	Sludge Conveyor	250 tons/hr	Inherent Moisture	1975
EU07(5)	Sludge Stockpile	250 tons/hr	Inherent Moisture	1975
EU07(6)	Sludge Truck Loadout	250 tons/hr	Inherent Moisture	1975
EU07(7)	Paved Haul Road	250 tons/hr	Chemical/Water Suppression	1975
EU07(8)	Unpaved Haul Road	250 tons/hr	Chemical/Water Water Suppression	1975
EU07(9)	Truck Dumping of Sludge to Landfill	250 tons/hr	Inherent Moisture	1975
EU07(10)	Landfill	250 tons/hr	Inherent Moisture	1975

APPLICABLE REGULATIONS:

401 KAR 63:010, Fugitive Emissions

40 CFR 52.21, (a) through (i) and (s) through (w), Prevention of Significant Deterioration of Air Quality applicable to major construction or modification commenced before August 7, 1979

1. Operating Limitations:

- a) Reasonable precautions shall be taken to prevent particulate matter from becoming airborne. Such reasonable precautions shall include, when applicable, but not be limited to the following:
 - i) Application and maintenance of asphalt, water, or suitable chemicals on roads, material stockpiles, and other surfaces, which can create airborne dusts 401 KAR 63:010, Section 3(1)(b)];
 - ii) The maintenance of paved roadways in a clean condition [401 KAR 63:010, Section 3(1)(e)]; and
 - iii) The prompt removal of earth or other material from a paved street which earth or other material has been transported thereto by trucking or earth moving equipment or erosion by water [401 KAR 63:010, Section 3(1)(f)]
- b) Once the Gas Conversion Project is completed or by September 1, 2022, whichever is sooner, Emission Units 07(1), 07(4), 07(5), and 07(6) shall cease operation. [401 KAR 52:020, Section 10, to preclude 401 KAR 51:017]

2. Emission Limitations:

Discharge of visible fugitive dust emissions beyond the property line is prohibited [401 KAR 63:010, Section 3].

Compliance Demonstration: See 4. **Specific Monitoring Requirements:** (b).

3. Testing Requirements:

N/A

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

4. Specific Monitoring Requirements:

- a) The permittee shall monitor the amount of fly ash and sludge processed on a weekly basis [401 KAR 52:020, Section 10].
- b) Visual observations shall be made on a daily basis during operations, to ensure that the fugitive air emissions are not being generated in such a manner as to cause a nuisance or to cross the property line. If such a condition develops, water or another wetting agent shall be applied to suppress the fugitive air emissions so as to comply with applicable requirements of 401 KAR 63:010. [401 KAR 52:020, Section 10]

5. Specific Recordkeeping Requirements:

- a) The permittee shall maintain the records of the amount of flyash and sludge on a weekly basis [401 KAR 52:020, Section 10].
- b) The permittee shall maintain records of the daily visual observations and, if applicable, records of when water or other wetting agents were used to suppress fugitive emissions as noted in 4. **Specific Monitoring Requirements: (b)** [401 KAR 52:020, Section 10].

6. Specific Reporting Requirements:

See **Section F - Monitoring, Recordkeeping, and Reporting Requirements** for further requirements.

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)**Emission Unit 07B: Ash and Sludge Handling Operations****Description:**

Emission Unit	Description	Maximum Rated Capacity	Controls	Commenced Construction
EU07(2)	Pug Mills	200 tons/hr	Baghouse	1975
EU07(3)	Fly Ash Silos	200 tons/hr	Baghouse	1975

APPLICABLE REGULATIONS:**401 KAR 59:010**, New Process Operations**40 CFR 52.21, (a) through (i) and (s) through (w)**, Prevention of Significant Deterioration of Air Quality applicable to major construction or modification commenced before August 7, 1979**1. Operating Limitations:**

Once the Gas Conversion Project is completed or by September 1, 2022, whichever is sooner, Emission Unit 07B shall cease operation. [401 KAR 52:020, Section 10, to preclude 401 KAR 51:017]

2. Emission Limitations:

a) Particulate matter emissions into the open air from shall not exceed:

- i) $[3.59(P)0.62]$ lbs/hr, where P is the processing rate in tons per hour, for $P < 30$ tons/hr [401 KAR 59:010, Section 3(2)].
- ii) $[17.31(P)0.16]$ lbs/hr, where P is the processing rate in tons per hour, for $P > 30$ tons/hr [401 KAR 59:010, Section 3(2)].

Compliance Demonstration: These units are assumed to be in compliance with the particulate emission limit based on the AP-42 particulate matter emission factor and the proper operation of the baghouse and dust collectors.

b) Visible emissions shall not equal or exceed 20% opacity based on a six minute average [401 KAR 59:010, Section 3(1)(a)].

Compliance Demonstration: See 4. **Specific Monitoring Requirements: (b).**

3. Testing Requirements:

Testing shall be conducted at such times as may be requested by the cabinet in accordance with 401 KAR 59:005, Section 2(2) and 401 KAR 50:045, Section 4.

4. Specific Monitoring Requirements:

- a) The permittee shall monitor the amount of fly ash and sludge processed on a weekly basis [401 KAR 52:020, Section 10].
- b) The permittee shall perform a qualitative visual observation of the opacity from the pug mill stack and slurry storage silo stacks on a daily basis and maintain a log of the observations. If visible emissions from any stack are seen, the permittee shall determine the opacity by U.S. EPA Reference Method 9 and the permittee shall initiate an inspection of the control equipment for any necessary repairs [401 KAR 52:020, Section 10].

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

5. Specific Recordkeeping Requirements:

- a) The permittee shall maintain the records of amount of fly ash and sludge processed on a weekly basis [401 KAR 52:020, Section 10].
- b) The permittee shall record and maintain a log of any U.S. EPA Reference Method 9 opacity observations made recording the date, time, and opacity reading. The permittee shall also document inspections and any repairs made [401 KAR 52:020, Section 10].

6. Specific Reporting Requirements:

See **Section F - Monitoring, Recordkeeping, and Reporting Requirements** for further requirements.

7. Specific Control Equipment Operating Conditions:

- a) The baghouse on the pug mills and fly ash silos shall be operated to maintain compliance with applicable requirements, consistent with manufacturer's specifications and standard operating practices [401 KAR 50:055].
- b) Records regarding the maintenance of the control equipment shall be maintained [401 KAR 52:020, Section 10].
- c) See Section E-Source Control Equipment Requirements.

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)**Emission Unit 08: Two Cooling Towers****Description:**

Emission Unit	Description	Operating Rate	Commenced Construction
EU08(1)	Cooling Tower	6.3 MMgal/hr	1975
EU08(2)	Cooling Tower	6.3 MMgal/hr	1975

APPLICABLE REGULATIONS:**401 KAR 59:010, New Process Operations****1. Operating Limitations:**

N/A

2. Emission Limitations:

- a) Particulate matter emissions into the open air from shall not exceed: [401 KAR 59:010, Section 3(2)]
 - i) 2.34 lb/hr, when the processing rate is less than or equal to 0.5 tons/hr.
 - ii) $[3.59(P)0.62]$ lbs/hr, where P is the processing rate in tons per hour, for $P < 30$ tons/hr.
 - iii) $[17.31(P)0.16]$ lbs/hr, where P is the processing rate in tons per hour, for $P > 30$ tons/hr
- b) Visible emissions shall not equal or exceed twenty 20% based on a six-minute average [401 KAR 59:010, Section 3(1)(a)].

Compliance Demonstration Method:

The permittee is assumed to be in compliance with the applicable opacity and particulate matter emission standard. [401 KAR 50:045, Section 4(3)(c)1.]

3. Testing Requirements:

Testing shall be conducted at such times as may be requested by the cabinet in accordance with 401 KAR 59:005, Section 2(2) and 401 KAR 50:045, Section 4.

4. Specific Monitoring Requirements:

The permittee shall monitor total dissolved solids content of the circulating water on a monthly basis. [401 KAR 52:020, Section 10]

5. Specific Recordkeeping Requirements:

The permittee shall maintain records of the maximum pumping capacity and monthly records of the total dissolved solids content. [401 KAR 52:020, Section 10]

6. Specific Reporting Requirements:

See **Section F - Monitoring, Recordkeeping, and Reporting Requirements** for further requirements.

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

Emission Unit 09: Diesel Emergency Fire Pump Engine

Description:

Emission Unit	Description	Model Year	Maximum Engine Rating	Fuel	Control Equipment
EU09	Cummins Model N-855-F, Serial # 10770141	1978	215 HP	Diesel	N/A

APPLICABLE REGULATIONS:

401 KAR 63:002, Section 2(4)(eeee), 40 CFR 63.6580 to 63.6675, Tables 1a to 8, and Appendix A (**Subpart ZZZZ**), National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines

Note: DC Circuit Court [*Delaware v. EPA*, 785 F. 3d 1 (DC Cir. 2015)] has vacated the provisions in 40 CFR 63, Subpart ZZZZ that contain the 100-hour exemption for operation of emergency engines for purposes of emergency demand response under 40 CFR 63.6640(f)(2)(ii)-(iii). The DC Circuit Court issued the mandate for the vacatur on May 4, 2016.

1. Operating Limitations:

- a) For the existing emergency fire pump unit the permittee shall [40 CFR 63.6602, 40 CFR 63.6625(e), 40 CFR 63.6595(a), and 40 CFR 63.6625(h), and 40 CFR 63, Subpart ZZZZ, Table 2c, Item 1]:
 - i) Change oil and filter every 500 hours of operation or annually, whichever comes first, or change oil utilizing an oil analysis program according to the methods and requirements in order to extend the specified oil change requirements [40 CFR 63, Subpart ZZZZ, Table 2c, Item 1.a.];
 - ii) Inspect air cleaner every 1,000 hours of operation or annually, whichever comes first [40 CFR 63, Subpart ZZZZ, Table 2c, Item 1.b.]; and
 - iii) Inspect all hoses and belts every 500 hours of operation or annually, whichever comes first, and replace as necessary [40 CFR 63, Subpart ZZZZ, Table 2c, Item 1.c.].
 - iv) Minimize the engine's time spent at idle and minimize the engine's startup time at startup to a period needed for appropriate and safe loading of the engine, not to exceed 30 minutes, after which time the non-startup emission limitations apply [40 CFR 63, Subpart ZZZZ, Table 2c, Item 1.d.].
- b) The permittee shall install a non-resettable hour meter if one is not already installed [40 CFR 63.6625(f)].
- c) The permittee has the option of utilizing an oil analysis program in order to extend the specified oil change requirement of Table 2c, Item 1 to 40 CFR 63 Subpart ZZZZ, as provided for in 40 CFR 63.6625(i). The oil analysis shall be performed at the same frequency as specified for changing the oil [40 CFR 63.6625(i)].
- d) The permittee shall operate and maintain the engine according to the manufacturer's emission-related operating and maintenance instructions, or develop and follow own maintenance plan which shall provide, to the extent practicable, for the maintenance and

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

operation of the engine in a manner consistent with good air pollution control practice for minimizing emissions [40 CFR 63.6625(e)].

- e) The permittee shall operate the emergency engine according to the requirements in **1. Operating Limitations: (e)(i) through (iii)**. In order for the engine to be considered an emergency engine under 40 CFR 63, Subpart ZZZZ, any operation other than emergency operation, maintenance and testing, emergency demand response, and operation in nonemergency situations for 50 hours per year, as described in 40 CFR 63.6640(f)(1) through (3), is prohibited. If the engine is not operated according to the requirements in 40 CFR 63.6640(f)(1) through (iii), the engine will not be considered an emergency engine under 40 CFR 63, Subpart ZZZZ and shall meet all requirements for non-emergency [40 CFR 63.6640(f)].
 - i) There is no time limit on the use of emergency engine in emergency situations [40 CFR 63.6640(f)(1)].
 - ii) The permittee may operate the emergency engine for any combination of the purposes specified in 40 CFR 63.6640(f)(2) for a maximum of 100 hours per calendar year. Any operation for non-emergency situations as allowed by 40 CFR 63.6640(f)(3) counts as part of the 100 hours per calendar year allowed by 40 CFR 63.6640(f)(2). The emergency engine may be operated for maintenance checks and readiness testing, provided that the tests are recommended by federal, state or local government, the manufacturer, the vendor, the regional transmission organization or equivalent balancing authority and transmission operator, or the insurance company associated with the engine. The permittee may petition the Administrator for approval of additional hours to be used for maintenance checks and readiness testing, but a petition is not required if the permittee maintains records indicating that federal, state, or local standards require maintenance and testing of the emergency engine beyond 100 hours per calendar year [40 CFR 63.6640(f)(2)].
 - iii) The emergency engine located at major sources of HAP may be operated for up to 50 hours per calendar year in non-emergency situations. The 50 hours of operation in non-emergency situations are counted as part of the 100 hours per calendar year for maintenance and testing and emergency demand response provided in 40 CFR 63.6640(f)(2). The 50 hours per year for non-emergency situations cannot be used for peak shaving or non-emergency demand response, or to generate income for a facility to supply power to an electric grid or otherwise supply power as part of a financial arrangement with another entity [40 CFR 63.6640(f)(3)].
- f) The permittee shall be in compliance with the emission limitations and operating limitations in 40 CFR 63, Subpart ZZZZ that apply at all times [40 CFR 63.6605(a)].

2. Emission Limitations:

N/A

3. Testing Requirements:

Testing shall be conducted at such time as may be requested by the cabinet in accordance with 401 KAR 50:045, Section 4.

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)**4. Specific Monitoring Requirements:**

The permittee shall monitor the amount of fuel usage and hours of operation on a monthly basis [401 KAR 52:020, Section 10].

5. Specific Recordkeeping Requirements:

- a) The permittee shall keep records of each notification and report that is submitted, the occurrence and duration of each malfunction of operation or the air pollution control and monitoring equipment, records of performance tests and performance evaluations as required in 40 CFR 63.10(b)(2)(viii), records of all required maintenance performed on the air pollution control and monitoring equipment, and records of action taken during periods of malfunction to minimize emissions in accordance with 40 CFR 63.6605(b), including corrective actions to restore malfunctioning process and air pollution control and monitoring equipment to its normal or usual manner of operation. [40 CFR 63.6655(a)]
- b) The permittee shall maintain records of the maintenance conducted on the engine in order to demonstrate that the engine was operated and maintained, including any after-treatment control device, according to the maintenance plan for the engine[40 CFR 63.6655(e)].
- c) The permittee shall document how many hours are spent for emergency operation, including what classified the operation as emergency and how many hours are spent for non-emergency operation [40 CFR 63.6655(f)(1)].
- d) The permittee shall maintain records for fuel usage on a monthly basis [401 KAR 52:020, Section 10].

6. Specific Reporting Requirements:

- a) The permittee shall report each instance in which the operating limitations in **1. Operating Limitations: (a)** have not been met. These instances are deviations from the emission and operating limitation in 40 CFR 63 Subpart ZZZZ and shall be reported according to 40 CFR 63.6650. [40 CFR 63.6640(b)]
- b) The permittee shall report each instance in which the requirements of Table 8 to 40 CFR 63 Subpart ZZZZ, that apply, have not been met. The notifications listed 40 CFR 63.7(b) and (c), 40 CFR 63.8(e), (f)(4) and (f)(6), 40 CFR 63.9(b) through (e) and (g) are not required. [40 CFR 63.6645(a)(5)]
- c) See **Section F - Monitoring, Recordkeeping, and Reporting Requirements** for further requirements.

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

Emission Unit 10: Diesel Fired Emergency Generator (new stationary RICE)

Description:

Emission Unit	Description	Model Year	Maximum Engine Rating	Fuel
EU10	Generac Model SD500 Engine Model TAD1641GE, Serial # 56815	2011	757 HP	Diesel

Applicable Regulations:

401 KAR 60:005, Section 2(2)(dddd), 40 C.F.R. 60.4200 to 60.4219, Tables 1 to 8 (**Subpart IIII**), Standards of Performance for Stationary Compression Ignition Internal Combustion Engines

401 KAR 63:002, Section 2(4)(eeee) 40 C.F.R. 63.6580 to 63.6675, Tables 1a to 8, and Appendix A (**Subpart ZZZZ**), National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines

Note: DC Circuit Court [*Delaware v. EPA*, 785 F. 3d 1 (DC Cir. 2015)] has vacated the provisions in 40 CFR 63, Subpart ZZZZ and 40 CFR 60 Subpart IIII that contain the 100-hour exemption for operation of emergency engines for purposes of emergency demand response under 40 CFR 63.6640(f)(2)(ii)-(iii) and 60.4211(f)(2)(ii)-(iii). The DC Circuit Court issued the mandate for the vacatur on May 4, 2016.

1. Operating Limitations:

- a) The permittee shall submit an initial notification requirement and include the information in 40 CFR 63.9(b)(2)(i) through (v), and a statement that the emergency engine has no additional requirements and explain the basis for the exclusion [40 CFR 63.6645(f)].
- b) The permittee shall use diesel fuel that meets the requirements of 40 CFR 80.510(b) for nonroad diesel fuel [40 CFR 60.4207(b)].

Compliance Demonstration: The permittee shall demonstrate compliance by using fuel supplier certification.

- c) The permittee must operate the emergency engine according to the requirements in 40 CFR 60.6640(f)(1) through (4). In order for the engine to be considered an emergency engine under 40 CFR 60, Subpart IIII, any operation other than emergency operation, maintenance and testing, emergency demand response, and operation in non-emergency situations for 50 hours per year, as described in 40 CFR 60.6640(f)(1) through (4), is prohibited. If the permittee do not operate the engine according to the requirements in 40 CFR 60.6640(f)(1) through (4), the engine will not be considered an emergency engine under 40 CFR 60, Subpart IIII and shall meet all requirements for non-emergency engines [40 CFR 60.4211(f)]:
 - i) There is no time limit on the use of emergency engine in emergency situations [40 CFR 60.4211(f)(1)].
 - ii) The permittee may operate the emergency engine for any combination of the purposes specified in 40 CFR 60.6640(f)(2) for a maximum of 100 hours per calendar year.

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- Any operation for non-emergency situations as allowed by paragraph 40 CFR 60.6640(f)(3) counts as part of the 100 hours per calendar year allowed by 40 CFR 60.6640(f)(2). The emergency engine may be operated for maintenance checks and readiness testing, provided that the tests are recommended by federal, state or local government, the manufacturer, the vendor, the regional transmission organization or equivalent balancing authority and transmission operator, or the insurance company associated with the engine. The owner or operator may petition the Administrator for approval of additional hours to be used for maintenance checks and readiness testing, but a petition is not required if the owner or operator maintains records indicating that federal, state, or local standards require maintenance and testing of emergency engine beyond 100 hours per calendar year.
- iii) Emergency engine may be operated for up to 50 hours per calendar year in non-emergency situations. The 50 hours of operation in non-emergency situations are counted as part of the 100 hours per calendar year for maintenance and testing and emergency demand response provided in 40 CFR 60.6640(f)(2). Except as provided in 40 CFR 60.6640(f)(ii), the 50 hours per calendar year for non-emergency situations cannot be used for peak shaving or non-emergency demand response, or to generate income for a facility to an electric grid or otherwise supply power as part of a financial arrangement with another entity. The 50 hours per year for non-emergency situations can be used to supply power as part of a financial arrangement with another entity if all of the following conditions are met:
 - A) The engine is dispatched by the local balancing authority or local transmission and distribution system operator;
 - B) The dispatch is intended to mitigate local transmission and/or distribution limitations so as to avert potential voltage collapse or line overloads that could lead to the interruption of power supply in a local area or region;
 - C) The dispatch follows reliability, emergency operation or similar protocols that follow specific NERC, regional, state, public utility commission or local standards or guidelines;
 - D) The power is provided only to the facility itself or to support the local transmission and distribution system;
 - E) The owner or operator identifies and records the entity that dispatches the engine and the specific NERC, regional, state, public utility commission or local standards or guidelines that are being followed for dispatching the engine. The local balancing authority or local transmission and distribution system operator may keep these records on behalf of the engine owner or operator.
 - d) The permittee shall operate and maintain each of the stationary CI internal combustion engines according to the manufacturer's emission-related settings that are permitted by the manufacturer [40 CFR 60.4211(a)].
 - e) The permittee shall meet the requirements of 40 CFR parts 89, 94, and/or 1068, as they apply [40 CFR 60.4211(a)(3)].

2. Emission Limitations:

The engines shall meet the certification emission standards for new nonroad CI engines for the same model year and maximum engine power in 40 CFR 89.112 and 40 CFR 89.113 for

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

all pollutants [40 CFR 60.4202(a)(2), 40 CFR 60.4205(b)]. Each engine shall meet the emission standards over the life of the engine [40 CFR 60.4206].

3. Testing Requirements:

Testing shall be conducted at such times as may be requested by the cabinet in accordance with 401 KAR 50:045, Section 4.

4. Specific Monitoring Requirements:

- a) The permittee shall monitor the fuel usage (gallons) and hours of operation on a monthly basis [401 KAR 52:020, Section 10].
- b) If an engine does not meet the standards applicable to non-emergency engines, the permittee shall install a non-resettable hour meter prior to startup of the engine [40 CFR 60.4209(a)].
- c) If the stationary CI internal combustion engine is equipped with a diesel particulate filter to comply with the emission standards in 40 CFR 60.4204, the diesel particulate filter shall be installed with a backpressure monitor that notifies the permittee when the high backpressure limit of the engine is approached [40 CFR 60.4209(b)].

5. Specific Recordkeeping Requirements:

- a) The permittee shall maintain records necessary to demonstrate compliance with the applicable emission limits, according to the method specified [401 KAR 52:020, Section 10].
- b) The permittee shall maintain records of fuel usage (gallons) and hours of operation on a monthly basis and fuel supplier certification according to the fuel requirements in subsection 1(b) [401 KAR 52:020, Section 10].
- c) Records of performance tests shall report emission limits and actual emissions in the unit of the applicable standard [401 KAR 52:020, Section 10].
- d) If the emergency engine does not meet the emission standards specified in 2. Operating Limitations: (c), the permittee shall keep records of the operation of the engine in emergency and non-emergency service that are recorded through the non-resettable hour meter. The permittee shall record the time of operation of the engine and the reason the engine was in operation during that time. [40 CFR 60.4214(b)]
- e) If the engine is equipped with a diesel particulate filter, the permittee shall keep records of any corrective action taken after the backpressure monitor has notified the permittee that the high backpressure limit of the engine is approached [40 CFR 60.4214(c)].

6. Specific Reporting Requirements:

- a) The permittee is required to submit an initial notification as required in 40 CFR 63.9(b)(1)(i) [40 CFR 63.6645(f)].
- b) See **Section F - Monitoring, Recordkeeping, and Reporting Requirements** for further requirements.

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)**Emission Unit 11: Natural Gas-Fired Indirect Heat Exchanger****Description:**

Gas-fired heater utilized to heat natural gas supplied to combustion units at the plant

Construction Commenced: Projected September 2021

Rated Capacity: 18.8 MMBtu/hr

Primary Fuel: Natural Gas

Applicable Regulations:

401 KAR 59:015, New indirect heat exchangers

401 KAR 60:005, Section 2(2)(d) 40 C.F.R. 60.40c through 60.48c (**Subpart Dc**), Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units

401 KAR 63:002, Section 2.(4)(iii), 40 C.F.R 63.7480 through 63.7575, Tables 1 to 13, (**Subpart DDDDD**), *National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters*

1. Operating Limitations

- a. During a startup period or shutdown period, the permittee shall comply with the work practice standards established in 401 KAR 59:015, Section 7. The permittee shall meet the work practice standards established in 40 CFR Part 63, Table 3 to Subpart DDDDD, as established in 401 KAR 63:002, Section 2(4)(iii) [401 KAR 59:015, Section 7 and 401 KAR 59:015, Section 7(2)(a)].
- b. The permittee shall comply with 40 CFR 63, Subpart DDDDD upon startup of the boiler. [40 CFR 63.7495(a)]
- c. The permittee shall meet the requirements in 40 CFR 63.7500(a)(1) through (3), except as provided in 40 CFR 63.7500(b) through (e). The permittee shall meet these requirements at all times the affected unit is operating, except as provided in 40 CFR 63.7500(f). The permittee shall meet each emission limit and work practice standard in 40 CFR 63, Subpart DDDDD Tables 1 through 3, and 11 through 13 that applies to the boiler or process heater, for each boiler or process heater at the source, except as provided under 40 CFR 63.7522. [40 CFR 63.7500(a) and (a)(1)]
- d. At all times, the permittee shall operate and maintain any affected source (as defined in 40 CFR 63.7490), including associated air pollution control equipment and monitoring equipment, in a manner consistent with safety and good air pollution control practices for minimizing emissions. Determination of whether such operation and maintenance procedures are being used will be based on information available to the Administrator that may include, but is not limited to, monitoring results, review of operation and maintenance procedures, review of operation and maintenance records, and inspection of the source. [40 CFR 63.7500(a)(3)]
- e. The permittee shall conduct an annual performance tune-up according to 40 CFR 63.7540(a)(10). Each annual tune-up specified in 40 CFR 63.7540(a)(10) shall be no

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

more than 13 months after the previous tune-up. The first annual tune-up shall be no later than 13 months after the initial startup of the new affected source. [40 CFR 63.7515(d)].

- f. The permittee shall conduct an annual tune-up of the boiler to demonstrate continuous compliance as specified in 40 CFR 63.7540(a)(10)(i) through (bi). The permittee shall conduct the tune-up while burning the type of fuel (or fuels in the case of units that routinely burn a mixture) that provided the majority of the heat input to the boiler or process heater over the 12 months prior to the tune-up. [40 CFR 63.7540(a)(10)]
 - i. As applicable, inspect the burner, and clean or replace any components of the burner as necessary (you may perform the burner inspection any time prior to the tune-up or delay the burner inspection until next scheduled unit shutdown). At units where entry into a piece of process equipment or into a storage vessel is required to complete the tune-up inspections, inspections are required only during planned entries into the storage vessel or process equipment [40 CFR 63.7540(a)(10)(i)];
 - ii. Inspect the flame pattern, as applicable, and adjust the burner as necessary to optimize the flame pattern. The adjustment should be consistent with the manufacturer's specifications, if available [40 CFR 63.7540(a)(10)(ii)];
 - iii. Inspect the system controlling the air-to-fuel ratio, as applicable, and ensure that it is correctly calibrated and functioning properly (you may delay the inspection until the next scheduled unit shutdown) [40 CFR 63.7540(a)(10)(iii)];
 - iv. Optimize total emissions of CO. This optimization should be consistent with the manufacturer's specifications, if available, and with any NO_x requirement to which the units are subject [40 CFR 63.7540(a)(10)(iv)];
 - v. Measure the concentrations in the effluent stream of CO in parts per million, by volume, and oxygen in volume percent, before and after the adjustments are made (measurements may be either on a dry or wet basis, as long as it is the same basis before and after the adjustments are made). Measurements may be taken using a portable CO analyzer; and [40 CFR 63.7540(a)(10)(v)]
 - vi. Maintain on-site and submit, if requested by the Administrator, a report containing the information in 40 CFR 63.7540(a)(10)(vi)(A) through (C) [40 CFR 63.7540(a)(10)(vi)],
 - 1. The concentrations of CO in the effluent stream in parts per million by volume, and oxygen in volume percent, measured at high fire or typical operating load, before and after the tune-up of the boiler or process heater [40 CFR 63.7540(a)(10)(vi)(A)];
 - 2. A description of any corrective actions taken as part of the tune-up; and [40 CFR 63.7540(a)(10)(vi)(B)]
 - 3. The type and amount of fuel used over the 12 months prior to the tune-up, but only if the unit was physically and legally capable of using more than one type of

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

fuel during that period. Units sharing a fuel meter may estimate the fuel used by each unit [40 CFR 63.7540(a)(10)(vi)(C)].

- g. If the unit is not operating on the required date for a tune-up, the tune-up shall be conducted within 30 calendar days of startup. [40 CFR 63.7540(a)(13)]

2. Emission Limitations

- a. PM emissions from the stack shall not exceed 0.10 lb/MMBtu actual heat input. [401 KAR 59:015, Section 4(1)(b)]
- b. Visible emissions from each stack shall not exceed 20% opacity, except: [401 KAR 59:015, Section 4(2)]
 - i. A maximum of 40 percent opacity shall be allowed for a maximum of 6 consecutive minutes in any 60 consecutive minutes during fire box cleaning or soot blowing. [401 KAR 59:015, Section 4(2)(b)]
 - ii. Emissions from an indirect heat exchanger during building a new fire for the period required to bring the boiler up to operating conditions, provided the method used is that recommended by the manufacturer and the time does not exceed the manufacturer's recommendations. [401 KAR 59:015, Section 4(2)(c)]
- c. SO₂ emissions from each stack shall not exceed 0.8 lb/MMBtu actual heat input. [401 KAR 59:015, Section 5(1)(b)1.]

Compliance Demonstration: The permittee is assumed to be in compliance with the applicable 401 KAR 59:015 PM, opacity, and SO₂ standards.

- d. See **Section D – Source Emission Limitations and Testing Requirements.**

3. Testing Requirements:

Testing shall be conducted at such times as may be requested by the cabinet in accordance with 401 KAR 59:005, Section 2(2) and 401 KAR 50:045, Section 1.

4. Specific Monitoring Requirements:

The permittee shall monitor fuel usage (MMscf) on a monthly basis [401 KAR 52:020, Section 10 and 40 CFR 60.48c(g)(2)].

5. Specific Recordkeeping Requirements:

- a. The permittee shall maintain records of fuel usage (MMscf) on a monthly basis [401 KAR 52:020, Section 10 and 40 CFR 60.48c(g)(2)].
- b. The permittee shall keep records according to 40 CFR 63.7555(a)(1) and (2). [40 CFR 63.7555(a)]
 - i. A copy of each notification and report that was submitted to comply with 40 CFR 63, Subpart DDDDD, including all documentation supporting any Initial Notification of Compliance Status or semiannual compliance report submitted, according to the requirements in 40 CFR 63.10(b)(2)(xiv). [40 CFR 63.7555(a)(1)]

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- ii. Records of performance tests, fuel analyses, or other compliance demonstrations and performance evaluations as required in 40 CFR 63.10(b)(2)(viii). [40 CFR 63.7555(a)(2)]
- c. Records shall be in a form suitable and readily available for expeditious review, according to 40 CFR 63.10(b)(1). [40 CFR 63.7560(a)]
- d. As specified in 40 CFR 63.10(b)(1), the permittee shall keep each record for 5 years following the date of each occurrence, measurement, maintenance, corrective action, report, or record. [40 CFR 63.7560(b)]
- e. The permittee shall keep each record on site, or they shall be accessible from on site (for example, through a computer network), for at least 2 years after the date of each occurrence, measurement, maintenance, corrective action, report, or record, according to 40 CFR 63.10(b)(1). The permittee can keep the records off site for the remaining 3 years. [40 CFR 63.7560(c)]

6. Specific Reporting Requirements:

- a. The permittee shall submit to the Administrator all of the notifications in 40 CFR 63.7(b) and (c), 63.8(e), (f)(4) and (6), and 63.9(b) through (h) that apply by the dates specified. [40 CFR 63.7545(a)]
- b. As specified in 40 CFR 63.9(b)(4) and (5), for startup of a new or reconstructed affected source on or after January 31, 2013, the permittee shall submit an Initial Notification not later than 15 days after the actual date of startup of the affected source. [40 CFR 63.7545(c)]
- c. The permittee shall submit a Notification of Compliance Status according to 40 CFR 63.9(h)(2)(ii). For the initial compliance demonstration for each boiler or process heater, the permittee shall submit the Notification of Compliance Status, including all performance test results and fuel analyses, before the close of business on the 60th day following the completion of all performance test and/or other initial compliance demonstrations for all boiler or process heaters at the facility according to 40 CFR 63.10(d)(2). The Notification of Compliance Status report shall contain all the information specified in 40 CFR 63.7545(e)(1) through (8), as applicable. If an initial compliance demonstration as specified in 40 CFR 63.7530(a) is not required, the Notification of Compliance Status shall only contain the information in 40 CFR 63.7545(e)(1) and (8) and shall be submitted within 60 days of the compliance date specified at 40 CFR 63.7495(b). [40 CFR 63.7545(e)]
 - i. A description of the affected unit(s) including identification of which subcategories the unit is in, the design heat input capacity of the unit, a description of the add-on controls used on the unit to comply with 40 CFR 63, Subpart DDDDD, description of the fuel(s) burned, including whether the fuel(s) were a secondary material determined by the permittee or EPA through a petition process to be non-waste under 40 CFR 241.3, whether the fuel(s) were a secondary material processed from discarded non-hazardous secondary materials within the meaning of 40 CFR 241.3,

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

and justification for the selection of fuel(s) burned during the compliance demonstration. [40 CFR 63.7545(e)(1)]

- ii. In addition to the information required in 40 CFR 63.9(h)(2), the notification of compliance status shall include the following certification(s) of compliance, as applicable, and signed by a responsible official: [40 CFR 63.7545(e)(8)]
 - 1. “This facility completed the required initial tune-up for all the boilers and process heaters covered by 40 CFR Part 63 Subpart DDDDD at this site according to the procedures in 40 CFR 63.7540(a)(10)(i) through (vi).” [40 CFR 63.7545(e)(8)(i)]
 - 2. “This facility has had an energy assessment performed according to 40 CFR 63.7530(e).” [40 CFR 63.7545(e)(8)(ii)]
- d. The permittee shall submit each report in 40 CFR 63, Subpart DDDDD, Table 9 that applies. [40 CFR 63.7550(a)]
- e. Unless the EPA Administrator has approved a different schedule for submission of reports under 40 CFR 63.10(a), the permittee shall submit each report, according to 40 CFR 63.7550(h), by the date in 40 CFR 63, Subpart DDDDD, Table 9 and according to the requirements in 40 CFR 63.7550(b)(1) through (4). For units that are subject only to a requirement to conduct subsequent annual, biennial, or 5-year tune-up according to 40 CFR 63.7540(a)(10), (11), or (12), respectively, and not subject to emission limits or 40 CFR 63, Subpart DDDDD, Table 4 operating limits, the permittee may submit only annual, biennial, or 5-year compliance report, as applicable, as specified in 40 CFR 63.7550(b)(1) through (4), instead of a semi-annual compliance report. For each affected source that is subject to permitting regulations pursuant to 40 CFR Part 70 or Part 71, and if the permitting authority has established dates for submitting semiannual reports pursuant to 40 CFR 70.6(a)(3)(iii)(A) or 71.6(a)(3)(iii)(A), the permittee may submit the first and subsequent compliance reports according to the dates the permitting authority has established in the permit instead of according to the dates in 40 CFR 63.7550(b)(1) through (4). [40 CFR 63.7550(b) and (b)(5)]
- f. A compliance report shall contain the following information depending on how the facility chooses to comply with the limits set in this rule. If the facility is subject to the requirements of a tune up, the permittee shall submit a compliance report with the information in 40 CFR 63.7550(c)(5)(i) through (iii), (xiv), and (xvii). [40 CFR 63.7550(c) and (c)(1)]
 - i. Company and Facility name and address. [40 CFR 63.7550(c)(5)(i)]
 - ii. Process unit information, emissions limitations, and operating parameter limitations. [40 CFR 63.7550(c)(5)(ii)]
 - iii. Date of report and beginning and ending dates of the reporting period. [40 CFR 63.7550(c)(5)(iii)]
 - iv. Include the date of the most recent tune-up for each unit subject to only the requirement to conduct an annual, biennial, or 5-year tune-up according to 40 CFR

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- 63.7540(a)(10), (11), or (12) respectively. Include the date of the most recent burner inspection if it was not done annually, biennially, or on a 5-year period and was delayed until the next scheduled or unscheduled unit shutdown. [40 CFR 63.7550(c)(5)(xiv)]
- v. Statement by a responsible official with that official's name, title, and signature, certifying the truth, accuracy, and completeness of the content of the report. [40 CFR 63.7550(c)(5)(xvii)]
- g. The permittee shall submit the reports according to the procedures specified in 40 CFR 63.7550(h)(1) through (3). The permittee shall submit all reports required by 40 CFR 63, Subpart DDDDD, Table 9 electronically to the EPA via the CEDRI. (CEDRI can be accessed through the EPA's CDX.) The permittee shall use the appropriate electronic report in CEDRI for 40 CFR 63, Subpart DDDDD. Instead of using the electronic report in CEDRI for 40 CFR 63, Subpart DDDDD, the permittee may submit an alternate electronic file consistent with the XML schema listed on the CEDRI Web site (<http://www.epa.gov/ttn/chief/cedri/index.html>) , once the XML schema is available. If the reporting form specific to 40 CFR 63, Subpart DDDDD is not available in CEDRI at the time that the report is due, the permittee shall submit the report to the Administrator at the appropriate address listed in 40 CFR 63.13. The permittee shall begin submitting reports via CEDRI no later than 90 days after the form becomes available in CEDRI. [40 CFR 63.7550(h) and (h)(3)]
- h. See **Section F – Monitoring, Recordkeeping, and Reporting Requirements.**

SECTION B - EMISSION POINTS, EMISSIONS UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

Emission Unit 12: Combustion Turbine

Description:

Natural Gas/No. 2 Fuel Oil-Fired unit
Rated Capacity: 803 MMBtu/hr
Construction commenced: 1970

Applicable Regulations:

401 KAR 63:002, Section 2(4)(dddd), 40 C.F.R. 63.6080 through 63.6175, Tables 1 through 7 (Subpart YYYYY), *National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines*

1. Operating Limitations:

Existing stationary combustion turbines in all subcategories do not have to meet the requirements of 40 CFR 63, Subpart YYYYY and of 40 CFR 63, Subpart A. No initial notification is necessary for any existing stationary combustion turbine, even if a new or reconstructed turbine in the same category would require an initial notification. [40 CFR 63.6090(b)(4)]

2. Emission Limitations:

N/A

3. Testing Requirements:

N/A

4. Monitoring Requirements:

The permittee shall monitor the fuel usage (in MMscf for natural gas and Mgal for No.2 fuel oil) on a monthly basis [401 KAR 52:020, Section 10].

5. Recordkeeping Requirements:

The permittee shall maintain records of the fuel usage (in MMscf for natural gas and Mgal for No.2 fuel oil) on a monthly basis [401 KAR 52:020, Section 10].

6. Reporting Requirements:

Refer to **Section C - General Conditions** for additional reporting requirements.

SECTION C - INSIGNIFICANT ACTIVITIES

The following listed activities have been determined to be insignificant activities for this source pursuant to 401 KAR 52:020, Section 6. Although these activities are designated as insignificant the permittee shall comply with the applicable regulation. Process and emission control equipment at each insignificant activity subject to an opacity standard shall be inspected monthly and a qualitative visible emissions evaluation made. Results of the inspection, evaluation, and any corrective action shall be recorded in a log.

<u>Description</u>	<u>Generally Applicable Regulation</u>
1. Kerosene tanks (500 gallons)	N/A
2. Kerosene tanks (340 gallons)	N/A
3. Unleaded gasoline tank (500 gallons)	N/A
4. Gasoline tank (300 gallons)	N/A
5. Diesel fuel oil storage tank (500 gallons)	N/A
6. No. 2 fuel storage tank (50,000 gallons)	N/A
7. Diesel fuel tank for emergency fire pump (500 gal)	N/A
8. Diesel fuel tank for emergency generator (797 gal)	N/A
9. Diesel fuel storage tank (500 gallons)	N/A
10. Closed cooling water system	N/A
11. Demineralizer process operation	N/A
12. Freeze protection operation for coal conveyors	N/A
13. Wastewater treatment plant operations	N/A
14. Pneumatic flyash conveyors and storage silos	401 KAR 63:010
15. PAC Storage Silos (2)	401 KAR 59:010
16. Hydrated Lime Storage Silos (2)	401 KAR 59:010

SECTION D - SOURCE EMISSION LIMITATIONS AND TESTING REQUIREMENTS

1. As required by Section 1b of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26; compliance with annual emissions and processing limitations contained in this permit, shall be based on emissions and processing rates for any twelve (12) consecutive months.
2. Particulate matter, sulfur dioxide, nitrogen oxides, and visible (opacity) emissions, measured by applicable reference methods, or an equivalent or alternative method specified in 40 C.F.R. Chapter I, or by a test method specified in the state implementation plan shall not exceed the respective limitations specified herein.
3. To preclude the applicability of 401 KAR 51:017, Prevention of Significant Deterioration of air quality, total emissions of NO_x from Emissions Units 01, 02, and 11 shall not exceed 3,657 tons during any consecutive 12 month period after completion of the Gas Conversion Project. [401 KAR 52:020, Section 10]

Compliance Demonstration:

- i) The permittee shall use the NO_x continuous emission monitoring system (CEMS) to determine the monthly and twelve consecutive rolling month emissions from Emission Units 01 and 02.
- ii) The permittee shall calculate and record the NO_x emission from Emission Unit 11 and total NO_x emissions from Emission Units 01, 02, and 11 on a monthly and 12 consecutive month basis.
- iii) The permittee shall submit a report of NO_x emissions for the previous twelve consecutive month period every six months in accordance with Section F.5. Exceedances of the emission limitation specified above shall be reported within 30 days following the date when the exceedance is determined.

SECTION E - SOURCE CONTROL EQUIPMENT REQUIREMENTS

Pursuant to 401 KAR 50:055, Section 2(5), at all times, including periods of startup, shutdown and malfunction, owners and operators shall, to the extent practicable, maintain and operate any affected facility including associated air pollution control equipment in a manner consistent with good air pollution control practice for minimizing emissions. Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to the Division which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures, and inspection of the source.

SECTION F - MONITORING, RECORDKEEPING, AND REPORTING REQUIREMENTS

1. Pursuant to Section 1b-IV-1 of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26, when continuing compliance is demonstrated by periodic testing or instrumental monitoring, the permittee shall compile records of required monitoring information that include:
 - a. Date, place as defined in this permit, and time of sampling or measurements;
 - b. Analyses performance dates;
 - c. Company or entity that performed analyses;
 - d. Analytical techniques or methods used;
 - e. Analyses results; and
 - f. Operating conditions during time of sampling or measurement.
2. Records of all required monitoring data and support information, including calibrations, maintenance records, and original strip chart recordings, and copies of all reports required by the Division for Air Quality, shall be retained by the permittee for a period of five (5) years and shall be made available for inspection upon request by any duly authorized representative of the Division for Air Quality [Sections 1b-IV-2 and 1a-8 of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26].
3. In accordance with the requirements of 401 KAR 52:020, Section 3(1)h, the permittee shall allow authorized representatives of the Cabinet to perform the following during reasonable times:
 - a. Enter upon the premises to inspect any facility, equipment (including air pollution control equipment), practice, or operation;
 - b. To access and copy any records required by the permit;
 - c. Sample or monitor, at reasonable times, substances or parameters to assure compliance with the permit or any applicable requirements.Reasonable times are defined as during all hours of operation, during normal office hours; or during an emergency.
4. No person shall obstruct, hamper, or interfere with any Cabinet employee or authorized representative while in the process of carrying out official duties. Refusal of entry or access may constitute grounds for permit revocation and assessment of civil penalties.
5. Summary reports of any monitoring required by this permit shall be submitted to the Regional Office listed on the front of this permit at least every six (6) months during the life of this permit, unless otherwise stated in this permit. For emission units that were still under construction or which had not commenced operation at the end of the 6-month period covered by the report and are subject to monitoring requirements in this permit, the report shall indicate that no monitoring was performed during the previous six months because the emission unit was not in operation [Sections 1b-V-1 of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26].

SECTION F - MONITORING, RECORDKEEPING, AND REPORTING REQUIREMENTS (CONTINUED)

6. The semi-annual reports are due by January 30th and July 30th of each year. All reports shall be certified by a responsible official pursuant to 401 KAR 52:020, Section 23. If continuous emission and opacity monitors are required by regulation or this permit, data shall be reported in accordance with the requirements of 401 KAR 59:005, General Provisions, Section 3(3). All deviations from permit requirements shall be clearly identified in the reports.
7. In accordance with the provisions of 401 KAR 50:055, Section 1, the owner or operator shall notify the Regional Office listed on the front of this permit concerning startups, shutdowns, or malfunctions as follows:
 - a. When emissions during any planned shutdowns and ensuing startups will exceed the standards, notification shall be made no later than three (3) days before the planned shutdown, or immediately following the decision to shut down, if the shutdown is due to events which could not have been foreseen three (3) days before the shutdown.
 - b. When emissions due to malfunctions, unplanned shutdowns and ensuing startups are or may be in excess of the standards, notification shall be made as promptly as possible by telephone (or other electronic media) and shall be submitted in writing upon request.
8. The permittee shall promptly report deviations from permit requirements, including those attributable to upset conditions as defined in the permit, the probable cause of such deviations, and any corrective actions or preventive measures taken shall be submitted to the Regional Office listed on the front of this permit. Where the underlying applicable requirement contains a definition of prompt or otherwise specifies a time frame for reporting deviations, that definition or time frame shall govern. Where the underlying applicable requirement does not identify a specific time frame for reporting deviations, prompt reporting, as required by Sections 1b-V, 3 and 4 of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26, shall be defined as follows:
 - a. For emissions of a hazardous air pollutant or a toxic air pollutant (as identified in an applicable regulation) that continue for more than an hour in excess of permit requirements, the report must be made within 24 hours of the occurrence.
 - b. For emissions of any regulated air pollutant, excluding those listed in F.8.a., that continue for more than two hours in excess of permit requirements, the report must be made within 48 hours.
 - c. All deviations from permit requirements, including those previously reported, shall be included in the semiannual report required by F.6.
9. Pursuant to 401 KAR 52:020, Title V permits, Section 21, the permittee shall annually certify compliance with the terms and conditions contained in this permit, by completing and returning a Compliance Certification Form (DEP 7007CC) (or an alternative approved by the regional office) to the Regional Office listed on the front of this permit and the U.S. EPA in accordance with the following requirements:
 - a. Identification of the term or condition;
 - b. Compliance status of each term or condition of the permit;
 - c. Whether compliance was continuous or intermittent;
 - d. The method used for determining the compliance status for the source, currently and over the reporting period.

SECTION F - MONITORING, RECORDKEEPING, AND REPORTING REQUIREMENTS (CONTINUED)

- e. For an emissions unit that was still under construction or which has not commenced operation at the end of the 12-month period covered by the annual compliance certification, the permittee shall indicate that the unit is under construction and that compliance with any applicable requirements will be demonstrated within the timeframes specified in the permit.
- f. The certification shall be submitted by January 30th of each year. Annual compliance certifications shall be sent to the following addresses:

Division for Air Quality
Owensboro Regional Office
3032 Alvey Park Dr. W STE 700
Owensboro, KY 42303-2191

U.S. EPA Region 4
Air Enforcement Branch
Atlanta Federal Center
61 Forsyth St. SW
Atlanta, GA 30303-8960

- 10. In accordance with 401 KAR 52:020, Section 22, the permittee shall provide the Division with all information necessary to determine its subject emissions within 30 days of the date the Kentucky Emissions Inventory System (KYEIS) emissions survey is mailed to the permittee.

SECTION G - GENERAL PROVISIONS

1. General Compliance Requirements

- a. The permittee shall comply with all conditions of this permit. Noncompliance shall be a violation of 401 KAR 52:020, Section 3(1)(b), and a violation of Federal Statute 42 USC 7401 through 7671q (the Clean Air Act). Noncompliance with this permit is grounds for enforcement action including but not limited to termination, revocation and reissuance, revision or denial of a permit [Section 1a-3 of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26].
- b. The filing of a request by the permittee for any permit revision, revocation, reissuance, or termination, or of a notification of a planned change or anticipated noncompliance, shall not stay any permit condition [Section 1a-6 of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26].
- c. This permit may be revised, revoked, reopened and reissued, or terminated for cause in accordance with 401 KAR 52:020, Section 19. The permit will be reopened for cause and revised accordingly under the following circumstances:
 - (1) If additional applicable requirements become applicable to the source and the remaining permit term is three (3) years or longer. In this case, the reopening shall be completed no later than eighteen (18) months after promulgation of the applicable requirement. A reopening shall not be required if compliance with the applicable requirement is not required until after the date on which the permit is due to expire, unless this permit or any of its terms and conditions have been extended pursuant to 401 KAR 52:020, Section 12;
 - (2) The Cabinet or the United States Environmental Protection Agency (U. S. EPA) determines that the permit shall be revised or revoked to assure compliance with the applicable requirements;
 - (3) The Cabinet or the U. S. EPA determines that the permit contains a material mistake or that inaccurate statements were made in establishing the emissions standards or other terms or conditions of the permit;
 - (4) New requirements become applicable to a source subject to the Acid Rain Program.

Proceedings to reopen and reissue a permit shall follow the same procedures as apply to initial permit issuance and shall affect only those parts of the permit for which cause to reopen exists. Reopenings shall be made as expeditiously as practicable. Reopenings shall not be initiated before a notice of intent to reopen is provided to the source by the Division, at least thirty (30) days in advance of the date the permit is to be reopened, except that the Division may provide a shorter time period in the case of an emergency.

- d. The permittee shall furnish information upon request of the Cabinet to determine if cause exists for modifying, revoking and reissuing, or terminating the permit; or to determine compliance with the conditions of this permit [Sections 1a- 7 and 8 of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26].
- e. Emission units described in this permit shall demonstrate compliance with applicable requirements if requested by the Division [401 KAR 52:020, Section 3(1)(c)].

SECTION G - GENERAL PROVISIONS (CONTINUED)

- f. The permittee, upon becoming aware that any relevant facts were omitted or incorrect information was submitted in the permit application, shall promptly submit such supplementary facts or corrected information to the permitting authority [401 KAR 52:020, Section 7(1)].
- g. Any condition or portion of this permit which becomes suspended or is ruled invalid as a result of any legal or other action shall not invalidate any other portion or condition of this permit [Section 1a-14 of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26].
- h. The permittee shall not use as a defense in an enforcement action the contention that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance [Section 1a-4 of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26].
- i. All emission limitations and standards contained in this permit shall be enforceable as a practical matter. All emission limitations and standards contained in this permit are enforceable by the U.S. EPA and citizens except for those specifically identified in this permit as state-origin requirements [Section 1a-15 of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26].
- j. This permit shall be subject to suspension if the permittee fails to pay all emissions fees within 90 days after the date of notice as specified in 401 KAR 50:038, Section 3(6) [Section 1a-10 of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26].
- k. Nothing in this permit shall alter or affect the liability of the permittee for any violation of applicable requirements prior to or at the time of permit issuance [401 KAR 52:020, Section 11(3)b.].
- l. This permit does not convey property rights or exclusive privileges [Section 1a-9 of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26].
- m. Issuance of this permit does not relieve the permittee from the responsibility of obtaining any other permits, licenses, or approvals required by the Cabinet or any other federal, state, or local agency.
- n. Nothing in this permit shall alter or affect the authority of U.S. EPA to obtain information pursuant to Federal Statute 42 USC 7414, Inspections, monitoring, and entry [401 KAR 52:020, Section 11(3)d.].
- o. Nothing in this permit shall alter or affect the authority of U.S. EPA to impose emergency orders pursuant to Federal Statute 42 USC 7603, Emergency orders [401 KAR 52:020, Section 11(3)a.].
- p. This permit consolidates the authority of any previously issued PSD, NSR, or Synthetic Minor source preconstruction permit terms and conditions for various emission units and

SECTION G - GENERAL PROVISIONS (CONTINUED)

incorporates all requirements of those existing permits into one single permit for this source.

- q. Pursuant to 401 KAR 52:020, Section 11, a permit shield shall not protect the owner or operator from enforcement actions for violating an applicable requirement prior to or at the time of permit issuance. Compliance with the conditions of this permit shall be considered compliance with:
 - (1) Applicable requirements that are included and specifically identified in this permit; and
 - (2) Non-applicable requirements expressly identified in this permit.

2. Permit Expiration and Reapplication Requirements

- a. This permit shall remain in effect for a fixed term of five (5) years following the original date of issue. Permit expiration shall terminate the source's right to operate unless a timely and complete renewal application has been submitted to the Division at least six (6) months prior to the expiration date of the permit. Upon a timely and complete submittal, the authorization to operate within the terms and conditions of this permit, including any permit shield, shall remain in effect beyond the expiration date, until the renewal permit is issued or denied by the Division [401 KAR 52:020, Section 12].
- b. The authority to operate granted shall cease to apply if the source fails to submit additional information requested by the Division after the completeness determination has been made on any application, by whatever deadline the Division sets [401 KAR 52:020, Section 8(2)].

3. Permit Revisions

- a. A minor permit revision procedure may be used for permit revisions involving the use of economic incentive, marketable permit, emission trading, and other similar approaches, to the extent that these minor permit revision procedures are explicitly provided for in the State Implementation Plan (SIP) or in applicable requirements and meet the relevant requirements of 401 KAR 52:020, Section 14(2).
- b. This permit is not transferable by the permittee. Future owners and operators shall obtain a new permit from the Division for Air Quality. The new permit may be processed as an administrative amendment if no other change in this permit is necessary, and provided that a written agreement containing a specific date for transfer of permit responsibility coverage and liability between the current and new permittee has been submitted to the permitting authority within ten (10) days following the transfer.

4. Construction, Start-Up, and Initial Compliance Demonstration Requirements

Pursuant to a duly submitted application the Kentucky Division for Air Quality hereby authorizes the construction of the equipment described herein, emission units 01, 02, and 11 in accordance with the terms and conditions of this permit (V-19-020 R2).

SECTION G - GENERAL PROVISIONS (CONTINUED)

- a. Construction of any process and/or air pollution control equipment authorized by this permit shall be conducted and completed only in compliance with the conditions of this permit.
- b. Within thirty (30) days following commencement of construction and within fifteen (15) days following start-up and attainment of the maximum production rate specified in the permit application, or within fifteen (15) days following the issuance date of this permit, whichever is later, the permittee shall furnish to the Regional Office listed on the front of this permit in writing, notification of the following:
 - (1) The date when construction commenced.
 - (2) The date of start-up of the affected facilities listed in this permit.
 - (3) The date when the maximum production rate specified in the permit application was achieved.
- c. Pursuant to 401 KAR 52:020, Section 3(2), unless construction is commenced within eighteen (18) months after the permit is issued, or begins but is discontinued for a period of eighteen (18) months or is not completed within a reasonable timeframe then the construction and operating authority granted by this permit for those affected facilities for which construction was not completed shall immediately become invalid. Upon written request, the Cabinet may extend these time periods if the source shows good cause.
- d. Pursuant to 401 KAR 50:055, Section 2(1)(a), an owner or operator of any affected facility subject to any standard within the administrative regulations of the Division for Air Quality shall demonstrate compliance with the applicable standard(s) within sixty (60) days after achieving the maximum production rate at which the affected facility will be operated, but not later than 180 days after initial start-up of such facility. Pursuant to 401 KAR 52:020, Section 3(3)(c), sources that have not demonstrated compliance within the timeframes prescribed in 401 KAR 50:055, Section 2(1)(a), shall operate the affected facility only for purposes of demonstrating compliance unless authorized under an approved compliance plan or an order of the cabinet.
- e. This permit shall allow time for the initial start-up, operation, and compliance demonstration of the affected facilities listed herein. However, within sixty (60) days after achieving the maximum production rate at which the affected facilities will be operated but not later than 180 days after initial start-up of such facilities, the permittee shall conduct a performance demonstration on the affected facilities in accordance with 401 KAR 50:055, General compliance requirements. Testing must also be conducted in accordance with General Provisions G.5 of this permit.
- f. Terms and conditions in this permit established pursuant to the construction authority of 401 KAR 51:017 or 401 KAR 51:052 shall not expire.

5. Testing Requirements

- a. Pursuant to 401 KAR 50:045, Section 2, a source required to conduct a performance test shall submit a completed Compliance Test Protocol form, DEP form 6028, or a test protocol a source has developed for submission to other regulatory agencies, in a format approved by the cabinet, to the Division's Frankfort Central Office a minimum of 60 days

SECTION G - GENERAL PROVISIONS (CONTINUED)

prior to the scheduled test date. Pursuant to 401 KAR 50:045, Section 7, the Division shall be notified of the actual test date at least 30 days prior to the test.

- b. Pursuant to 401 KAR 50:045, Section 5, in order to demonstrate that a source is capable of complying with a standard at all times, any required performance test shall be conducted under normal conditions that are representative of the source's operations and create the highest rate of emissions. If [When] the maximum production rate represents a source's highest emissions rate and a performance test is conducted at less than the maximum production rate, a source shall be limited to a production rate of no greater than 110 percent of the average production rate during the performance tests. If and when the facility is capable of operation at the rate specified in the application, the source may retest to demonstrate compliance at the new production rate. The Division for Air Quality may waive these requirements on a case-by-case basis if the source demonstrates to the Division's satisfaction that the source is in compliance with all applicable requirements.
- c. Results of performance test(s) required by the permit shall be submitted to the Division by the source or its representative within 45 days or sooner if required by an applicable standard, after the completion of the fieldwork.

6. Acid Rain Program Requirements

- a. If an applicable requirement of Federal Statute 42 USC 7401 through 7671q (the Clean Air Act) is more stringent than an applicable requirement promulgated pursuant to Federal Statute 42 USC 7651 through 7651o (Title IV of the Act), both provisions shall apply, and both shall be state and federally enforceable.
- b. The permittee shall comply with all applicable requirements and conditions of the Acid Rain Permit and the Phase II permit application (including the Phase II NO_x compliance plan and averaging plan, if applicable) incorporated into the Title V permit issued for this source. The source shall also comply with all requirements of any revised or future acid rain permit(s) issued to this source.

7. Emergency Provisions

- a. Pursuant to 401 KAR 52:020, Section 24(1), an emergency shall constitute an affirmative defense to an action brought for the noncompliance with the technology-based emission limitations if the permittee demonstrates through properly signed contemporaneous operating logs or relevant evidence that:
 - (1) An emergency occurred and the permittee can identify the cause of the emergency;
 - (2) The permitted facility was at the time being properly operated;
 - (3) During an emergency, the permittee took all reasonable steps to minimize levels of emissions that exceeded the emissions standards or other requirements in the permit; and
 - (4) Pursuant to 401 KAR 52:020, 401 KAR 50:055, and KRS 224.01-400, the permittee notified the Division as promptly as possible and submitted written notice of the emergency to the Division when emission limitations were exceeded due to an emergency. The notice shall include a description of the emergency, steps taken to mitigate emissions, and corrective actions taken.

SECTION G - GENERAL PROVISIONS (CONTINUED)

- (5) This requirement does not relieve the source of other local, state or federal notification requirements.
 - b. Emergency conditions listed in General Condition G.7.a above are in addition to any emergency or upset provision(s) contained in an applicable requirement [401 KAR 52:020, Section 24(3)].
 - c. In an enforcement proceeding, the permittee seeking to establish the occurrence of an emergency shall have the burden of proof [401 KAR 52:020, Section 24(2)].
8. Ozone Depleting Substances
- a. The permittee shall comply with the standards for recycling and emissions reduction pursuant to 40 CFR 82, Subpart F, except as provided for Motor Vehicle Air Conditioners (MVACs) in Subpart B:
 - (1) Persons opening appliances for maintenance, service, repair, or disposal shall comply with the required practices contained in 40 CFR 82.156 and 82.157.
 - (2) Equipment used during the maintenance, service, repair, or disposal of appliances shall comply with the standards for recycling and recovery equipment contained in 40 CFR 82.158.
 - (3) Persons performing maintenance, service, repair, or disposal of appliances shall be certified by an approved technician certification program pursuant to 40 CFR 82.161.
 - (4) Persons disposing of small appliances, MVACs, and MVAC-like appliances (as defined at 40 CFR 82.152) shall comply with the recordkeeping requirements pursuant to 40 CFR 82.166
 - (5) Persons owning commercial or industrial process refrigeration equipment shall comply with the leak repair requirements pursuant to 40 CFR 82.156 and 82.157.
 - (6) Owners/operators of appliances normally containing 50 or more pounds of refrigerant shall keep records of refrigerant purchased and added to such appliances pursuant to 40 CFR 82.166.
 - b. If the permittee performs service on motor (fleet) vehicle air conditioners containing ozone-depleting substances, the source shall comply with all applicable requirements as specified in 40 CFR 82, Subpart B, *Servicing of Motor Vehicle Air Conditioners*.
9. Risk Management Provisions
- a. The permittee shall comply with all applicable requirements of 401 KAR Chapter 68, Chemical Accident Prevention, which incorporates by reference 40 CFR Part 68, Risk Management Plan provisions. If required, the permittee shall comply with the Risk Management Program and submit a Risk Management Plan to U.S. EPA using the RMP* eSubmit software.
 - b. If requested, submit additional relevant information to the Division or the U.S. EPA.

SECTION H - ALTERNATE OPERATING SCENARIOS

Emissions Units 1 and 2: Identical Pulverized Coal-fired, Dry Bottom, Wall-fired Boilers

Description:

Controls: Low NO_x burner (LNB), dry electrostatic precipitator (ESP), wet (scrubber) flue gas desulfurization (FGD) (dolomitic lime), coal re-burn technology, dry sorbent injection (DSI) (hydrated lime), activated carbon injection (ACI)

Monitoring Equipment: Continuous Opacity Monitoring System (COMS), Continuous Emissions Monitoring (CEMS) Mercury (Hg), Sulfur Dioxide (SO₂), Nitrogen Oxides (NO_x), Carbon Dioxide (CO₂)

No. 2 fuel oil used for startup and stabilization

Secondary Fuel: Petroleum Coke

Maximum Continuous Rating: 2,660 MMBtu/hour, each

Construction Commenced: June 1976

Commercial Operation: December 1979 (EU 1) January 1981 (EU 2)

APPLICABLE REGULATIONS:

401 KAR 51:160, *NO_x Requirements for Large Utility and Industrial Boilers*

401 KAR 51:210, *CAIR NO_x annual trading program*

401 KAR 51:220, *CAIR NO_x Ozone Season Group 2 trading program*

401 KAR 51:230, *CAIR SO₂ Trading Program*

401 KAR 51:240, *Cross-State Air Pollution Rule (CSAPR) NO_x annual trading program*

401 KAR 52: 260, *Cross-State Air Pollution Rule (CSAPR) SO₂ group 1 trading program*

401 KAR 52:060, *Acid Rain Permits*

401 KAR 59:015, *New Indirect Heat Exchangers*

401 KAR 60:005, Section 2(2)(a), 40 C.F.R. 60.40 to 60.46, (**Subpart D**), *Standards of Performance for Fossil-Fuel-Fired Steam Generators*

401 KAR 63:002, Section 2(4)(yyyy), 40 C.F.R. 63.9980 to 63.10042, (**Subpart UUUUU**), *National Emission Standards for Hazardous Air Pollutants: Coal and Oil-fired Electric Utility Steam Generating Units*

40 CFR 52.21, (a) through (i) and (s) through (w), *Prevention of Significant Deterioration of Air Quality applicable to major construction or modification commenced before August 7, 1979*

40 CFR Part 64, *Compliance Assurance Monitoring (CAM)*

40 CFR Part 75, *Continuous Emissions Monitoring (CEM)*

40 CFR 97, Subpart GGGGG, *CSAPR NO_x Ozone Season Group 3 Trading Program*

1. Operating Limitations:

- a) Once the Gas Conversion Project is completed or by September 1, 2022, whichever is sooner, Emission Units 1 and 2 shall no longer utilize coal, petroleum coke, or No. 2 fuel oil and shall only utilize natural gas as a fuel. [401 KAR 52:020, Section 10, to preclude 401 KAR 51:017]
- b) The permittee is required to meet work practice requirements specified in 40 CFR 63, Subpart UUUUU, Table 3, Items 3 and 4 at all times except during periods of startup per paragraph 1. **Operating Limitations: (a)(i) and (ii)** and shutdown requirements per 1. **Operating Limitations: (a)(iii)** [40 CFR 63.9991(a) and 40 CFR 63.10000(a)]

SECTION H - ALTERNATE OPERATING SCENARIOS (CONTINUED)

- i) The permittee shall comply with the following because they have chosen to comply using paragraph (1) of the definition of “startup” in 40 CFR 63.10042: [Startup means the first-ever firing of fuel in a boiler after a shutdown event for any purpose. Startup ends when any of the steam from the boiler is used to generate electricity for sale over the grid or for any other purpose (including on-site use). Any fraction of any hour in which startup occurs constitutes a full hour of startup] [40 CFR 63.10000(a) and 40 CFR 63, Subpart UUUUU, Table 3, Item 3a].
 - A) The Permittee shall operate all Continuous Monitoring System(s) (CMS) during startup [40 CFR 63, Subpart UUUUU, Table 3, Item 3a].
 - B) For startup of a unit, the permittee shall use clean fuels as defined in 40 CFR 63.10042 for ignition [40 CFR 63, Subpart UUUUU, Table 3, Item 3a].
 - C) Once the permittee converts to firing coal the permittee shall engage all of the applicable control technologies except dry scrubber and SCR. The permittee shall start the dry scrubber and SCR systems, if present, appropriately to comply with relevant standards applicable during normal operation [40 CFR 63, Subpart UUUUU, Table 3, Item 3a].
 - D) The permittee shall comply with all applicable emissions limits at all times except for periods that meet the applicable definitions of startup and shutdown in 40 CFR 63, Subpart UUUUU [40 CFR 63, Subpart UUUUU, Table 3, Item 3a].
 - E) The permittee shall collect monitoring data during startups as specified in 40 CFR 63.10020(a) and (e) and maintain records during startup periods, as specified in 40 CFR 63.10032 and 63.10021(h). The permittee shall provide reports concerning activities and startup periods, as specified in 40 CFR 63.10011(g), 63.10021(i), and 63.10031 [40 CFR 63, Subpart UUUUU, Table 3, Item 3a and 3d].
 - F) The permittee shall provide reports concerning activities and startup periods, as specified in 40 CFR 63.10011(g) and 40 CFR 63.10021(h) and (i) and 40 CFR 63.10031 [40 CFR 63, Subpart UUUUU, Table 3 Item 3(1)(a) and Item 3(2)(d)].
 - G) To satisfy the initial and continuous compliance requirements of 40 CFR 63.10011(g) and 63.10021(h), respectively, the permittee may use diluent cap and default gross output values, as described in 40 CFR 63.10007(f), during startup periods.
 - H) The permittee shall provide reports concerning activates and startup periods, as specified in 40 CFR 63.10011(g) and 40 CFR 63.10021(h) and (i), and 40 CFR 63.10031.
- ii) The permittee has the option of using either definition of startup defined in 40 CFR 63, Subpart UUUUU, Table 3 Item 3(a)(1) or Item 3(a)(2) for demonstrating initial compliance. The permittee may switch from Item 3(a)(1) to Item 3(a)(2) of 40 CFR 63, Subpart UUUUU, Table 3 (or vice-versa) provided that all the Notification, Reporting and Recordkeeping requirements of 40 CFR 63.10030(e)(8)(iii)(A) through (E) are fulfilled [40 CFR 63.10030(e)(8)].
- iii) The permittee shall comply with the following during a shutdown [shutdown means the period in which cessation of operation of an EGU is initiated for any purpose. Shutdown begins when the EGU no longer generates electricity or makes useful thermal energy (such as heat or steam) for industrial, commercial, heating, or cooling purposes or when no coal, liquid gas, syngas, or solid oil-derived fuel is being fired in the EGU, whichever is earlier. Shutdown ends when the EGU no longer generates

SECTION H - ALTERNATE OPERATING SCENARIOS (CONTINUED)

electricity or makes useful thermal energy (such as steam or heat) for industrial commercial, heating, or cooling purposes, and no fuel is being fired in the EGU. Any fraction of an hour in which shutdown occurs constitutes a full hour of shutdown.] [40 CFR 63.10000(a) and 40 CFR 63, Subpart UUUUU, Table 3, Item 4.]

- A) The permittee shall operate all CMS during shutdown [40 CFR 63, Subpart UUUUU, Table 3, Item 4, 1st Paragraph].
- B) The permittee shall also collect appropriate data, and the permittee shall calculate the pollutant emission rate for each hour of shutdown for these pollutants for which a CMS is used [40 CFR 63, Subpart UUUUU, Table 3, Item 4, 1st Paragraph].
- C) While firing coal during shutdown, the permittee shall vent emissions to the main stack(s) and operate all applicable control devices and continue to operate those control devices after the cessation of coal fuel being fed into the EGU and for as long as possible thereafter considering operational and safety concerns [40 CFR 63, Subpart UUUUU, Table 3, Item 4, 2nd Paragraph].
- D) In any case, the permittee shall operate the controls when necessary to comply with other standards made applicable to the EGU by a permit limit or a rule other than 40 CFR 63, Subpart UUUUU and that require operation of the control devices [40 CFR 63, Subpart UUUUU, Table 3, Item 4, 2nd Paragraph].
- E) If, in addition to the fuel used prior to initiation of shutdown, another fuel shall be used to support the shutdown process, that additional fuel shall be one or a combination of the clean fuels defined in 40 CFR 63.10042 and shall be used to the maximum extent possible, taking into account considerations such as not compromising boiler or control device integrity [40 CFR 63, Subpart UUUUU, Table 3, Item 4, 3rd Paragraph].
- F) The permittee shall comply with all applicable emission limits at all times except during shutdown periods at which time the permittee shall meet this work practice [40 CFR 63, Subpart UUUUU, Table 3, Item 4, 5th Paragraph].
- G) The permittee shall collect monitoring data during shutdown periods, as specified in 40 CFR 63.10020(a) [40 CFR 63, Subpart UUUUU, Table 3, Item 4, 5th Paragraph].
- H) The permittee shall maintain records during shutdown periods as provided in 40 CFR 63.10032 and 40 CFR 63.10021(h) [40 CFR 63, Subpart UUUUU, Table 3, Item 4, 5th Paragraph].
- I) To satisfy the initial and continuous compliance requirements of 40 CFR 63.10011(g) and 63.10021(h), respectively, the permittee may use diluent cap and default gross output values, as described in 40 CFR 63.10007(f), during shutdown periods.
- J) The permittee shall provide reports concerning shutdown periods, as specified in 40 CFR 63.10011(g), 40 CFR 63.10021(h), 40 CFR 63.10021(i), and 40 CFR 63.10031 [40 CFR 63, Subpart UUUUU, Table 3, Item 4, 5th Paragraph].

Compliance Demonstration: See 1. **Operating Limitations:** (c) and (g), 5. **Specific Recordkeeping Requirements:** (b), (h), and (k) through (m).

- c) The permittee shall conduct periodic performance tune-ups for each EGU, as specified in 40 CFR 63.10021(e)(1) through (9). Subsequently the permittee shall perform an inspection of the burner at least once every 36 calendar months. If an EGU is offline

SECTION H - ALTERNATE OPERATING SCENARIOS (CONTINUED)

when a deadline to perform the tune-up passes, the permittee shall perform the tune-up work practice requirements within 30 days after the re-start of the affected unit [40 CFR 63.10021(e)].

- i) Inspect the burner and combustion controls, and clean or replace any components of the burner or combustion controls as necessary upon initiation of the work practice program and at least once every required inspection period. Repair of a burner or combustion control component requiring special order parts may be scheduled as follows [40 CFR 63.10021(e)(1)]:
 - A) Burner or combustion control component parts needing replacement that affect the ability to optimize NO_x and CO shall be installed within three calendar months after the burner inspection [40 CFR 63.10021(e)(1)(i)];
 - B) Burner or combustion control component parts that do not affect the ability to optimize NO_x and CO may be installed on a schedule determined by the operator [40 CFR 63.10021(e)(1)(ii)];
- ii) As applicable, inspect the flame pattern and make any adjustments to the burner or combustion controls necessary to optimize the flame pattern. The adjustment should be consistent with the manufacturer's specifications, if available, or in accordance with best combustion engineering practice for that burner type [40 CFR 63.10021(e)(2)];
- iii) As applicable, observe the damper operations as a function of mill and/or cyclone loadings, cyclone and pulverizer coal feeder loadings, or other pulverizer and coal mill performance parameters, making adjustments and effecting repair to dampers, controls, mills, pulverizers, cyclones, and sensors [40 CFR 63.10021(e)(3)];
- iv) As applicable, evaluate windbox pressures and air proportions, making adjustments and effecting repair to dampers, actuators, controls, and sensors [40 CFR 63.10021(e)(4)];
- v) Inspect the system controlling the air-to-fuel ratio and ensure that it is correctly calibrated and functioning properly. Such inspection may include calibrating excess O₂ probes and/or sensor, adjusting overfire air systems, changing software parameters, and calibrating associated actuators and dampers to ensure that the systems are operated as designed. Any component out of calibration, in or near failure, or in a state that is likely to negate combustion optimization efforts prior to the next tune-up, should be corrected or repaired as necessary [40 CFR 63.10021(e)(5)];
- vi) Optimize combustion to minimize generation of CO and NO_x. The optimization should be consistent with the manufacturer's specification, if available, or best combustion engineering practice for the applicable burner type. NO_x optimization includes burners, overfire air controls, concentric firing system improvements, neural network or combustion efficiency software, control systems calibrations, adjusting combustion zone temperature profiles, and add-on controls such as SCR and SNCR; CO optimization includes burner, overfire air controls, concentric firing system improvements, neural network or combustion efficiency software, control systems calibrations, and adjusting combustion zone temperature profiles [40 CFR 63.10021(e)(6)];
- vii) While operating at full load or the predominantly operated load, measure the concentration in the effluent stream of CO and NO_x in ppm, by volume, and oxygen in volume percent, before and after the tune-up adjustments are made (measurements

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- may be either on a dry or wet basis, as long as it is the same basis before and after the adjustments are made). The permittee may use portable CO, NO_x and O₂ monitors for this measurement. EGU's employing neural network optimization systems need only provide a single pre- and post-tune-up value rather than continual values before and after each optimization adjustment made by the system [40 CFR 63.10021(e)(7)];
- viii) Maintain on-site and submit, if requested by the Administrator, an annual report containing the information specified here-in including [40 CFR 63.10021(e)(8)];
- A) The concentrations of CO and NO_x in the effluent stream in ppm by volume, and oxygen in volume percent, measured before and after an adjustment of the EGU combustion systems [40 CFR 63.10021(e)(8)(i)];
- B) A description of any corrective actions taken as a part of the combustion adjustment [40 CFR 63.10021(e)(8)(ii)]; and
- C) The type(s) and amount(s) of fuel used over the 12 calendar months prior to an adjustment, but only if the unit was physically and legally capable of using more than one type of fuel during that period [40 CFR 63.10021(e)(8)(iii)]; and
- ix) Report the dates of the initial and subsequent tune-ups in hard copy, as specified in 40 CFR 63.10031(f)(5), through June 30, 2020. On or after July 1, 2020, report the date of all tune-ups electronically, in accordance with 40 CFR 63.10031(f). The tune-up report date is the date when tune-up requirements in 40 CFR 63.10021(e)(6) and (e)(7) are completed [40 CFR 63.10021(e)(9)].

Compliance Demonstration: See 5. **Specific Recordkeeping Requirements:** (d) and (h).

- d) If the permittee elects to (or is required to) use CEMS to continuously monitor Hg, HCl, HF, SO₂, or PM emissions (or, if applicable, sorbent trap monitoring systems to continuously collect Hg emissions data), the following default values are available for use in the emission rate calculations during startup periods or shutdown periods (as defined in 40 CFR 63.10042). For the purposes of 40 CFR 63, Subpart UUUUU, these default values are not considered to be substitute data.
- i) *Diluent cap values.* If the permittee uses CEMS (or, if applicable, sorbent trap monitoring systems) to comply with a heat input-based emission rate limit, the permittee may use the following diluent cap values for a startup or shutdown hour in which the measured CO₂ concentration is below the cap value or the measured O₂ concentration is above the cap value. The permittee may use 5% for CO₂ or 14% for O₂ [40 CFR 63.10007(f)].
- ii) *Default gross output.* If the permittee uses CEMS to continuously monitor Hg, HCl, HF, SO₂, or PM emissions (or, if applicable, sorbent trap monitoring systems to continuously collect Hg emissions data), the following default value is available for use in the emission rate calculations during startup periods or shutdown periods (as defined in 40 CFR 63.10042). For the purposes of 40 CFR 63, Subpart UUUUU, this default value is not considered to be substitute data. For a startup or shutdown hour in which there is heat input to an affected EGU but zero gross output, the permittee shall calculate the pollutant emission rate using a value equivalent to 5% of the maximum sustainable gross output, expressed in megawatts, as defined in 40 CFR 75, Appendix A, section 6.5.2.1(a)(1). This default gross output is either the nameplate capacity of the EGU or the highest gross output observed in at least four representative quarters of EGU operation. For a monitored common stack, the default gross output is used

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- only when all EGUs are operating (*i.e.*, combusting fuel) are in startup or shutdown mode, and have zero electrical generation. Under those conditions, a default gross output equal to 5% of the combined maximum sustainable gross output of the EGUs that are operating but have a total of zero gross output must be used to calculate the hourly gross output-based pollutant emissions rate [40 CFR 63.10007(f)(2)].
- e) The permittee shall either install the required CEMS, PM CPMS, and sorbent trap monitoring systems in the stack or at a location in the ductwork downstream of all emissions control devices, where the pollutant and diluents concentrations are representative of the emissions that exit to the atmosphere [40 CFR 63.10010(a)(1)].
 - f) The permittee shall comply with the applicable General Provisions in 40 CFR 63.1 through 40 CFR 63.15 that are provided in Table 9 of 40 CFR 63, Subpart UUUUU [40 CFR 63.10040].
 - g) The permittee shall comply with all applicable notification and recording requirements in 40 CFR 60.10030 through 40 CFR 63.10033 according to the schedule in 40 CFR 63.10030 and Subpart A of 40 CFR 63, Subpart UUUUU, no later than April 16, 2016. The permittee shall demonstrate compliance no later than one-hundred-eighty (180) days after April 16, 2016 (October 13, 2016).
 - h) During a startup period or a shutdown period, the permittee shall comply with the work practice standards established in 40 CFR 63, Subpart UUUUU. An affected facility subject to 40 C.F.R. 63.9991 shall meet the work practice standards established in 40 C.F.R. Part 63, Table 3 to Subpart UUUUU, as established in 401 KAR 63:002, Section 2(4)(yyyy). [401 KAR 59:015, Section 7 and Section 7(2)(b)]

2. Emission Limitations:

- a) Particulate matter (PM) emissions from each stack shall not exceed 0.10 lb/MMBtu, based on a 3-hour average [40 CFR 60.42(a)(1) and 40 CFR 52.21].
Compliance Demonstration: Compliance with **2. Emission Limitations:** (b) substantiates compliance with this PM emission limitation.
- b) Visible emissions shall not exceed twenty 20% opacity based on a six-minute average, except that a maximum of 27% opacity shall be allowed for one six-minute period in any 60 consecutive minutes [40 CFR 60.42(a)(2)].
Compliance Demonstration: See **3. Testing Requirements:** (a) and **4. Specific Monitoring Requirements:** (a) and **6. Specific Reporting Requirements:** (a).
- c) SO₂ emissions from each stack shall not exceed 1.2 lb/MMBtu based on a three-hour average [40 CFR 60.43(a)(2)].
Compliance Demonstration: Compliance with **2. Emission Limitations:** (d) substantiates compliance with this emission limitation.
- d) SO₂ emissions from each stack shall not exceed 0.8 lb/MMBtu based on a three-hour average [40 CFR 52.21].
Compliance Demonstration: See **4. Specific Monitoring Requirements:** (c) through (f).

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- e) NO_x emissions from each stack shall not exceed 0.70 lb/MMBtu based on a three-hour average [40 CFR 60.44(a)(3)].

Compliance Demonstration: See 4. **Specific Monitoring Requirements:** (c) through (f).

- f) For filterable PM, emissions shall not exceed 3.0E-2 lb/MMBtu based on the appropriate requirements in Table 2 of 40 CFR 63, Subpart UUUUU and shall apply at all times except during periods of startup or shutdown [40 CFR 63.9991(a), 40 CFR 63, Subpart UUUUU Table 2, Item 1.a, and 40 CFR 63.10000(a)].

Compliance Demonstration: See 3. **Testing Requirements:** (b), (e) though (h), and (j) and 6. **Specific Reporting Requirements:** (c).

- g) For hydrogen chloride (HCl), emissions shall not exceed 2.0E-3 lb/MMBtu based on the appropriate requirements in Table 2 of 40 CFR 63, Subpart UUUUU and shall apply at all times except during periods of startup or shutdown [40 CFR 63.9991(a), 40 CFR 63, Subpart UUUUU Table 2, Item 1.b., and 40 CFR 63.10000(a)].

Compliance Demonstration: See 3. **Testing Requirements:** (c), (e) through (j), and 6. **Specific Reporting Requirements:** (c).

- h) For mercury (Hg), emissions shall not exceed 1.2 lb/TBtu based on calculating the 30-boiler operating day rolling arithmetic average emissions rate in units of the applicable emissions standard basis at the end of each boiler operating day using all of the quality assured hourly average CEMS data for the previous 30-boiler operating days, excluding data recorded during periods of startup or shut down [40 CFR 63.9991(a), 40 CFR 63, Subpart UUUUU, Table 2, Item 1.c.].

Compliance Demonstration: See 3. **Testing Requirements:** (d) and (e) through (j), 4. **Specific Monitoring Requirements:** (g) through (l), and 5. **Specific Recordkeeping Requirements:** (f) and (g).

3. Testing Requirements:

- a) If no U.S. EPA Reference Method 9 tests are performed pursuant to paragraph 4. **Specific Monitoring Requirements:** (a), then the permittee shall determine the opacity from the stack by U.S. EPA Reference Method 9 at least once every 14 boiler operating days, or more frequently if requested by the Division, to demonstrate compliance with the opacity standard. If no U.S. EPA Reference Method 9 test is completed during the time period, the reason for not completing a test shall be documented and the permittee may use the COM system for assuring compliance with the visible emission limitation during that period.
- b) Since the coal-fired EGU's have not qualified as LEEs for filterable particulate matter (PM), the permittee shall demonstrate compliance through initial and periodic quarterly performance stack test for PM according to Table 5 and 40 CFR 63.10007, except as otherwise provided in 40 CFR 63.10021(d)(1) [40 CFR 63.10000(c)(1)(iv), 40 CFR 63.10006(c) and 40 CFR 63.10011(a)].
- c) Since the coal-fired EGUs have not qualified as LEEs for hydrogen chloride (HCl), the permittee shall demonstrate initial and continuous compliance by conducting initial and periodic quarterly performance stack test for HCl according to Table 5 and 40 CFR 63.10007, except as otherwise provided in 40 CFR 63.10021(d)(1) [40 CFR

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63.10000(c)(1)(v), 40 CFR 63.10006(d), and 40 CFR 63.10011(a)].

- d) Since the coal-fired EGUs have not qualified as LEEs for Hg, the permittee shall demonstrate initial and continuous compliance through use of a Hg CEMS, in accordance with appendix A of 40 CFR 63, Subpart UUUUU. The initial performance test shall consist of a 30-boiler operating day rolling average emissions rate obtained with a certified CEMS, expressed in units of the standard. If the monitoring system is certified prior to the applicable compliance date, the initial averaging period shall either begin with: The first boiler operating day on or after the compliance date; or 30 boiler operating days prior to that date, as described in 40 CFR 63.10005(b). In all cases, the initial 30-operating day averaging period shall be completed on or before the date that compliance shall be demonstrated, in accordance with 40 CFR 63.9984(f). Initial compliance is demonstrated if the results of the performance test meet the applicable emission limit in Table 2 of 40 CFR 63, Subpart UUUUU [40 CFR 63.10000(c)(1)(vi) and 40 CFR 63.10011(c)(1)].
- e) For complying with emission standards under 40 CFR 63, Subpart UUUUU, the permittee may skip performance testing in those quarters during which less than 168 boiler operating hours occur, except that a performance test shall be conducted at least once every calendar year [40 CFR 63.10021(d)(1)].
- f) The permittee shall conduct all required performance tests according to 40 CFR 63.7(d), (e), (f), and (h). The permittee shall also develop a site-specific test plan according to the requirements in 40 CFR 63.7(c) [40 CFR 63.10007(a)].
 - i) For Hg CEMS, to determine compliance with a 30-boiler operating day rolling average emission limit, the permittee shall collect data for all nonexempt unit operating conditions (see 40 CFR 63.10011(g) and Table 3 of 40 CFR 63, Subpart UUUUU) [40 CFR 63.10007(a)(1)].
 - ii) For PM and HCl performance testing, maximum normal operating load will be generally between 90 and 110 percent of design capacity but should be representative of site specific normal operations during each test run [40 CFR 63.10007(a)(2)].
- g) The permittee shall conduct each performance test (including traditional 3-run stack tests, 30-boiler operating day tests based on CEMS data) according to the requirements in Table 5 of 40 CFR 63, Subpart UUUUU [40 CFR 63.10007(b)].
- h) The permittee shall conduct a minimum of three separate test runs for each performance tests, as specified in 40 CFR 63.7(e)(3). Each test run shall comply with the minimum applicable sampling time or volume specified in Table 2 of 40 CFR 63, Subpart UUUUU [40 CFR 63.10007(d)].
- i) The permittee is required to (or elects to) demonstrate initial compliance using a CMS, for a particular emission or operating limit, the CMS shall pass a performance evaluation prior to the initial compliance demonstration. If a CMS has been previously certified under another state or federal program and is continuing to meet the on-going quality-assurance (QA) requirements of that program, then, provided that the certification and QA provisions of that program meet the applicable requirement of 40 CFR 63.10010(b) through (h), an additional performance evaluation of the CMS is not required under 40

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CFR 63, Subpart UUUUU. To demonstrate compliance with the applicable Hg emission limit specified in **2. Emission Limitations: (h)**, using Hg CEMS, initial compliance shall be demonstrated no later than the applicable date specified in 40 CFR 63.9984(f). Initial compliance is achieved if the arithmetic average of 30-boiler operating days of quality-assured CEMS data, expressed in units of the standard (see section 6.2 of appendix A of 40 CFR 63, Subpart UUUUU), meets the applicable Hg emission limit in Table 2 of 40 CFR 63, Subpart UUUUU [40 CFR 63.10005(d)].

- j) The permittee shall complete performance tests for the EGU at least 45 calendar days, measured from the test's end date, shall separate performance tests conducted every quarter. For units demonstrating compliance through quarterly emission testing, the permittee shall conduct a performance test in the 4th quarter of a calendar year if the EGU has skipped performance tests in the first 3 quarters of the calendar year. If the EGU misses a performance test deadline due to being inoperative and if 168 or more boiler operating hours occur in the next test period, the permittee shall complete an additional performance test in that period as follows[40 CFR 63.10006(f)]:
 - i) At least 15 calendar days shall separate two performance tests conducted in the same quarter [40 CFR 63.10006(f)(1)];
 - ii) At least 107 calendar days shall separate two performance tests conducted in the same calendar year [40 CFR 63.10006(f)(2)]; and
 - iii) At least 350 calendar days shall separate two performance tests conducted in the same 3 year period [40 CFR 63.10006(f)(3)].

4. Specific Monitoring Requirements:

- a) A continuous opacity monitoring (COM) system shall conform to requirements of these sections which include installing, calibrating, operating, and maintaining the continuous monitoring system for accurate opacity measurement. Excluding exempted time periods, if any three consecutive six-minute average opacity values exceed the applicable opacity standard, the permittee shall, as appropriate [40 CFR 60.45(a), 401 KAR 59:005, Section 4(3)(a)(1), 40 CFR 64.5(c)(1), and 401 KAR 52:020, Section 10]:
 - 1) Accept the readout from the COM as an indicator of equipment performance and perform an inspection of the COM and/or the control equipment and make any repairs or;
 - 2) Within 30 minutes after the third consecutive COM indicated exceedance of the opacity standards, if emissions are visible, initiate a determination of opacity using U.S. EPA Reference Method 9 test. Also within 30 minutes after the third consecutive COM indicated exceedance, inspect the COM and/or the control equipment, and initiate any repairs. If a U.S. EPA Reference Method 9 cannot be performed, the reason for not performing the test shall be documented.
- b) The permittee shall monitor the voltage and amperage readings of the ESP transformer/rectifier sets once per shift. Corrective action shall be initiated when an excursion occurs outside the indicator ranges established in the approved CAM plan for those parameters [401 KAR 52:020, Section 10].
- c) Continuous emission monitoring systems (CEMS) shall be installed, calibrated, maintained, and operated for SO₂ emissions, NO_x emissions, and either oxygen (O₂) or carbon dioxide (CO₂) emissions [40 CFR 60.45(a), 401 KAR 52:020, Section 10]. The

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continuous emission monitoring systems shall be used to satisfy CAM requirements for SO₂ and NO_x [40 CFR 64.3(d)].

- 1) NO_x and SO₂ CEMS shall comply with Performance Specification 2 of Appendix B to 40 CFR Part 60 and 40 CFR Part 75 [40 CFR 64.3(d)(2)(ii) and (d)(2)(iv)].
 - 2) O₂ or CO₂ CEMS shall comply with Performance Specification 3 of Appendix B to 40 CFR Part 60 and 40 CFR Part 75 [40 CFR 64.3(d)(2)(ii) and (d)(2)(iv)].
 - 3) The continuous emission monitoring systems shall be used to satisfy CAM requirements for SO₂ and NO_x [40 CFR 64.3(d)].
- d) To meet the monitoring requirement for SO₂ and NO_x, the permittee shall use a continuous emission monitor (CEM). Excluding the startup and shutdown periods, if any three-hour average nitrogen oxide or sulfur dioxide value exceeds the standard, the permittee shall, as appropriate, initiate an investigation of the cause of the exceedance and/or the CEM system and make any necessary repairs or take corrective actions as soon as practicable [401 KAR 52:020, Section 10].
- e) Performance evaluations of CEMS required under 40 CFR 60.13(c) and calibration checks required under 40 CFR 60.13(d), shall be completed based on the procedures in 40 CFR 60.45(c) and listed below [40 CFR 60.45(c)]:
- 1) Methods 6, 7, and 3B of appendix A of this part, as applicable, shall be used for the performance evaluations of SO₂ and NO_x continuous monitoring systems. Acceptable alternative methods for Methods 6, 7, and 3B in Appendix A of 40 CFR 60 are given in 40 CFR 60.46(d). [40 CFR 60.45(c)(1)]
 - 2) Sulfur dioxide or nitric oxide, as applicable, shall be used for preparing calibration gas mixtures under Performance Specification 2 of Appendix B to 40 CFR 60 [40 CFR 60.45(c)(2)].
 - 3) The span value for a continuous monitoring system measuring the opacity of emissions shall be 80, 90, or 100 percent. The span value for a continuous monitoring system measuring sulfur oxides or NO_x shall be determined based on the table in 40 CFR 60.45(c)(3)(i) or the permittee may elect to use the span values for SO₂ and NO_x according to section 2.1.1 and 2.1.2 in Appendix A of 40 CFR 75 [40 CFR 60.45(c)(3)].
- f) Continuous emission monitoring data shall be converted into the units of applicable standards using the conversion procedure described 40 CFR 60.45(e) and 40 CFR 60.45(f) [40 CFR 60.45(e)].
- g) The permittee shall install, certify, maintain, and operate a Hg CEMS for Emission Unit 01 and 02, in accordance with Appendix A of 40 CFR 63, Subpart UUUUU [40 CFR 63, Subpart UUUUU, Table 5, Item 4].
- h) If the permittee demonstrates compliance with any applicable emissions limit through use of a continuous monitoring system (CMS) where a CMS includes a continuous parameter monitoring system (CPMS) as well as a continuous emissions monitoring system (CEMS), the permittee shall develop a site-specific monitoring plan and submit this site-specific monitoring plan, if requested, at least 60 days before the initial performance evaluation (where applicable) of the CMS. This requirement also applies to the permittee if the permittee petitions the Administrator for alternative monitoring parameters under

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40 CFR 63.8(f). This requirement to develop and submit a site-specific monitoring plan does not apply to affected sources with existing monitoring plans that apply to CEMS and CPMS prepared under Appendix B to 40 CFR part 60 or 40 CFR part 75, and meet the requirements of 40 CFR 63.10010. Using the process described in 40 CFR 63.8(f)(4), the permittee may request approval of monitoring system quality assurance and quality control procedures alternative to those specified, if approved, include those in the site-specific monitoring plan [40 CFR 63.10000(d)(1)].

- i) The site-specific monitoring plan shall include the information specified in 40 CFR 63.10000 (d)(5)(i) through (d)(5)(vii). Alternatively, the requirements of 40 CFR 63.10000 (d)(5)(i) through (d)(5)(vii) are considered to be met for a particular CMS [40 CFR 63.10000(d)(2)]:
 - A) The CMS is installed, certified, maintained, operated, and quality-assured either according to 40 CFR 75, or appendix A or B of 40 CFR 63, Subpart UUUUU [40 CFR 63.10000(d)(2)(i)]; and
 - B) The recordkeeping and reporting requirements of 40 CFR 75, or appendix A or B of 40 CFR 63, Subpart UUUUU, that pertain to CMS are met [40 CFR 63.10000(d)(2)(ii)].
- ii) If requested by the Administrator, the permittee shall submit the monitoring plan (or relevant portion of the plan) at least 60 days before the initial performance evaluation of a particular CMS, except where the CMS has already undergone a performance evaluation that meets the requirements of 40 CFR 63.10010 (e.g., if the CMS was previously certified under another program) [40 CFR 63.10000(d)(3)].
- iii) The permittee shall operate and maintain the CMS according to the site-specific monitoring plan [40 CFR 63.10000(d)(4)].
- iv) The provisions of the site-specific monitoring plan shall address the following items [40 CFR 63.10000(d)(5)]:
 - A) Installation of the CMS sampling probe or other interface at a measurement location relative to each affected process unit such that the measurement is representative of control of the exhaust emissions (e.g., on or downstream of the last control device). See 40 CFR 63.10010(a) for further details [40 CFR 63.10000(d)(5)(i)];
 - B) Performance and equipment specifications for the sample interface, the pollutant concentration or parametric signal analyzer, and the data collection and reduction systems [40 CFR 63.10000(d)(5)(ii)];
 - C) Schedule for conducting initial and periodic performance evaluations [40 CFR 63.10000(d)(5)(iii)];
 - D) Performance evaluation procedures and acceptance criteria (e.g., calibrations), including the quality control program in accordance with the general requirements of 40 CFR 63.8(d) [40 CFR 63.10000(d)(5)(iv)];
 - E) On-going operation and maintenance procedures, in accordance with the general requirements of 40 CFR 63.8(c)(1)(ii), (c)(3), and (c)(4)(ii) [40 CFR 63.10000(d)(5)(v)];
 - F) Conditions that define a CMS that is out of control consistent with 40 CFR 63.8(c)(7)(i) and for responding to out of control periods consistent with 40 CFR 63.8(c)(7)(ii) and (c)(8) [40 CFR 63.10000(d)(5)(vi)];

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- G) On-going recordkeeping and reporting procedures, in accordance with the general requirements of 40 CFR 63.10(c), (e)(1), and (e)(2)(i), or as specifically required under 40 CFR 63, Subpart UUUUU [40 CFR 63.10000(d)(4)(vii)].
- i) The permittee shall operate the monitoring system and collect data at all required intervals at all times that the affected EGU is operating, except for periods of monitoring system malfunctions or out-of-control periods (see 40 CFR 63.8(c)(7)), and required monitoring system quality assurance or quality control activities, including, as applicable, calibration checks and required zero and span adjustments. The permittee is required to affect monitoring system repairs in response to monitoring system malfunctions and to return the monitoring system to operation as expeditiously as practicable [40 CFR 63.10020(b)].
 - j) The permittee shall not use data recorded during EGU startup or shutdown in calculations used to report emissions. In addition, data recorded during monitoring system malfunctions or monitoring system out-of-control periods, repairs associated with monitoring system malfunctions or monitoring system out-of-control periods, or required monitoring system quality assurance or control activities may not be used in calculations used to report emissions or operating levels. The permittee shall use all of the quality-assured data collected during all other periods in assessing the operation of the control device and associated control system [40 CFR 63.10020(c)].
 - k) Except for periods of monitoring system malfunctions or monitoring system out-of-control periods, repairs associated with monitoring system malfunctions or monitoring system out-of-control periods, and required monitoring system quality assurance or quality control activates including, as applicable, calibration checks and required zero and span adjustments, failure to collect required data is a deviation from the monitoring requirements [40 CFR 63.10020(d)].
 - l) Since the permittee use a CEMS to measure Hg emissions, the permittee shall demonstrate continuous compliance by using all quality-assured hourly data recorded by the CEMS and the other required monitoring systems (e.g., flow rate, CO₂, O₂, or moisture systems) to calculate the arithmetic average emissions rate in units of the standard on a continuous 30-boiler operating day rolling average basis, updated at the end of each new boiler operating day [40 CFR 63.10021(b)].
 - m) See **Section F - Monitoring, Recordkeeping, and Reporting Requirements** for further requirements.

5. Specific Recordkeeping Requirements:

- a) The permittee shall maintain a file of all measurements, including continuous monitoring system, monitoring device, and performance testing measurements; all continuous monitoring system performance evaluations; all continuous monitoring system or monitoring device calibration checks; adjustments and maintenance performed on these systems and devices; and all other information required by 40 CFR 60. All information shall be recorded in a permanent form suitable for inspection [40 CFR 60.7(f)].

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- b) The permittee shall maintain the records of the occurrence and duration of any startup, shutdown, or malfunction in the operation of the emission unit; any malfunction of the air pollution control equipment; or any period during which a continuous monitoring system or monitoring device is inoperative [40 CFR 60.7(b)].
- c) Records of primary/secondary voltage and current shall be maintained with long-term operational records for a period of five years [40 CFR 64 and 401 KAR 52:020, Section 10].
- d) The permittee shall maintain adequate records of the accounts of each tune-up and provide documentation that all tune-up meet all rule requirements [40 CFR 63.10005(f)].
- e) Upon request, the permittee shall make available to the EPA Administrator such records as may be necessary to determine whether the performance tests have been done according to the requirements in 40 CFR 63, Subpart UUUUU [40 CFR 63.10007(g)].
- f) For Hg, the permittee shall maintain records according to Appendix A of 40 CFR 63, Subpart UUUUU and the following [40 CFR 63.10032(a)]:
 - i) A copy of each notification and report that the permittee submitted to comply with 40 CFR 63, Subpart UUUUU, including all documentation supporting any Initial Notification or Notification of Compliance Status or semiannual compliance report that the permittee submitted, according to the requirements in 40 CFR 63.10(b)(2)(xiv) [40 CFR 63.10032(a)(1)];
 - ii) Records of performance stack tests, fuel analysis, or other compliance demonstrations and performance evaluations, as required in 40 CFR 63.10(b)(2)(viii) [40 CFR 63.10032(a)(2)].
- g) For each CEMS, the permittee shall maintain the following [40 CFR 63.10032(b)]:
 - i) Records described in 40 CFR 63.10(b)(2)(vi) through (xi) [40 CFR 63.10032(b)(1)];
 - ii) Previous versions of the performance evaluation plan as required in 40 CFR 63.8(d)(3) [40 CFR 63.10032(b)(2)];
 - iii) Request for alternatives to relative accuracy test for CEMS as required in 40 CFR 63.8(f)(6)(i) [40 CFR 63.10032(b)(3)];
 - iv) Records of the date and time that each deviation started and stopped, and whether the deviation occurred during the period of startup, shutdown, or malfunction or during another period [40 CFR 63.10032(b)(4)].
- h) The permittee shall maintain the records required in Table 7 of 40 CFR 63, Subpart UUUUU to show continuous compliance with each emission limit and operating limit that applies to the permittee [40 CFR 63.10032(c)].
- i) The permittee shall maintain the following:
 - i) Records of monthly fuel use by each EGU, including the type(s) of fuel and amount(s) used [40 CFR 63.10032(d)(1)];
 - ii) If the permittee combust non-hazardous secondary materials that have been determined not to be solid waste pursuant to 40 CFR 241.3(b)(1), the permittee shall maintain a record which documents how the secondary material meets each of the legitimacy criteria. If the permittee combust a fuel that has been processed from a

SECTION H - ALTERNATE OPERATING SCENARIOS (CONTINUED)

- discarded non-hazardous secondary material pursuant to 40 CFR 241.3(b)(2), the permittee shall maintain records as to how the operations that produced the fuel satisfies the definition of processing in 40 CFR 241.2. If the fuel received a non-waste determination pursuant to the petition process submitted under 40 CFR 241.3(c), the permittee shall maintain a record which documents how the fuel satisfies the requirements of the petition [40 CFR 63.10032(d)(2)].
- j) The permittee shall maintain records of the occurrence and duration of each malfunction of an operation (i.e., process equipment) or the air pollution control and monitoring equipment [40 CFR 63.10032(g)].
 - k) The permittee shall maintain records of actions taken during periods of malfunction to minimize emissions in accordance with 40 CFR 63.10000(b), including corrective actions to restore malfunctioning process and air pollution control and monitoring equipment to its normal or usual manner of operation [40 CFR 63.10032(h)].
 - l) The records shall be in a form suitable and readily available for expeditious review, according to 40 CFR 63.10(b)(1) [40 CFR 63.10033(a)].
 - m) As specified in 40 CFR 63.10(b)(1), the permittee shall maintain each record for 5 years following the date of each occurrence, measurement, maintenance, corrective action, report, or record [40 CFR 63.10033(b)].
 - n) The permittee shall maintain each record on site for at least 2 years after the date of each occurrence, measurement, maintenance, corrective action, report, or record, according to 40 CFR 63.10(b)(1). The permittee can keep the records off site for the remaining 3 years [40 CFR 63.10033(c)].
 - o) The permittee shall keep visible observation records and U.S. EPA Reference Method 9 observations in a designated logbook and/or an electronic format. Records shall be maintained for five years [KAR 52:020, Section 10].
- 6. Specific Reporting Requirements:**
- a) Excess emission and monitoring system performance reports shall be submitted to the Administrator semiannually for each six-month period in the calendar year. All semiannual reports shall be postmarked by the 30th day following the end of each six-month period. Each excess emission and MSP report shall include the information required in 40 CFR 60.7(c). Periods of excess emissions and monitoring systems (MS) downtime that shall be reported are defined as follows [40 CFR 60.45(g)]:
 - 1) Excess emissions for opacity are defined as any six-minute period during which the average opacity exceeds twenty percent, except that one six-minute average per hour of up to 27% opacity need not be reported [40 CFR 60.45(g)(1)].
 - 2) Excess emissions of sulfur dioxide are defined as any three hour period during which the average emissions (arithmetic average of three contiguous one hour periods) as measure by CEMS exceed the applicable sulfur dioxide emissions standards [40 CFR 60.45(g)(2)].
 - 3) Excess emissions for emissions units using a continuous monitoring system for measuring nitrogen oxides are defined as any three hour period during which the

SECTION H - ALTERNATE OPERATING SCENARIOS (CONTINUED)

- average emissions (arithmetic average of three contiguous one hour periods) exceed the applicable nitrogen oxides emissions standards [40 CFR 60.45(g)(3)].
- b) The permittee shall submit all of the notifications in 40 CFR 63.7(b) and (c), 40 CFR 63.8(e), (f)(4) and (6) and 40 CFR 63.9(b) through (h) that apply to the permittee [40 CFR 63.10030(a)].
 - c) The permittee shall submit Notification of Intent to conduct a performance test at least 30 days before the performance test is scheduled to begin [40 CFR 63.10030(d)].
 - d) The permittee may switch from paragraph (1) of the definition of “startup” in 40 CFR 63.10042 to paragraph (2) of the definition of “startup” (or vice-versa), provided that [40 CFR 63.10021(i) and 40 CFR 63.10030(e)(8)(iii)]:
 - i) The permittee submits a request that identifies for each EGU or EGU emissions averaging group involved in the proposed switch both the current definition of “startup” relied on and the proposed definition you plan to rely on;
 - ii) The request arrives to the Administrator at least 30 calendar days prior to the date that the switch is proposed to occur;
 - iii) The permittee revises and submits all other applicable plans, e.g., monitoring and emissions averaging, with your submission;
 - iv) The permittee maintains records of all information regarding your choice of the definition of “startup”; and
 - v) The permittee begins to use the revised definition of “startup” in the next reporting period after receipt of written acknowledgement from the Administrator of the switch.
 - e) The permittee shall submit each report according to Table 8 of 40 CFR 63, Subpart UUUUU that applies. For continuously monitoring Hg emissions, the permittee shall also submit the electronic reports required under appendix A, at the specified frequency [40 CFR 63.10031(a)].
 - f) Unless the Administrator has approved a different schedule for submission of reports under 40 CFR 63.10(a), the permittee shall submit each report by the date in Table 8 of 40 CFR 63, Subpart UUUUU and according to the requirements specified [40 CFR 63.10031(b)]:
 - i) The first compliance report shall cover the initial period (April 16, 2016) and end on December 31, 2017 (at least 180 days after the applicable start date) [40 CFR 63.10031(b)(1)];
 - ii) The first compliance report shall be postmarked or submitted electronically no later than January 31, 2017 [40 CFR 63.10031(b)(2)];
 - iii) Each subsequent compliance report shall cover the semiannual reporting period from January 1 to June 30 or July 1 through December 31 [40 CFR 63.10031(b)(3)];
 - iv) Each subsequent compliance report shall be postmarked or submitted electronically no later than July 31 or January 31, whichever date is the first date following the end of the semiannual reporting period [40 CFR 63.10031(b)(4)];
 - v) For each affected source that is subject to permitting regulations pursuant 40 CFR 70 or 71 and if the permitting authority has established dates for submitting semiannual reports pursuant to 40 CFR 70.6(a)(3)(iii)(A) or 40 CFR 71.6(a)(3)(iii)(A), the permittee may submit the first and subsequent compliance reports according to the

SECTION H - ALTERNATE OPERATING SCENARIOS (CONTINUED)

dates the permitting authority has established instead of according to the dates specified in 40 CFR 63.10031(b)(1) through (4) [40 CFR 63.10031(b)(5)].

- g) The semiannual compliance report shall contain the following [40 CFR 63.10011(g), Table 3, 40 CFR 63.10021(f) through (i) 40 CFR 63.10031(c) and 40 CFR 63, Subpart UUUUU, Table 8, Item 1]:
 - i) The information required by the summary report located in 40 CFR 63.10(e)(3)(vi) [40 CFR 63.10031(c)(1)];
 - ii) The total fuel use by each affected source subject to an emission limit, for each calendar month within the semiannual reporting period, including, but not limited, to , a description of the fuel, whether the fuel has received a non-waste determination by the EPA or the basis for concluding that the fuel is not a waste, and the total fuel usage amount with units of measure [40 CFR 63.10031(c)(2)];
 - iii) Indicate whether the permittee burned new types of fuel during the reporting period. If new type of fuel was burned, the permittee shall include the date of the performance test where that fuel was in use[40 CFR 63.10031(c)(3)];
 - iv) Include the date of the most recent tune-up for each EGU. The date of the tune-up is the date the tune-up provisions specified in 40 CFR 63.10021(e)(6) and (7) where completed [40 CFR 63.10031(c)(4)];
 - v) A summary of the results of the annual performance tests and documentation of any operating limits that were reestablished during the test[40 CFR 63.10031(c)(7)];
 - vi) A certification [40 CFR 63.10031(c)(8)];
 - vii) For deviations from any emission limit, work practice standard, or operating limit, the permittee shall also submit a brief description of the deviation, the duration of the deviation, emissions point identification, and the cause of the deviation [40 CFR 63.10031(c)(9)];
 - viii) If there are no deviations from any emission limitations (emission limit and operating limit) that apply and there are no deviations from the requirements for work practice standards, the permittee shall provide a statement that there were no deviations from the emission limitations and work practice standards during the reporting period. If there were no periods during which the CMS were out-of-control as specified in 40 CFR 63.8(c)(7), the permittee shall provide a statement that there were no periods during which the CMS were out-of-control during the reporting period [40 CFR 63, Subpart UUUUU, Table 8 Item 1(b)];
 - ix) If the permittee has a deviation from any emission limitation (emission limit and operating limit) or work practice standard during the reporting period, the report shall contain the information in 40 CFR 63.10031(d). If there were periods during which the CMS were out-of-control, as specified in 40 CFR 63.8(c)(7), the report shall control the information in 40 CFR 63.10031(e). [40 CFR 63, Subpart UUUUU, Table 8 Item 1(c)].
- h) For each excess emissions occurring where the permittee is using a CMS to comply with that emission limit or operating limit, the permittee shall include the information required in 40 CFR 63.10(e)(3)(v) in the compliance report specified in 40 CFR 63.10031(c) [40 CFR 63.10031(d)].
- i) The permittee shall report all deviations as defined in 40 CFR 63, Subpart UUUUU, in the semiannual monitoring report required by 40 CFR 70.6(a)(3)(iii)(A) or 40 CFR

SECTION H - ALTERNATE OPERATING SCENARIOS (CONTINUED)

71.6(a)(3)(iii)(A). If an affected source submits a compliance report pursuant to Table 8 along with, or as part of, the semiannual monitoring report required by 40 CFR 70.6(a)(3)(iii)(A) or 40 CFR 71.6(a)(3)(iii)(A), and the compliance report includes all required information concerning deviations from any emission limit, operating limit, or work practice requirement, submission of the compliance report satisfies any obligation to report the same deviations in the semiannual monitoring report. Submission of a compliance report does not otherwise affect any obligation the affected source may have to report deviations from permit requirements to the permit authority [40 CFR 63.10031(e)].

- j) If the permittee has a malfunction during the reporting period, the compliance report shall include the number, duration, and a brief description for each type of malfunction which occurred during the reporting period and which caused or may have cause any applicable emission limitation to be exceeded [40 CFR 63.10031(g)].
- k) On or after July 1, 2020, within 60 days after the date of completing each performance test, you must submit the performance test reports required by this subpart to the EPA's WebFIRE database by using the Compliance and Emissions Data Reporting Interface (CEDRI) that is accessed through the EPA's Central Data Exchange (CDX) (<https://cdx.epa.gov>). Performance test data must be submitted in the file format generated through use of EPA's Electronic Reporting Tool (ERT) (see <https://www.epa.gov/ttn/chief/ert/index.html>). Only data collected using those test methods on the ERT website are subject to this requirement for submitting reports electronically to WebFIRE. Owners or operators who claim that some of the information being submitted for performance tests is confidential business information (CBI) must submit a complete ERT file including information claimed to be CBI on a compact disk or other commonly used electronic storage media (including, but not limited to, flash drives) to EPA. The electronic media must be clearly marked as CBI and mailed to U.S. EPA/OAPQS/CORE CBI Office, Attention: WebFIRE Administrator, MD C404-02, 4930 Old Page Rd., Durham, NC 27703. The same ERT file with the CBI omitted must be submitted to EPA via CDX as described earlier in this paragraph. At the discretion of the delegated authority, you must also submit these reports, including the confidential business information, to the delegated authority in the format specified by the delegated authority [40 CFR 63.10031(f)].
- i) On or after July 1, 2020, within 60 days after the date of completing each CEMS (SO₂, PM, HCl, HF, and Hg) performance evaluation test, as defined in §63.2 and required by this subpart, you must submit the relative accuracy test audit (RATA) data (or, for PM CEMS, RCA and RRA data) required by this subpart to EPA's WebFIRE database by using CEDRI that is accessed through EPA's CDX (<https://cdx.epa.gov>). The RATA data shall be submitted in the file format generated through use of EPA's Electronic Reporting Tool (ERT) (<https://www.epa.gov/ttn/chief/ert/index.html>). Only RATA data compounds listed on the ERT website are subject to this requirement. Owners or operators who claim that some of the information being submitted for RATAs is confidential business information (CBI) shall submit a complete ERT file including information claimed to be CBI on a compact disk or other commonly used electronic storage media (including, but not limited to, flash drives) by registered letter to EPA and the same ERT file with the CBI omitted to EPA via CDX as described earlier in this paragraph.

SECTION H - ALTERNATE OPERATING SCENARIOS (CONTINUED)

- The compact disk or other commonly used electronic storage media shall be clearly marked as CBI and mailed to U.S. EPA/OAPQS/CORE CBI Office, Attention: WebFIRE Administrator, MD C404-02, 4930 Old Page Rd., Durham, NC 27703. At the discretion of the delegated authority, owners or operators shall also submit these RATAs to the delegated authority in the format specified by the delegated authority. Owners or operators shall submit calibration error testing, drift checks, and other information required in the performance evaluation as described in §63.2 and as required in this chapter [40 CFR 63.10031(f)(1)].
- ii) On or after July 1, 2020, for a PM CEMS, PM CPMS, or approved alternative monitoring using a HAP metals CEMS, within 60 days after the reporting periods ending on March 31st, June 30th, September 30th, and December 31st, you must submit quarterly reports to the EPA's WebFIRE database by using the CEDRI that is accessed through the EPA's CDX (<https://cdx.epa.gov>). You must use the appropriate electronic reporting form in CEDRI or provide an alternate electronic file consistent with EPA's reporting form output format. For each reporting period, the quarterly reports must include all of the calculated 30-boiler operating day rolling average values derived from the CEMS and PM CPMS. [40 CFR 63.10031(f)(2)].
 - iii) Reports for an SO₂ CEMS, a Hg CEMS or sorbent trap monitoring system, an HCl or HF CEMS, and any supporting monitors for such systems (such as a diluent or moisture monitor) shall be submitted using the ECMPS Client Tool, as provided for in Appendices A and B to this subpart and 40 CFR 63.10021(f) [40 CFR 63.10031(f)(3)].
 - iv) On or after July 1, 2020, submit the compliance reports required under paragraphs (c) and (d) of this section and the notification of compliance status required under 40 CFR 63.10030(e) to the EPA's WebFIRE database by using the CEDRI that is accessed through the EPA's CDX (<https://cdx.epa.gov>). You must use the appropriate electronic reporting form in CEDRI or provide an alternate electronic file consistent with EPA's reporting form output format [40 CFR 63.10031(f)(4)].
 - v) All reports required by this subpart not subject to the requirements in paragraphs (f) introductory text and (f)(1) through (4) of this section must be sent to the Administrator at the appropriate address listed in §63.13. If acceptable to both the Administrator and the owner or operator of an EGU, these reports may be submitted on electronic media. The Administrator retains the right to require submittal of reports subject to paragraphs (f) introductory text and (f)(1) through (4) of this section in paper format [40 CFR 63.10031(f)(5)].
 - vi) Prior to July 1, 2020, all reports subject to electronic submittal in paragraphs (f) introductory text, (f)(1), (2), and (4) of this section shall be submitted to the EPA at the frequency specified in those paragraphs in electronic portable document format (PDF) using the ECMPS Client Tool. Each PDF version of a submitted report must include sufficient information to assess compliance and to demonstrate that the testing was done properly. The following data elements must be entered into the ECMPS Client Tool at the time of submission of each PDF file [40 CFR 63.10031(f)(6)]:
 - A) The facility name, physical address, mailing address (if different from the physical address), and county [40 CFR 63.10031(f)(6)(i)];
 - B) The ORIS code (or equivalent ID number assigned by EPA's Clean Air Markets Division (CAMD)) and the Facility Registry System (FRS) ID [40 CFR

SECTION H - ALTERNATE OPERATING SCENARIOS (CONTINUED)

- 63.10031(f)(6)(ii)];
- C) The EGU (or EGUs) to which the report applies. Report the EGU IDs as they appear in the CAMD Business System [40 CFR 63.10031(f)(6)(iii)];
 - D) If any of the EGUs in paragraph (f)(6)(iii) of this section share a common stack, indicate which EGUs share the stack. If emissions data are monitored and reported at the common stack according to part 75 of this chapter, report the ID number of the common stack as it is represented in the electronic monitoring plan required under §75.53 of this chapter [40 CFR 63.10031(f)(6)(iv)];
 - E) If any of the EGUs described in paragraph (f)(6)(iii) of this section are in an averaging plan under §63.10009, indicate which EGUs are in the plan and whether it is a 30- or 90-day averaging plan [40 CFR 63.10031(f)(6)(v)];
 - F) The identification of each emission point to which the report applies. An “emission point” is a point at which source effluent is released to the atmosphere, and is either a dedicated stack that serves one of the EGUs identified in paragraph (f)(6)(iii) of this section or a common stack that serves two or more of those EGUs. To identify an emission point, associate it with the EGU or stack ID in the CAMD Business system or the electronic monitoring plan (e.g., “Unit 2 stack,” “common stack CS001,” or “multiple stack MS001”) [40 CFR 63.10031(f)(6)(vi)];
 - G) The rule citation (e.g., 40 CFR 63.10031(f)(1), 40 CFR 63.10031(f)(2), etc.) for which the report is showing compliance [40 CFR 63.10031(f)(6)(vii)];
 - H) The pollutant(s) being addressed in the report [40 CFR 63.10031(f)(6)(viii)];
 - I) The reporting period being covered by the report (if applicable) [40 CFR 63.10031(f)(6)(ix)];
 - J) The relevant test method that was performed for a performance test (if applicable) [40 CFR 63.10031(f)(6)(x)];
 - K) The date the performance test was conducted (if applicable) [40 CFR 63.10031(f)(6)(xi)]; and
 - L) The responsible official's name, title, and phone number [40 CFR 63.10031(f)(6)(xii)].

7. Specific Control Equipment Operating Conditions:

- a) The electrostatic precipitator (ESP), wet flue gas desulfurization unit (FGD), and low NO_x burner system shall be operated to maintain compliance with permitted emission limitations, consistent with manufacturer's specifications and good operating practices [401 KAR 50:055].
- b) Records regarding the maintenance of the control equipment shall be maintained [401 KAR 52:020 Section 10 and 40 CFR 63.10032].
- c) See **Section E-Source Control Equipment Requirements** for further requirements.
- d) At all times the permittee shall operate and maintain any affected source, including associated air pollution control equipment and monitoring equipment, in a manner consistent with safety and good air pollution control practices for minimizing emissions. Determination of whether such operation and maintenance procedures are being used will be based on information available to the EPA Administrator which may include, but is not limited to, monitoring results, review of operation and maintenance procedures,

SECTION H - ALTERNATE OPERATING SCENARIOS (CONTINUED)

review of operation and maintenance records, and inspection of the source [40 CFR 63.10000(b)].

Compliance Demonstration: See 4. Specific Monitoring Requirements: (b) and (i) through (k); 5. Specific Recordkeeping Requirements: (a) through (c), and (j) through (n).

SECTION I - COMPLIANCE SCHEDULE

NA

SECTION J - ACID RAIN PERMIT**1. Statutory and Regulatory Authority:**

In accordance with KRS 224.10-100 and Titles IV and V of the Clean Air Act, the Kentucky Environmental and Public Protection Cabinet, Division for Air Quality issues this permit pursuant to 401 KAR 52:020, Permits, 401 KAR 52:060, Acid Rain Permit, and 40 CFR Part 52:060, Acid Rain Permit, and Federal Regulation 40 CFR Part 76.

2. Permit Requirements:

This Acid Rain Permit covers Acid Rain Units 1-2 (Emission Units 01-02) at the R.D. Green Generating Station (ORIS Code: 6639). Units 1-2 are coal-fired based load electric generating units. The Acid Rain Permit Application and NO_x Compliance Plan received on December 27, 2011, for Phase II are hereby incorporated into and made part of this permit and the permittee shall comply with the standard requirements and special provisions set forth in the application [40 CFR 72.9(a)(2)].

3. Acid Rain Program Emission and Operating Limitations:

The applicable Acid Rain emission limitations for the permittee are set in 40 CFR 73.10, Table 2, 40 CFR 76.5, and 40 CFR 76.11 and they are tabulated in the table below:

Affected Unit: Green River Generation Station (Emissions Unit 01)					
Year for SO₂ Allowances	2019	2020	2021	2022	2023
40 CFR Part 73.10	5,303*	5,303*	5,303*	5,303*	5,303*
NO_x Limits and Requirements					
Big Rivers Electric Corporation terminated the NO_x averaging plan in accordance with 40 CFR 72.40 via a letter dated September 25, 2018, reverting to the NO_x emission rate specified under 40 CFR 76.5(a)(2) of 0.50 lb/MMBtu for dry bottom wall-fired boilers. This unit shall comply with all other applicable requirements of 40 CFR part 76, including the duty to reapply for a NO_x compliance plan and requirements covering excess emissions.					

* The number of allowances allocated to Phase II affected units by the U.S. EPA may change under 40 CFR part 73. In addition, the number of allowances actually held by an affected source in a unit account may differ from the number allocated by U. S. EPA. Neither of the aforementioned conditions necessitates a revision to the unit SO₂ allowance allocations identified in this permit (See 40 CFR 72.84).

SECTION J - ACID RAIN (CONTINUED)

Affected Unit: Green River Generation Station (Emissions Unit 02)					
Year for SO₂ Allowances	2019	2020	2021	2022	2023
40 CFR Part 73.10	6,389*	6,389*	6,389*	6,389*	6,389*
NO_x Limit and Requirements					
Big Rivers Electric Corporation terminated the NO_x averaging plan in accordance with 40 CFR 72.40 via a letter dated September 25, 2018, reverting to the NO_x emission rate specified under 40 CFR 76.5(a)(2), of 0.50 lb/MMBtu for dry bottom wall-fired boilers. This unit shall comply with all other applicable requirements of 40 CFR part 76, including the duty to reapply for a NO_x compliance plan and requirements covering excess emissions.					

* The number of allowances allocated to Phase II affected units by the U.S. EPA may change under 40 CFR part 73. In addition, the number of allowances actually held by an affected source in a unit account may differ from the number allocated by U.S. EPA. Neither of the aforementioned conditions necessitates a revision to the unit SO₂ allowance allocations identified in this permit (See 40 CFR 72.84).

SECTION K – CLEAN AIR INTERSTATE RULE (CAIR)

1. Statutory and Regulatory Authority:

In accordance with KRS 224.10-100, the Kentucky Energy and Environmental Cabinet issues this permit pursuant to 401 KAR 52:020, Title V permits, 401 KAR 51:210, CAIR NO_x Annual Trading Program, 401 KAR 51:220, CAIR NO_x ozone season trading program, and 401 KAR 51:230, CAIR SO₂ Trading Program.

2. Application and Requirements:

The CAIR application for two (2) electrical generating units was submitted to the Division and received on September 10, 2007. The standard requirements and special provisions set forth in the application are hereby incorporated into and made part of this CAIR Permit. [401 KAR 51:210, 401 KAR 51:220, and 401 KAR 51:230]. Pursuant to 401 KAR 52:020, Section 3, the source shall operate in compliance with those requirements.

3. Unit Description:

The affected units are two dry bottom wall fired boiler each rated at 2,660 MMBtu/hour (EU 01-02). Each unit has a capacity to generate 25 megawatts or more of electricity, which is offered for sale. The units use coal and pet coke as a fuel source, and are used as base load electric generating units.

4. Summary of Actions:

The CAIR Permit is being issued as part of the Title V permit for this source. Public, affected state and U.S. EPA review will follow procedures specified in 401 KAR 52:100.

CSAPR implementation is now in place and replaces requirements under EPA's 2005 Clean Air Interstate Rule.

SECTION L – CROSS-STATE AIR POLLUTION RULE (CSAPR)

The CSAPR subject unit, and the unit-specific monitoring provisions at this source, are identified in the following table. The unit is subject to the requirements for the CSAPR NO_x Annual Trading Program, CSAPR NO_x Ozone Season Group 3 Trading Program, and CSAPR SO₂ Group 1 Trading Program

Unit ID: 1 and 2, Pulverized Coal Fired Boilers					
Parameter	Continuous emission monitoring system or systems (CEMS) requirements pursuant to 40 CFR part 75, Subpart B (for SO ₂ monitoring) and 40 CFR part 75, Subpart H (for NO _x monitoring)	Excepted monitoring system requirements for gas- and oil-fired units pursuant to 40 CFR part 75, appendix D	Excepted monitoring system requirements for gas- and oil-fired peaking units pursuant to 40 CFR part 75, appendix E	Low Mass Emissions excepted monitoring (LME) requirements for gas- and oil-fired units pursuant to 40 CFR 75.19	EPA-approved alternative monitoring system requirements pursuant to 40 CFR part 75, Subpart E
SO ₂	X				
NO _x	X				
Heat input	X				

Unit ID: 1 and 2, Natural Gas Fired Boilers					
Parameter	Continuous emission monitoring system or systems (CEMS) requirements pursuant to 40 CFR part 75, Subpart B (for SO ₂ monitoring) and 40 CFR part 75, Subpart H (for NO _x monitoring)	Excepted monitoring system requirements for gas- and oil-fired units pursuant to 40 CFR part 75, appendix D	Excepted monitoring system requirements for gas- and oil-fired peaking units pursuant to 40 CFR part 75, appendix E	Low Mass Emissions excepted monitoring (LME) requirements for gas- and oil-fired units pursuant to 40 CFR 75.19	EPA-approved alternative monitoring system requirements pursuant to 40 CFR part 75, Subpart E
SO ₂		X			
NO _x	X				
Heat input		X			

SECTION L – CROSS-STATE AIR POLLUTION RULE (CSAPR) (CONTINUED)

Unit ID: RT, Peaking Natural Gas-Fired Combustion Turbine					
Parameter	Continuous emission monitoring system or systems (CEMS) requirements pursuant to 40 CFR part 75, Subpart B (for SO ₂ monitoring) and 40 CFR part 75, Subpart H (for NO _x monitoring)	Excepted monitoring system requirements for gas- and oil-fired units pursuant to 40 CFR part 75, appendix D	Excepted monitoring system requirements for gas- and oil-fired peaking units pursuant to 40 CFR part 75, appendix E	Low Mass Emissions excepted monitoring (LME) requirements for gas- and oil-fired units pursuant to 40 CFR 75.19	EPA-approved alternative monitoring system requirements pursuant to 40 CFR part 75, Subpart E
SO ₂				X	
NO _x				X	
Heat input			X		

1. The above description of the monitoring used by a unit does not change, create an exemption from, or otherwise affect the monitoring, recordkeeping, and reporting requirements applicable to the unit under 401 KAR 51:240, Section 3(25) through 401 KAR 51:240, Section 3(30) (CSAPR NO_x Annual Trading Program), 40 CFR 97.1030 through 40 CFR 97.1035 (CSAPR NO_x Ozone Season Group 3 Trading Program), and 401 KAR 51:260 Section 3(25) through 401 KAR 51:260, Section 3(30) (CSAPR SO₂ Group 1 Trading Program). The monitoring, recordkeeping, and reporting requirements applicable to each unit are included below in the standard conditions for the applicable CSAPR trading programs.
2. Owners and operators shall submit to the Administrator a monitoring plan for each unit in accordance with 40 CFR 75.53, 75.62 and 75.73, as applicable. The monitoring plan for each unit is available at the EPA's website:
<http://www.epa.gov/airmarkets>.
3. Owners and operators that want to use an alternative monitoring system shall submit to the Administrator a petition requesting approval of the alternative monitoring system in accordance with 40 CFR 75, Subpart E, 40 CFR 75.66, 401 KAR 51:240, Section 3(30) (CSAPR NO_x Annual Trading Program), 40 CFR 97.1035 (CSAPR NO_x Ozone Season Group 3 Trading Program), and/or 401 KAR 51:260, Section 3(30) (CSAPR SO₂ Group 1 Trading Program). The Administrator's response approving or disapproving any petition for an alternative monitoring system is available on the EPA's website at:
<http://www.epa.gov/airmarkets/part-75-petition-responses>.

**SECTION L – CROSS-STATE AIR POLLUTION RULE (CSAPR)
(CONTINUED)**

4. Owners and operators that want to use an alternative to any monitoring, recordkeeping, or reporting requirements under 401 KAR 51:240, Section 3(25) through 401 KAR 51:240, Section 3(29) (CSAPR NO_x Annual Trading Program), 40 CFR 97.1030 through 40 CFR 97.1034 (CSAPR NO_x Ozone Season Group 3 Trading Program), and/or 401 KAR 51:260, Section 3(25) through 401 KAR 51:260, Section 3(29) (CSAPR SO₂ Group 1 Trading Program) must submit to the Administrator a petition requesting approval of the alternative in accordance with 401 KAR 51:240, Section 3(30) (CSAPR NO_x Annual Trading Program), 40 CFR 97.1035 (CSAPR SO₂ Group 1 Trading Program), and 401 KAR 51:260, Section 3(30) (CSAPR NO_x Ozone Season Group 3 Trading Program). The Administrator's response approving or disapproving any petition for an alternative to a monitoring, recordkeeping, or reporting requirement is available on the EPA's website at <https://www.epa.gov/airmarkets/data-resources>.
5. The descriptions of monitoring applicable to the unit included above meet the requirement of 401 KAR 51:240, Section 3(25) through 401 KAR 51:240, Section 3(29) (CSAPR NO_x Annual Trading Program), 40 CFR 97.1030 through 40 CFR 97.1034 (CSAPR NO_x Ozone Season Group 3 Trading Program), and 401 KAR 51:260, Section 3(25) through 401 KAR 51:260, Section 3(29) (CSAPR SO₂ Group 1 Trading Program), and therefore minor permit modification procedures, in accordance with 40 CFR 70.7(e)(2)(i)(B), may be used to add or change this unit's monitoring system description.

CSAPR NO_x Annual Trading Program requirements (401 KAR 51:240, Section 3(4))**a) Designated representative requirements.**

The owners and operators shall comply with the requirement to have a designated representative, and may have an alternate designated representative, in accordance with 401 KAR 51:240, Section 3(10) through 401 KAR 51:240, Section 3(15).

b) Emissions monitoring, reporting, and recordkeeping requirements.

- 1) The owners and operators, and the designated representative, of each CSAPR NO_x Annual source and each CSAPR NO_x Annual unit at the source shall comply with the monitoring, reporting, and recordkeeping requirements of 401 KAR 51:240, Section 3(25) (general requirements, including installation, certification, and data accounting, compliance deadlines, reporting data, prohibitions, and long-term cold storage), 401 KAR 51:240, Section 3(26) (initial monitoring system certification and recertification procedures), 401 KAR 51:240, Section 3(27) (monitoring system out-of-control periods), 401 KAR 51:240, Section 3(28) (notifications concerning monitoring), 401 KAR 51:240, Section 3(29) (recordkeeping and reporting, including monitoring plans, certification applications, quarterly reports, and compliance certification), and 401 KAR 51:240, Section 3(30) (petitions for alternatives to monitoring, recordkeeping, or reporting requirements).
- 2) The emissions data determined in accordance with 401 KAR 51:240, Section 3(25) through 401 KAR 51:240, Section 3(30) shall be used to calculate allocations of CSAPR NO_x Annual allowances under 401 KAR 51:240, Section 3(8) (40 CFR 97.411(a)(2) and (b)) and 401 KAR 51:240, Section 3(9) and to determine compliance with the CSAPR NO_x Annual emissions limitation and assurance provisions under paragraph (c) below, provided that, for each monitoring location from which mass emissions are reported, the mass emissions amount used in calculating such allocations and determining such

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(CONTINUED)**

compliance shall be the mass emissions amount for the monitoring location determined in accordance with 401 KAR 51:240, Section 3(25) through 401 KAR 51:240, Section 3(30) and rounded to the nearest ton, with any fraction of a ton less than 0.50 being deemed to be zero.

c) NO_x emissions requirements.**1) CSAPR NO_x Annual emissions limitation.**

- i) As of the allowance transfer deadline for a control period in a given year, the owners and operators of each CSAPR NO_x Annual source and each CSAPR NO_x Annual unit at the source shall hold, in the source's compliance account, CSAPR NO_x Annual allowances available for deduction for such control period under 401 KAR 51:240, Section 3(20) (40 CFR 97.424(a)) in an amount not less than the tons of total NO_x emissions for such control period from all CSAPR NO_x Annual units at the source.
- ii) If total NO_x emissions during a control period in a given year from the CSAPR NO_x Annual units at a CSAPR NO_x Annual source are in excess of the CSAPR NO_x Annual emissions limitation set forth in paragraph (c)(1)(i) above, then:
 - A) The owners and operators of the source and each CSAPR NO_x Annual unit at the source shall hold the CSAPR NO_x Annual allowances required for deduction under 401 KAR 51:240, Section 3(20) (40 CFR 97.424(d)); and
 - B) The owners and operators of the source and each CSAPR NO_x Annual unit at the source shall pay any fine, penalty, or assessment or comply with any other remedy imposed, for the same violations, under the Clean Air Act, and each ton of such excess emissions and each day of such control period shall constitute a separate violation of 401 KAR 51:240 (40 CFR 97, Subpart AAAAA) and the Clean Air Act.

2) CSAPR NO_x Annual assurance provisions.

- i) If total NO_x emissions during a control period in a given year from all CSAPR NO_x Annual units at CSAPR NO_x Annual sources in the state exceed the state assurance level, then the owners and operators of such sources and units in each group of one or more sources and units having a common designated representative for such control period, where the common designated representative's share of such NO_x emissions during such control period exceeds the common designated representative's assurance level for the state and such control period, shall hold (in the assurance account established for the owners and operators of such group) CSAPR NO_x Annual allowances available for deduction for such control period under 401 KAR 51:240, Section 3(21) (40 CFR 97.425(a)) in an amount equal to two times the product (rounded to the nearest whole number), as determined by the Administrator in accordance with 401 KAR 51:240, Section 3(21) (40 CFR 97.425(b)), of multiplying— (A) The quotient of the amount by which the common designated representative's share of such NO_x emissions exceeds the common designated representative's assurance level divided by the sum of the amounts, determined for all common designated representatives for such sources and units in the state for such control period, by which each common designated representative's share of such NO_x emissions exceeds the respective common designated representative's assurance level; and (B) The amount by which total NO_x emissions from all CSAPR NO_x Annual units at CSAPR NO_x Annual sources in the state for such control period exceed the state assurance level.

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(CONTINUED)**

- ii) The owners and operators shall hold the CSAPR NO_x Annual allowances required under paragraph (c)(2)(i) above, as of midnight of November 1 (if it is a business day), or midnight of the first business day thereafter (if November 1 is not a business day), immediately after such control period.
- iii) Total NO_x emissions from all CSAPR NO_x Annual units at CSAPR NO_x Annual sources in the State during a control period in a given year exceed the state assurance level if such total NO_x emissions exceed the sum, for such control period, of the state NO_x Annual trading budget under 401 KAR 51:240, Section 3(7)(a)(1) and the state's variability limit under 401 KAR 51:240, Section 3(7)(a)(3).
- iv) It shall not be a violation of 401 KAR 51:240, 40 CFR 97, Subpart AAAAA, or of the Clean Air Act if total NO_x emissions from all CSAPR NO_x Annual units at CSAPR NO_x Annual sources in the State during a control period exceed the state assurance level or if a common designated representative's share of total NO_x emissions from the CSAPR NO_x Annual units at CSAPR NO_x Annual sources in the state during a control period exceeds the common designated representative's assurance level.
- v) To the extent the owners and operators fail to hold CSAPR NO_x Annual allowances for a control period in a given year in accordance with paragraphs (c)(2)(i) through (iii) above,
 - A) The owners and operators shall pay any fine, penalty, or assessment or comply with any other remedy imposed under the Clean Air Act; and
 - B) Each CSAPR NO_x Annual allowance that the owners and operators fail to hold for such control period in accordance with paragraphs (c)(2)(i) through (iii) above and each day of such control period shall constitute a separate violation of 401 KAR 51:240, 40 CFR 97, Subpart AAAAA, and the Clean Air Act.
- 3) Compliance periods.
 - i) A CSAPR NO_x Annual unit shall be subject to the requirements under paragraph (c)(1) above for the control period starting on the later of January 1, 2015, or the deadline for meeting the unit's monitor certification requirements under 401 KAR 51:240, Section 3(25) (40 CFR 97.430(b)) and for each control period thereafter.
 - ii) A CSAPR NO_x Annual unit shall be subject to the requirements under paragraph (c)(2) above for the control period starting on the later of January 1, 2017 or the deadline for meeting the unit's monitor certification requirements under 401 KAR 51:240, Section 3(25) (40 CFR 97.430(b)) and for each control period thereafter.
- 4) Vintage of allowances held for compliance.
 - i) A CSAPR NO_x Annual allowance held for compliance with the requirements under paragraph (c)(1)(i) above for a control period in a given year shall be a CSAPR NO_x Annual allowance that was allocated for such control period or a control period in a prior year.
 - ii) A CSAPR NO_x Annual allowance held for compliance with the requirements under paragraphs (c)(1)(ii)(A) and (2)(i) through (iii) above for a control period in a given year shall be a CSAPR NO_x Annual allowance that was allocated for a control period in a prior year or the control period in the given year or in the immediately following year.
- 5) Allowance Management System requirements. Each CSAPR NO_x Annual allowance shall be held in, deducted from, or transferred into, out of, or between Allowance Management System accounts in accordance with 401 KAR 51:240.

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- 6) Limited authorization. A CSAPR NO_x Annual allowance is a limited authorization to emit one ton of NO_x during the control period in one year. Such authorization is limited in its use and duration as follows:
 - i) Such authorization shall only be used in accordance with the CSAPR NO_x Annual Trading Program; and
 - ii) Notwithstanding any other provision of 40 CFR 97, the Administrator has the authority to terminate or limit the use and duration of such authorization to the extent the Administrator determines is necessary or appropriate to implement any provision of the Clean Air Act.
- 7) Property right. A CSAPR NO_x Annual allowance does not constitute a property right.

d) Title V permit revision requirements.

- 1) No Title V permit revision shall be required for any allocation, holding, deduction, or transfer of CSAPR NO_x Annual allowances in accordance with 401 KAR 51:240.
- 2) This permit incorporates the CSAPR emissions monitoring, recordkeeping, and reporting requirements pursuant to 401 KAR 51:240, Section 3(25) through 401 KAR 51:240, Section 3(30), and the requirements for a continuous emission monitoring system (pursuant to 40 CFR 75, Subparts B and H), an excepted monitoring system (pursuant to 40 CFR 75, Appendices D and E), a low mass emissions excepted monitoring methodology (pursuant to 40 CFR 75.19), and an alternative monitoring system (pursuant to 40 CFR 75, Subpart E). Therefore, the Description of CSAPR Monitoring Provisions table for units identified in this permit may be added to, or changed, in this Title V permit using minor permit modification procedures in accordance with 401 KAR 51:240, Section 3(4) (40 CFR 97.406(d)(2)) and 70.7(e)(2)(i)(B).

e) Additional recordkeeping and reporting requirements.

- 1) Unless otherwise provided, the owners and operators of each CSAPR NO_x Annual source and each CSAPR NO_x Annual unit at the source shall maintain on site at the source each of the following documents (in hardcopy or electronic format) for a period of 5 years from the date the document is created. This period may be extended for cause, at any time before the end of 5 years, in writing by the Administrator.
 - i) The certificate of representation under 401 KAR 51:240, Section 3(13) for the designated representative for the source and each CSAPR NO_x Annual unit at the source and all documents that demonstrate the truth of the statements in the certificate of representation; provided that the certificate and documents shall be retained on site at the source beyond such 5-year period until such certificate of representation and documents are superseded because of the submission of a new certificate of representation under 401 KAR 51:240, Section 3(13) changing the designated representative.
 - ii) All emissions monitoring information, in accordance with 401 KAR 51:240.
 - iii) Copies of all reports, compliance certifications, and other submissions and all records made or required under, or to demonstrate compliance with the requirements of, the CSAPR NO_x Annual Trading Program.
- 2) The designated representative of a CSAPR NO_x Annual source and each CSAPR NO_x Annual unit at the source shall make all submissions required under the CSAPR NO_x Annual Trading Program, except as provided in 401 KAR 51:240, Section 3(15). This requirement does not change, create an exemption from, or otherwise affect the

**SECTION L – CROSS-STATE AIR POLLUTION RULE (CSAPR)
(CONTINUED)**

responsible official submission requirements under a Title V operating permit program in 40 CFR 70.

f) Liability.

- 1) Any provision of the CSAPR NO_x Annual Trading Program that applies to a CSAPR NO_x Annual source or the designated representative of a CSAPR NO_x Annual source shall also apply to the owners and operators of such source and of the CSAPR NO_x Annual units at the source.
- 2) Any provision of the CSAPR NO_x Annual Trading Program that applies to a CSAPR NO_x Annual unit or the designated representative of a CSAPR NO_x Annual unit shall also apply to the owners and operators of such unit.

g) Effect on other authorities.

No provision of the CSAPR NO_x Annual Trading Program or exemption under 401 KAR 51:240, Section 3(3) shall be construed as exempting or excluding the owners and operators, and the designated representative, of a CSAPR NO_x Annual source or CSAPR NO_x Annual unit from compliance with any other provision of the applicable, approved state implementation plan, a federally enforceable permit, or the Clean Air Act.

CSAPR NO_x Ozone Season Group 3 Trading Program Requirements (40 CFR 97.1006)**a) Designated representative requirements.**

The owners and operators shall comply with the requirement to have a designated representative, and may have an alternate designated representative, in accordance with 40 CFR 97.1013 through 40 CFR 97.1018.

b) Emissions monitoring, reporting, and recordkeeping requirements.

- a) The owners and operators, and the designated representative, of each CSAPR NO_x Ozone Season Group 3 source and each CSAPR NO_x Ozone Season Group 3 unit at the source shall comply with the monitoring, reporting, and recordkeeping requirements of 40 CFR 97.1030 through 40 CFR 97.1035.
- b) The emissions data determined in accordance with 40 CFR 97.1030 through 40 CFR 97.1035 shall be used to calculate allocations of CSAPR NO_x Ozone Season Group 3 allowances under 40 CFR 97.1011(a)(2) and (b) and 40 CFR 97.1012 and to determine compliance with the CSAPR NO_x Ozone Season Group 3 emissions limitation and assurance provisions under paragraph (c) below, provided that, for each monitoring location from which mass emissions are reported, the mass emissions amount used in calculating such allocations and determining such compliance shall be the mass emissions amount for the monitoring location determined in accordance with 40 CFR 97.1030 through 40 CFR 97.1035 and rounded to the nearest ton, with any fraction of a ton less than 0.50 being deemed to be zero.

c) NO_x emissions requirements.

- 1) CSAPR NO_x Ozone Season Group 3 emissions limitation.
 - i) As of the allowance transfer deadline for a control period in a given year, the owners and operators of each CSAPR NO_x Ozone Season Group 3 source and each CSAPR NO_x Ozone Season Group 3 unit at the source shall hold, in the source's compliance account, CSAPR NO_x Ozone Season Group 3 allowances available for deduction for such control period under 40 CFR 97.1024(a) in an amount not less than the tons of

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(CONTINUED)**

- total NO_x emissions for such control period from all CSAPR NO_x Ozone Season Group 3 units at the source.
- ii) If total NO_x emissions during a control period in a given year from the CSAPR NO_x Ozone Season Group 3 units at a CSAPR NO_x Ozone Season Group 3 source are in excess of the CSAPR NO_x Ozone Season Group 3 emissions limitation set forth in paragraph (c)(1)(i) above, then:
 - A) The owners and operators of the source and each CSAPR NO_x Ozone Season Group 3 unit at the source shall hold the CSAPR NO_x Ozone Season Group 3 allowances required for deduction under 40 CFR 97.1024(d); and
 - B) The owners and operators of the source and each CSAPR NO_x Ozone Season Group 3 unit at the source shall pay any fine, penalty, or assessment or comply with any other remedy imposed, for the same violations, under the Clean Air Act, and each ton of such excess emissions and each day of such control period shall constitute a separate violation of 40 CFR 97, Subpart GGGGG, and the Clean Air Act.
 - 2) CSAPR NO_x Ozone Season Group 3 assurance provisions.
 - i) If total NO_x emissions during a control period in a given year from all base CSAPR NO_x Ozone Season Group 3 units at CSAPR NO_x Ozone Season Group 3 sources in the state exceed the state assurance level, then the owners and operators of such sources and units in each group of one or more sources and units having a common designated representative for such control period, where the common designated representative's share of such NO_x emissions during such control period exceeds the common designated representative's assurance level for the state and such control period, shall hold (in the assurance account established for the owners and operators of such group) CSAPR NO_x Ozone Season Group 3 allowances available for deduction for such control period under 40 CFR 97.1025(a) in an amount equal to two times the product (rounded to the nearest whole number), as determined by the Administrator in accordance with 40 CFR 97.1025(b), of multiplying—
 - A) The quotient of the amount by which the common designated representative's share of such NO_x emissions exceeds the common designated representative's assurance level divided by the sum of the amounts, determined for all common designated representatives for such sources and units in the state for such control period, by which each common designated representative's share of such NO_x emissions exceeds the respective common designated representative's assurance level; and
 - B) The amount by which total NO_x emissions from all base CSAPR NO_x Ozone Season Group 3 units at base CSAPR NO_x Ozone Season Group 3 sources in the state for such control period exceed the state assurance level.
 - ii) The owners and operators shall hold the CSAPR NO_x Ozone Season Group 3 allowances required under paragraph (c)(2)(i) above, as of midnight of November 1 (if it is a business day), or midnight of the first business day thereafter (if November 1 is not a business day), immediately after the year of such control period.
 - iii) Total NO_x emissions from all CSAPR NO_x Ozone Season Group 3 units at CSAPR NO_x Ozone Season Group 3 sources in the state during a control period in a given year exceed the state assurance level if such total NO_x emissions exceed the sum, for such control period, of the State NO_x Ozone Season Group 3 trading budget under 40

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- CFR 97.1010(a), the state's variability limit under 40 CFR 97.1010(b), and, for the control period in 2021 only, the product (rounded to the nearest allowance) of 1.21 multiplied by the supplemental amount of CSAPR NO_x Ozone Season Group 3 allowances determined for the state under 40 CFR 97.1010(d).
- iv) It shall not be a violation of 40 CFR 97, Subpart GGGGG, or of the Clean Air Act if total NO_x emissions from all base CSAPR NO_x Ozone Season Group 3 units at base CSAPR NO_x Ozone Season Group 3 sources in the state during a control period exceed the state assurance level or if a common designated representative's share of total NO_x emissions from the base CSAPR NO_x Ozone Season Group 3 units at base CSAPR NO_x Ozone Season Group 3 sources in the state during a control period exceeds the common designated representative's assurance level.
 - v) To the extent the owners and operators fail to hold CSAPR NO_x Ozone Season Group 3 allowances for a control period in a given year in accordance with paragraphs (c)(2)(i) through (iii) above,
 - A) The owners and operators shall pay any fine, penalty, or assessment or comply with any other remedy imposed under the Clean Air Act; and
 - B) Each CSAPR NO_x Ozone Season Group 3 allowance that the owners and operators fail to hold for such control period in accordance with paragraphs (c)(2)(i) through (iii) above and each day of such control period shall constitute a separate violation of 40 CFR 97, Subpart GGGGG and the Clean Air Act.
 - 3) Compliance periods.
 - i) A CSAPR NO_x Ozone Season Group 3 unit shall be subject to the requirements under paragraph (c)(1) above for the control period starting on the later of May 1, 2021 or the deadline for meeting the unit's monitor certification requirements under 40 CFR 97.1030(b) and for each control period thereafter.
 - ii) A base CSAPR NO_x Ozone Season Group 3 unit shall be subject to the requirements under paragraph (c)(2) above for the control period starting on the later of May 1, 2021 or the deadline for meeting the unit's monitor certification requirements under 40 CFR 97.1030(b) and for each control period thereafter.
 - 4) Vintage of CSAPR NO_x Ozone Season Group 3 allowances held for compliance.
 - i) A CSAPR NO_x Ozone Season Group 3 allowance held for compliance with the requirements under paragraph (c)(1)(i) above for a control period in a given year shall be a CSAPR NO_x Ozone Season Group 3 allowance that was allocated or auctioned for such control period or a control period in a prior year.
 - ii) A CSAPR NO_x Ozone Season Group 3 allowance held for compliance with the requirements under paragraphs (c)(1)(ii)(A) and (2)(i) through (iii) above for a control period in a given year shall be a CSAPR NO_x Ozone Season Group 3 allowance that was allocated or auctioned for a control period in a prior year or the control period in the given year or in the immediately following year.
 - 5) Allowance Management System requirements. Each CSAPR NO_x Ozone Season Group 3 allowance shall be held in, deducted from, or transferred into, out of, or between Allowance Management System accounts in accordance with 40 CFR 97, Subpart GGGGG.
 - 6) Limited authorization. A CSAPR NO_x Ozone Season Group 3 allowance is a limited authorization to emit one ton of NO_x during the control period in one year. Such authorization is limited in its use and duration as follows:

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- i) Such authorization shall only be used in accordance with the CSAPR NO_x Ozone Season Group 3 Trading Program; and
 - ii) Notwithstanding any other provision of 40 CFR 97, Subpart GGGGG, the Administrator has the authority to terminate or limit the use and duration of such authorization to the extent the Administrator determines is necessary or appropriate to implement any provision of the Clean Air Act.
- 7) Property right. A CSAPR NO_x Ozone Season Group 3 allowance does not constitute a property right.

d) Title V permit requirements.

- 1) No Title V permit revision shall be required for any allocation, holding, deduction, or transfer of CSAPR NO_x Ozone Season Group 3 allowances in accordance with 40 CFR 97, Subpart GGGGG.
- 2) A description of whether a unit is required to monitor and report NO_x emissions using a continuous emission monitoring system (pursuant to 40 CFR 75, Subpart H), an excepted monitoring system (pursuant to 40 CFR 75, Appendices D and E), a low mass emissions excepted monitoring methodology (pursuant to 40 CFR 75.19), or an alternative monitoring system (pursuant to 40 CFR 75, Subpart E) in accordance with 40 CFR 97.1030 through 40 CFR 97.1035 may be added to, or changed in, this Title V permit using minor permit modification procedures in accordance with 40 CFR 70.7(e)(2) and 40 CFR 71.7(e)(1), provided that the requirements applicable to the described monitoring and reporting (as added or changed, respectively) are already incorporated in such permit. This paragraph explicitly provides that the addition of, or change to, a unit's description as described in the prior sentence is eligible for minor permit modification procedures in accordance with 40 CFR 70.7(e)(2)(i)(B) and 40 CFR 71.7(e)(1)(i)(B).

e) Additional recordkeeping and reporting requirements.

- 1) Unless otherwise provided, the owners and operators of each CSAPR NO_x Ozone Season Group 3 source and each CSAPR NO_x Ozone Season Group 3 unit at the source shall maintain on site at the source each of the following documents (in hardcopy or electronic format) for a period of 5 years from the date the document is created. This period may be extended for cause, at any time before the end of 5 years, in writing by the Administrator.
 - i) The certificate of representation under 40 CFR 97.1016 for the designated representative for the source and each CSAPR NO_x Ozone Season Group 3 unit at the source and all documents that demonstrate the truth of the statements in the certificate of representation; provided that the certificate and documents shall be retained on site at the source beyond such 5-year period until such certificate of representation and documents are superseded because of the submission of a new certificate of representation under 40 CFR 97.1016 changing the designated representative.
 - ii) All emissions monitoring information, in accordance with 40 CFR 97, Subpart GGGGG.
 - iii) Copies of all reports, compliance certifications, and other submissions and all records made or required under, or to demonstrate compliance with the requirements of, the CSAPR NO_x Ozone Season Group 3 Trading Program.
- 2) The designated representative of a CSAPR NO_x Ozone Season Group 3 source and each CSAPR NO_x Ozone Season Group 3 unit at the source shall make all submissions required under the CSAPR NO_x Ozone Season Group 3 Trading Program, except as

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provided in 40 CFR 97.1018. This requirement does not change, create an exemption from, or otherwise affect the responsible official submission requirements under a Title V operating permit program in 40 CFR Parts 70 and 71.

f) Liability.

- 1) Any provision of the CSAPR NO_x Ozone Season Group 3 Trading Program that applies to a CSAPR NO_x Ozone Season Group 3 source or the designated representative of a CSAPR NO_x Ozone Season Group 3 source shall also apply to the owners and operators of such source and of the CSAPR NO_x Ozone Season Group 3 units at the source.
- 2) Any provision of the CSAPR NO_x Ozone Season Group 3 Trading Program that applies to a CSAPR NO_x Ozone Season Group 3 unit or the designated representative of a CSAPR NO_x Ozone Season Group 3 unit shall also apply to the owners and operators of such unit.

g) Effect on other authorities.

No provision of the CSAPR NO_x Ozone Season Group 3 Trading Program or exemption under 40 CFR 97.1005 shall be construed as exempting or excluding the owners and operators, and the designated representative, of a CSAPR NO_x Ozone Season Group 3 source or CSAPR NO_x Ozone Season Group 3 unit from compliance with any other provision of the applicable, approved state implementation plan, a federally enforceable permit, or the Clean Air Act.

CSAPR SO₂ Group 1 Trading Program requirements (401 KAR 51:260, Section 3(4))**a) Designated representative requirements.**

The owners and operators shall comply with the requirement to have a designated representative, and may have an alternate designated representative, in accordance with 401 KAR 51:260, Section 3(10) through 401 KAR 51:260, Section 3(15).

b) Emissions monitoring, reporting, and recordkeeping requirements.

- 1) The owners and operators, and the designated representative, of each CSAPR SO₂ Group 1 source and each CSAPR SO₂ Group 1 unit at the source shall comply with the monitoring, reporting, and recordkeeping requirements of 401 KAR 51:260, Section 3(25) (general requirements, including installation, certification, and data accounting, compliance deadlines, reporting data, prohibitions, and long-term cold storage), 401 KAR 51:260, Section 3(26) (initial monitoring system certification and recertification procedures), 401 KAR 51:260, Section 3(27) (monitoring system out-of-control periods), 401 KAR 51:260, Section 3(28) (notifications concerning monitoring), 401 KAR 51:260, Section 3(29) (recordkeeping and reporting, including monitoring plans, certification applications, quarterly reports, and compliance certification), and 401 KAR 51:260, Section 3(30) (petitions for alternatives to monitoring, recordkeeping, or reporting requirements).
- 2) The emissions data determined in accordance with 401 KAR 51:260, Section 3(25) through 401 KAR 51:260, Section 3(30) shall be used to calculate allocations of CSAPR SO₂ Group 1 allowances under 401 KAR 51:260, Section 3(8) (40 CFR 97.611(a)(2)) and (b)) and 401 KAR 51:260, Section 3(9) and to determine compliance with the CSAPR SO₂ Group 1 emissions limitation and assurance provisions under paragraph (c) below, provided that, for each monitoring location from which mass emissions are reported, the mass emissions amount used in calculating such allocations and determining such compliance shall be the mass emissions amount for the monitoring location determined in

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accordance with 401 KAR 51:260, Section 3(25) through 401 KAR 51:260, Section 3(30) and rounded to the nearest ton, with any fraction of a ton less than 0.50 being deemed to be zero.

c) SO₂ emissions requirements.**1) CSAPR SO₂ Group 1 emissions limitation.**

- i) As of the allowance transfer deadline for a control period in a given year, the owners and operators of each CSAPR SO₂ Group 1 source and each CSAPR SO₂ Group 1 unit at the source shall hold, in the source's compliance account, CSAPR SO₂ Group 1 allowances available for deduction for such control period under 401 KAR 51:260, Section 3(20) (40 CFR 97.624(a)) in an amount not less than the tons of total SO₂ emissions for such control period from all CSAPR SO₂ Group 1 units at the source.
- ii) If total SO₂ emissions during a control period in a given year from the CSAPR SO₂ Group 1 units at a CSAPR SO₂ Group 1 source are in excess of the CSAPR SO₂ Group 1 emissions limitation set forth in paragraph (c)(1)(i) above, then:
 - A) The owners and operators of the source and each CSAPR SO₂ Group 1 unit at the source shall hold the CSAPR SO₂ Group 1 allowances required for deduction under 401 KAR 51:260, Section 3(20) (40 CFR 97.624(d)); and
 - B) The owners and operators of the source and each CSAPR SO₂ Group 1 unit at the source shall pay any fine, penalty, or assessment or comply with any other remedy imposed, for the same violations, under the Clean Air Act, and each ton of such excess emissions and each day of such control period shall constitute a separate violation 401 KAR 51:260, 40 CFR 97, Subpart CCCCC, and the Clean Air Act.

2) CSAPR SO₂ Group 1 assurance provisions.

- i) If total SO₂ emissions during a control period in a given year from all CSAPR SO₂ Group 1 units at CSAPR SO₂ Group 1 sources in the state exceed the state assurance level, then the owners and operators of such sources and units in each group of one or more sources and units having a common designated representative for such control period, where the common designated representative's share of such SO₂ emissions during such control period exceeds the common designated representative's assurance level for the state and such control period, shall hold (in the assurance account established for the owners and operators of such group) CSAPR SO₂ Group 1 allowances available for deduction for such control period under 401 KAR 51:260, Section 3(21) (40 CFR 97.625(a)) in an amount equal to two times the product (rounded to the nearest whole number), as determined by the Administrator in accordance with 401 KAR 51:260, Section 3(21) (40 CFR 97.625(b)), of multiplying—
 - A) The quotient of the amount by which the common designated representative's share of such SO₂ emissions exceeds the common designated representative's assurance level divided by the sum of the amounts, determined for all common designated representatives for such sources and units in the state for such control period, by which each common designated representative's share of such SO₂ emissions exceeds the respective common designated representative's assurance level; and

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- B) The amount by which total SO₂ emissions from all CSAPR SO₂ Group 1 units at CSAPR SO₂ Group 1 sources in the state for such control period exceed the state assurance level.
- ii) The owners and operators shall hold the CSAPR SO₂ Group 1 allowances required under paragraph (c)(2)(i) above, as of midnight of November 1 (if it is a business day), or midnight of the first business day thereafter (if November 1 is not a business day), immediately after such control period.
- iii) Total SO₂ emissions from all CSAPR SO₂ Group 1 units at CSAPR SO₂ Group 1 sources in the state during a control period in a given year exceed the state assurance level if such total SO₂ emissions exceed the sum, for such control period, of the state SO₂ Group 1 trading budget under 401 KAR 51:260, Section 3(7)(a)(1) and the state's variability limit under 401 KAR 51:260, Section 3(7)(a)(3).
- iv) It shall not be a violation of 401 KAR 51:260, 40 CFR 97, Subpart CCCCC, or of the Clean Air Act if total SO₂ emissions from all CSAPR SO₂ Group 1 units at CSAPR SO₂ Group 1 sources in the state during a control period exceed the state assurance level or if a common designated representative's share of total SO₂ emissions from the CSAPR SO₂ Group 1 units at CSAPR SO₂ Group 1 sources in the state during a control period exceeds the common designated representative's assurance level.
- v) To the extent the owners and operators fail to hold CSAPR SO₂ Group 1 allowances for a control period in a given year in accordance with paragraphs (c)(2)(i) through (iii) above,
 - A) The owners and operators shall pay any fine, penalty, or assessment or comply with any other remedy imposed under the Clean Air Act; and
 - B) Each CSAPR SO₂ Group 1 allowance that the owners and operators fail to hold for such control period in accordance with paragraphs (c)(2)(i) through (iii) above and each day of such control period shall constitute a separate violation of 401 KAR 51:260, 40 CFR 97, Subpart CCCCC and the Clean Air Act.
- 3) Compliance periods.
 - i) A CSAPR SO₂ Group 1 unit shall be subject to the requirements under paragraph (c)(1) above for the control period starting on the later of January 1, 2015 or the deadline for meeting the unit's monitor certification requirements under 401 KAR 51:260, Section 3(25) (40 CFR 97.630(b)) and for each control period thereafter.
 - ii) A CSAPR SO₂ Group 1 unit shall be subject to the requirements under paragraph (c)(2) above for the control period starting on the later of January 1, 2017 or the deadline for meeting the unit's monitor certification requirements under 401 KAR 51:260, Section 3(25) (40 CFR 97.630(b)) and for each control period thereafter.
- 4) Vintage of allowances held for compliance.
 - i) A CSAPR SO₂ Group 1 allowance held for compliance with the requirements under paragraph (c)(1)(i) above for a control period in a given year shall be a CSAPR SO₂ Group 1 allowance that was allocated for such control period or a control period in a prior year.
 - ii) A CSAPR SO₂ Group 1 allowance held for compliance with the requirements under paragraphs (c)(1)(ii)(A) and (2)(i) through (iii) above for a control period in a given year shall be a CSAPR SO₂ Group 1 allowance that was allocated for a control period in a prior year or the control period in the given year or in the immediately following year.

**SECTION L – CROSS-STATE AIR POLLUTION RULE (CSAPR)
(CONTINUED)**

- 5) Allowance Management System requirements. Each CSAPR SO₂ Group 1 allowance shall be held in, deducted from, or transferred into, out of, or between Allowance Management System accounts in accordance with 401 KAR 51:260.
 - 6) Limited authorization. CSAPR SO₂ Group 1 allowance is a limited authorization to emit one ton of SO₂ during the control period in one year. Such authorization is limited in its use and duration as follows:
 - i) Such authorization shall only be used in accordance with the CSAPR SO₂ Group 1 Trading Program; and
 - ii) Notwithstanding any other provision of 401 KAR 51:260, the Administrator has the authority to terminate or limit the use and duration of such authorization to the extent the Administrator determines is necessary or appropriate to implement any provision of the Clean Air Act.
 - 7) Property right. CSAPR SO₂ Group 1 allowance does not constitute a property right.
- d) Title V permit revision requirements.**
- 1) No Title V permit revision shall be required for any allocation, holding, deduction, or transfer of CSAPR SO₂ Group 1 allowances in accordance with 401 KAR 51:260.
 - 2) This permit incorporates the CSAPR emissions monitoring, recordkeeping and reporting requirements pursuant to 401 KAR 51:260, Section 3(25) through 401 KAR 51:260, Section 3(30), and the requirements for a continuous emission monitoring system (pursuant to 40 CFR 75, Subparts B and H), an excepted monitoring system (pursuant to 40 CFR 75, Appendices D and E), a low mass emissions excepted monitoring methodology (pursuant to 40 CFR 75.19), and an alternative monitoring system (pursuant to 40 CFR 75, Subpart E). Therefore, the Description of CSAPR Monitoring Provisions table for units identified in this permit may be added to, or changed, in this Title V permit using minor permit modification procedures in accordance with 401 KAR 51:260, Section 3(4) (40 CFR 97.606(d)(2)) and 70.7(e)(2)(i)(B).
- e) Additional recordkeeping and reporting requirements.**
- 1) Unless otherwise provided, the owners and operators of each CSAPR SO₂ Group 1 source and each CSAPR SO₂ Group 1 unit at the source shall maintain on site at the source each of the following documents (in hardcopy or electronic format) for a period of 5 years from the date the document is created. This period may be extended for cause, at any time before the end of 5 years, in writing by the Administrator.
 - i). The certificate of representation under 401 KAR 51:260, Section 3(13) for the designated representative for the source and each CSAPR SO₂ Group 1 unit at the source and all documents that demonstrate the truth of the statements in the certificate of representation; provided that the certificate and documents shall be retained on site at the source beyond such 5-year period until such certificate of representation and documents are superseded because of the submission of a new certificate of representation under 40 CFR 97.616 changing the designated representative.
 - ii). All emissions monitoring information, in accordance with 401 KAR 51:260.
 - iii). Copies of all reports, compliance certifications, and other submissions and all records made or required under, or to demonstrate compliance with the requirements of, the CSAPR SO₂ Group 1 Trading Program.
 - 2) The designated representative of a CSAPR SO₂ Group 1 source and each CSAPR SO₂ Group 1 unit at the source shall make all submissions required under the CSAPR SO₂ Group 1 Trading Program, except as provided in 401 KAR 51:260, Section 3(15). This

SECTION L – CROSS-STATE AIR POLLUTION RULE (CSAPR) (CONTINUED)

requirement does not change, create an exemption from, or otherwise affect the responsible official submission requirements under a Title V operating permit program in 40 CFR 70.

f) Liability.

- 1) Any provision of the CSAPR SO₂ Group 1 Trading Program that applies to a CSAPR SO₂ Group 1 source or the designated representative of a CSAPR SO₂ Group 1 source shall also apply to the owners and operators of such source and of the CSAPR SO₂ Group 1 units at the source.
- 2) Any provision of the CSAPR SO₂ Group 1 Trading Program that applies to a CSAPR SO₂ Group 1 unit or the designated representative of a CSAPR SO₂ Group 1 unit shall also apply to the owners and operators of such unit.

g) Effect on other authorities.

No provision of the CSAPR SO₂ Group 1 Trading Program or exemption under 401 KAR 51:260, Section 3(3) shall be construed as exempting or excluding the owners and operators, and the designated representative, of a CSAPR SO₂ Group 1 source or CSAPR SO₂ Group 1 unit from compliance with any other provision of the applicable, approved state implementation plan, a federally enforceable permit, or the Clean Air Act.

APPENDIX F

Technical Summary Document – MOVES Onroad Inputs;

Vehicle Miles Traveled and Vehicle Hours Traveled Summary File

Summary of Emissions Modeling Decisions

The Kentucky Division for Air Quality (KYDAQ) performed an air quality analyses using the U.S. EPA MOVES3.0.4 mobile emissions simulator. The model demonstration generated SO₂ emissions from Onroad activities in Kentucky counties (Henderson and Webster) for State Implementation Plan (SIP) inclusion. The base year selected to model was 2017 along with the projected years 2021, 2026 and 2033. The MOVES results are presented in tons per year.

Inventory

The raw Fleet data, utilized in the demonstration, was provided by Kentucky Transportation Cabinet (KYTC). The values, in the VMT_VHT spreadsheet, were generated using Kentucky's 5,999 zone Statewide Model. The model ran in Caliper's TransCAD version 8.

The Louisville Metro Air Pollution Control District (LMAPCD) of Jefferson County, Kentucky supplied the Vehicle Type VMT, Road Type Distribution and Source Type Population inventory. RoadTypeDistrib.csv, VehTypeVMT.csv and SourceTypePop.csv files developed using VMT data from KYDAQ (from Evansville MPO) and Fleet data from KYTC. All processed with LMAPCD workbooks that made use of MOVES default data and FHWA methodology to account for heavy duty pass-through traffic. Oldham County KY was used as a surrogate to assist the development of the input data files for Henderson and Webster counties, scaling the fleet population with county population ratios. All data used included the most recent MOVES input data developed to date by LMAPCD.

Technical Parameters

The parameter selections for the MOVES run specifications and the inputs for the County Data Manager are given in Tables 1 and 2. Run specifications were performed individually by county and year, which resulted in 8 unique iterations of MOVES outputs for this demonstration.

Table 1. Run Specification Parameters

MOVES Version	MOVES3.0.4
Scale	Model: Onroad Domain/Scale: County Calculation Type: Inventory
Time Spans	Years: 2017, 2021, 2026, 2033 Month: All Months Day: Weekdays, Weekends Hours: All Hours
Geographic Bounds	Region: County State: Kentucky County: Henderson, Webster
Onroad Vehicles	All fuels, source use types and combinations
Road Type	All available road types
Pollutants and Processes	SO ₂ , and Total energy consumption
General Output	Mass Units: Pounds Energy Units: Joules Distance Units: Miles
Output Emissions	Time: Hour Location: County

Table 2. County Data Manager Inputs

Age Distribution	Default
Average Speed Distribution	Default
Fuel	Default
Meteorology Data	Default
Road Type Distribution	Data developed and received from LMAPCD
Source Type Population	Data developed and received from LMAPCD
Vehicle Type VMT	Data developed and received from LMAPCD, KYTC
I/M Programs	No I/M Program

Please see attached spreadsheet:
“VMT_VHT Summaries_fix_042623”

APPENDIX G

Century Aluminum Response to Information Request, 2021

November 8, 2021

Ms. Kelly Lewis
Program Planning Branch Manager
Kentucky Division for Air Quality
300 Sower Blvd, 2nd Floor
Frankfort, KY 40601
kelly.lewis@ky.gov

*RE: 1-hour SO₂ NAAQS Henderson-Webster Nonattainment Area SIP – Response to Information Request
Century Aluminum Sebree (AI # 1788)*

Dear Ms. Lewis:

During an initial planning call between the Kentucky Division for Air Quality (Division), Century Aluminum Sebree LLC (Century), and Trinity Consultants (Trinity) on October 6, 2021, we discussed the nature of the initial work that needs to be completed to make progress towards an end goal of the Division having a sulfur dioxide (SO₂) Nonattainment State Implementation Plan (SIP) for the Henderson-Webster area ready for submittal to the U.S. Environmental Protection Agency (EPA) by October 31, 2022. Century summarized investigative work that has already been completed to better characterize the SO₂ emissions at the Sebree Plant as well as analyses that have been performed to-date on the data from the SO₂ ambient monitoring station and co-located meteorological data monitoring station. We also discussed the options being explored to reduce ambient concentrations at the monitoring station and the challenges associated with implementing those options.

In follow-up to the call, the Division sent an email to Century on October 8, 2021 containing a list of information the Division is looking to obtain to facilitate initial work on the nonattainment SIP. The Division requested that Century respond within 30 days. This letter contains our initial response to the information request.

COMPILATION OF ACTUAL SO₂ EMISSIONS DATA

This section of our response addresses the Division's request for the following information:

- *"Batch processes and information on how emissions are calculated"*
- *"Hourly emissions for each unit (2019, 2020, and 2021)"*

Background on Operations and Emission Units

At the Sebree Plant, Century produces primary aluminum through the electrolytic reduction of raw alumina (Al₂O₃) in vessels termed reduction cells or "pots". Century operates three nearly identical potlines at the Sebree Plant. Each potline is composed of two potroom buildings that each contain 64 reduction cells for a total of 128 cells per potline.

Each pot in the potrooms is constructed as a complete electrolytic circuit with anode, cathode, and electrolyte. The exterior of the pots consists of a rectangular steel shell lined with refractory thermal

insulation. Raw material inputs to the pots include alumina, bath, carbon anodes, and various other additives to the aluminum production process such as aluminum fluoride. Within the pot is an inner lining of carbon (the cathode). Carbon anode blocks are placed just below the surface of a fluoride electrolyte (cryolite) to complete the reaction circuit. A current is applied to metal rods attached to the anode blocks, which passes thorough the molten bath (molten aluminum, cryolite, and alumina) and the carbon cathode lining, and then to the current collector bars. The molten aluminum formed in the reduction cells (as it is liberated from the oxygen in alumina) settles between the anode and cathode where it accumulates. The oxygen liberated reacts with the carbon anode blocks forming carbon dioxide. The accumulated molten metal is siphoned from the pots into crucibles each day. The anode blocks, which are gradually consumed by the reaction in the pots, last a few weeks before they must be replaced with new anodes.



On each potline, the emissions from the reduction cells are captured through hooding systems and are sent to two Alcoa A-398 alumina fluidized bed dry scrubber/baghouse systems, each of which has five reactors. Thus, there are a total of six A-398 alumina fluidized bed dry scrubbers at the plant (2 for each potline) with each one serving half of the pots on a potline. Any fugitive emissions not caught by the hooding system are vented through the roof of each potline.

To provide baked carbon anodes to the reduction cells, Century operates an anode paste mixing and forming operation and an anode bake furnace, in which “green anodes” are baked. The green anodes are formed from petroleum coke, recycled spent anode material, and coal tar pitch, which serves as a binder. The formed anodes are compressed and placed within the bake furnace, where they are baked to remove volatiles, leaving a solid carbon block. The emissions from the paste mixing and anode forming units are vented to a common control device, a Proceadair dry coke scrubber. The emissions from the anode bake furnace are sent to an Alcoa A-446 alumina fluidized bed scrubber.

The molten aluminum produced by the reduction cells from all three potlines is sent to the casthouse to be formed into billets and T-bars, along with other products. The casthouse utilizes natural gas-fired holding furnaces to condition molten aluminum and homogenizing furnaces to condition the aluminum billets.

Most of the major equipment and emission units at the Seabree Plant were constructed in 1972 and operations began in 1973. The original emission units included Potlines 1 and 2, the Anode Bake Furnace (ABF) and other support operations. Potline 3 and a second Anode Bake Furnace (now out of service) began operation in 1979. In 2010, following the implementation of an amperage increase project, the production capacity of the plant was increased. The plant currently has a permitted capacity of 253,531 tons per year of aluminum from the potlines.

SO₂ Emissions Calculation Methodology

SO₂ emissions from Century's Seabree Plant are a by-product of the production of primary aluminum due to the residual sulfur content in the petroleum coke and pitch used in the carbon anodes. Carbon anodes are a critical and integral component of the electrolysis process used to produce aluminum. Except for a negligible amount of SO₂ emissions attributable to natural gas combustion, essentially all the SO₂ emitted

from the plant comes from the oxidation of sulfur that comes into the plant in the petroleum coke and pitch raw materials.

Although dry alumina scrubbers (with associated baghouses) are employed on all the Potlines and ABF, these air pollution control systems are designed primarily to control gaseous and particulate fluoride emissions. They do not offer any control for SO₂. As a result, the total SO₂ emissions from the plant can be accurately calculated on a mass balance basis using information known about the total sulfur in the raw materials.

To calculate SO₂ emissions each month, Century compiles data on the sulfur content in the raw petroleum coke and pitch provided from the suppliers, conducts multiple sulfur content samples of green anodes, baked anodes, and packing coke, and tracks other process variables such as green anode mass, baked anode mass, packing coke usage rate, and carbon block consumption rates at the Potlines. The mass balance approach is encompassed in what historically has been termed the "SO₂ Calculation Engine". The SO₂ Calculation Engine has previously been reviewed and approved by the Division and is currently the stipulated method within the Title V permit for calculating actual 12-month rolling average SO₂ emissions to demonstrate compliance with the existing SO₂ emission limit in place.¹ That SO₂ emissions limit, which is a cap on total SO₂ emissions from the ABF and Potlines combined, represents the application of the Best Available Control Technology (BACT) as established in the last Prevention of Significant Deterioration (PSD) permit action completed at the plant in 2010 (V-05-088 R2).²

SO₂ Emissions from the Anode Bake Furnace (ABF)

In the SO₂ Calculation Engine mass balance methodology, the sulfur input to the ABF is calculated based on (1) the sulfur content and throughput of green anodes and (2) the sulfur content and usage rate of packing coke. The sulfur output from the furnace is based on the sulfur content and production rate of baked anodes. The difference between the sulfur input to the furnace and sulfur leaving the furnace (in the baked anodes) represents the net sulfur released, which is all assumed to be emitted as SO₂ gas out the A-446 scrubber stacks serving the ABF.

Century tracks the monthly throughputs of green anodes and baked anodes by weighing each anode loaded and unloaded in the pits during a given month. Monthly packing coke usage is tracked based on the make-up supply added each month. Aside from anode and packing coke production rate values, the key inputs that determine the actual SO₂ emissions each month are the sulfur content values for green anodes, baked anodes, and packing coke. The green anode sulfur content in turn is a function of the sulfur content in the raw petroleum coke, pitch, and anode butts material recycled from the potlines. Sulfur content measurements (of green anodes, baked anodes, and packing coke) are conducted multiple times per month in an on-site laboratory. For example, there are typically 120-140 sulfur content samples for baked anodes conducted per month, roughly 4-5 samples per day. Packing coke data is also supplemented with sulfur content data provided directly from the supplier. The samples within a month are then aggregated to define the monthly average sulfur contents for each of the three materials (green anodes, baked anodes, and packing coke), which are then input into the SO₂ calculation. Example sample calculations are provided in the SO₂ emissions tables included in Attachment 1 of this letter. Given the number of sulfur content sampling events (for the green anodes, baked anodes, and packing coke), and the tracking of production

¹ Refer to Condition 3 in Section D of permit V-19-010 R2.

² The V-05-088 R2 permit was issued as Proposed and Final on August 19, 2010 and October 6, 2010, respectively, and authorized a roughly 18% increase in the plant capacity achieved through implementation of a new potline amperage increase technology.

rates, this method yields an accurate calculation of the total plant SO₂ emissions on a monthly average basis.

SO₂ Emissions from the Potlines

The sulfur that is retained in the baked anodes is assumed to be emitted at the Potlines as these anodes are consumed in the pots. The sulfur released is a function of the aluminum production rate, the anode consumption rate (i.e., tons of anode consumed per ton of aluminum produced), and the baked anode sulfur content. A small portion of the sulfur released in the pots (5%) is assumed to be emitted as carbonyl sulfide (COS). This is consistent with assumptions inherently made by EPA in setting the COS emission standard for potlines in the *National Emission Standards for Hazardous Air Pollutants for Primary Aluminum Production* (40 CFR Part 63, Subpart LL, "PMACT").³ Attributing 5% of the sulfur to COS leaves 95% remaining. Historically, for the purposes of defining potential SO₂ emissions, Century has assumed that 2% of the sulfur is emitted as particulate sulfate compounds in the form of condensable particulate matter, and thus would not count towards the SO₂ total. However, for purposes of tabulating monthly actual SO₂ emissions, Century has typically ignored the 2% CPM conversion rate and more conservatively assumed that 95% of the sulfur in the baked anodes consumed in the potlines is emitted as SO₂. This more conservative approach is retained in the SO₂ actual emission tallies provided in Attachment 1.

As to the distribution of the potline SO₂ emissions between the A-398 stacks and potroom building roof vents, it has been assumed historically that 99% of the SO₂ generated in the pots is captured and routed to the A-398 scrubber systems and is emitted (uncontrolled) at those stacks, while the remaining 1% is emitted from the potroom building roof vents. However, on June 29-30, 2020, in fulfillment of obligations of Condition 3.r.ii in Section B of V-19-010 R2 for the Potlines, Century conducted an SO₂ emissions test on Potline 3. This test included sampling at the A-398 scrubber system stacks and at the downcomer vent (which is used to quantify secondary emissions from the roof vents). During this test, the captured SO₂ emissions emitted at the stack represented 97% of the total, slightly less than the historical 99% assumption. This data point suggests that a lower capture rate should be assumed for tallying actual SO₂ emissions between the stacks and roof vents. However, this test consists of only three 1-hour test runs and thus only defines the capture being achieved over a timeframe that is very short relative to the production cycles of the pots. Data from prior emission tests has shown higher capture rates consistent with the 99% capture assumption. For purposes of defining actual emissions for the data set the Division has requested, Century has assumed that the SO₂ capture rate on average was **98%**. Century plans to conduct additional testing in the next 6 months to further validate this assumption. Note that because emissions are uncontrolled, this assumption does not change the total SO₂ potline emissions calculated, only the location of the emissions.

Actual SO₂ Emissions Data for 2017 to Present

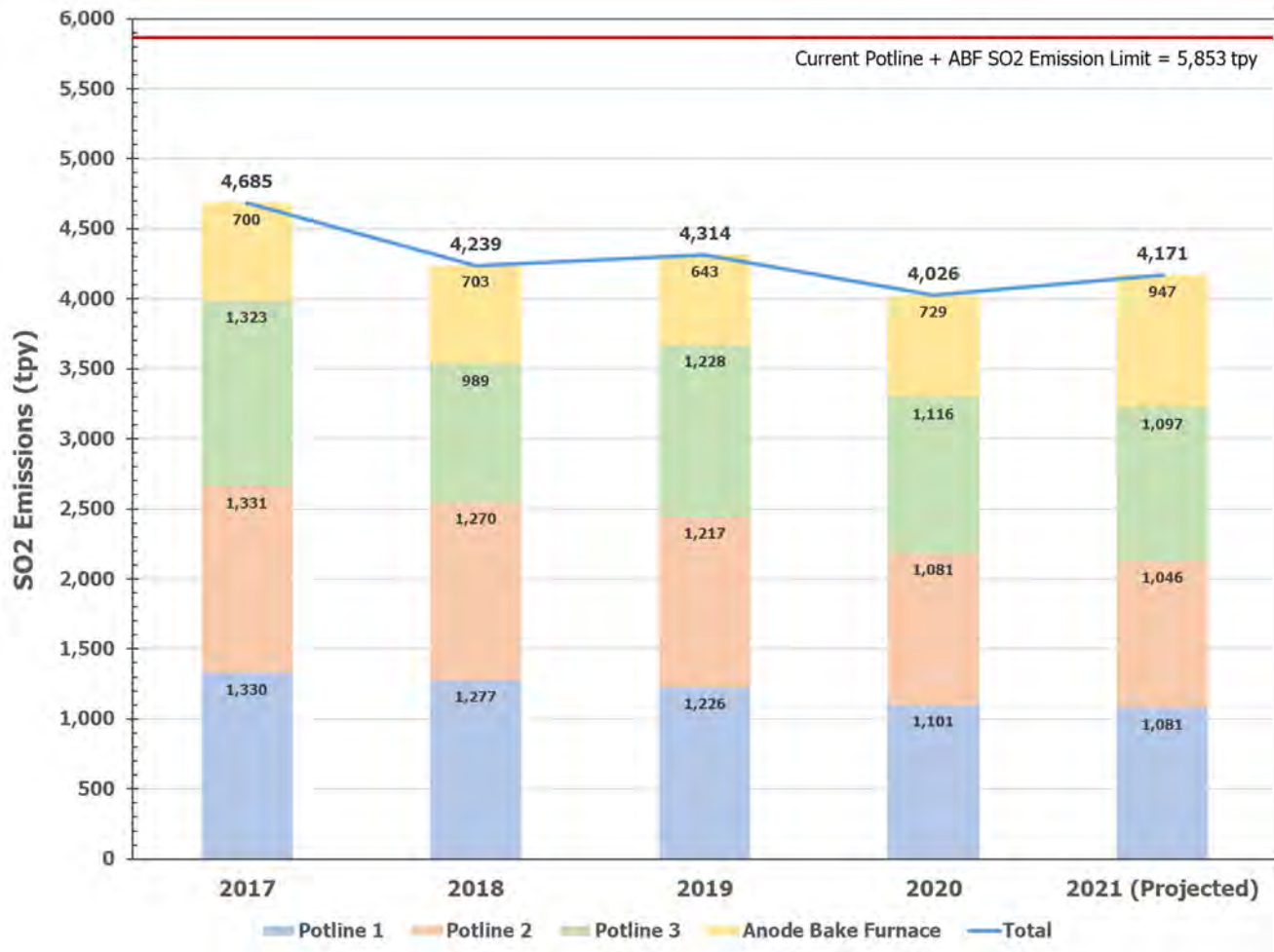
In its October 8, 2021 information request, the Division requested that Century provide information on how SO₂ actual emissions are calculated and to also provide hourly emissions for each unit for 2019, 2020, and 2021. The methodology for how SO₂ emissions are calculated has been presented earlier in this section. As explained, the SO₂ mass balance approach can only be used to resolve emissions to a monthly average basis. In the absence of having continuous emission monitors (CEMS) on all seven dry alumina scrubber

³ Pursuant to 40 CFR 63.843(e), emissions of COS from potlines are limited to 3.9 lb/ton of aluminum produced. The K-factor in Equation 4 in 40 CFR 63.847(j), which owners and operators must use to calculate COS emissions, embeds an assumption about the amount of sulfur assumed to be converted to COS. Based on data collected from the industry, EPA assumed that 8% of the sulfur in the raw petroleum coke, which they assumed makes up 78% of an anode on average, ends up being emitted as COS, which translates into an effective conversion rate of 6.25%. Century has historically assumed a smaller conversion rate of 5%, which results in a slightly higher estimate of SO₂ emissions from the potlines.

systems (6 for the A-398 systems and 1 for the A-446 system), there would be no feasible way to define emissions that are resolved to the hour. Even if CEMS were in place on all these exhaust streams, the hour-by-hour potroom building roof vent emissions would still be undefined.

The existing mass balance approach, as required by the current permit, yields accurate estimates of total monthly emissions. Because there are so many pots (128 per potline) in continuous operation, it is reasonable to expect that the potline emission rate is relatively stable. Thus, in response to Division's request, Century has compiled and organized the monthly average hourly emissions for the potlines and ABF (which account for more than 99.99% of SO₂ emissions from the plant) from 2017 to present. We included 2017 and 2018 data so that the Division has a complete data set from the time the SO₂ ambient monitoring commenced. The data tables are presented in Attachment 1. These tables also include the anode and potline production rates and sulfur content data used in the SO₂ Calculation Engine methodology described along with sample calculations. A bar graph of the annual SO₂ emissions from the potlines and ABF for 2017 through 2021 (projected) is provided in Figure 1.

Figure 1. ABF and Potline Actual SO₂ Emissions from 2017-Present



As shown in Figure 1, the facility's actual SO₂ emissions are roughly 25% below the current emissions cap. Currently, the plant is running at around 89% of capacity for aluminum production. The additional difference reflects the use of petroleum coke with an actual sulfur content less than the limit (3%) and anode consumption efficiency rates that are better than was used in setting the current SO₂ emission limit in 2010.

Considering the most recent 5-year period, SO₂ emissions have trended downward by roughly 10%. Part of the reduction is due to a small reduction in annual aluminum production rates over this period. Additionally, in the past two years, Century has been able to acquire petroleum coke with slightly lower average sulfur contents. The petroleum coke sulfur content values averaged 2.71% in 2020 and 2021 versus 2.81% in 2017 and 2018.

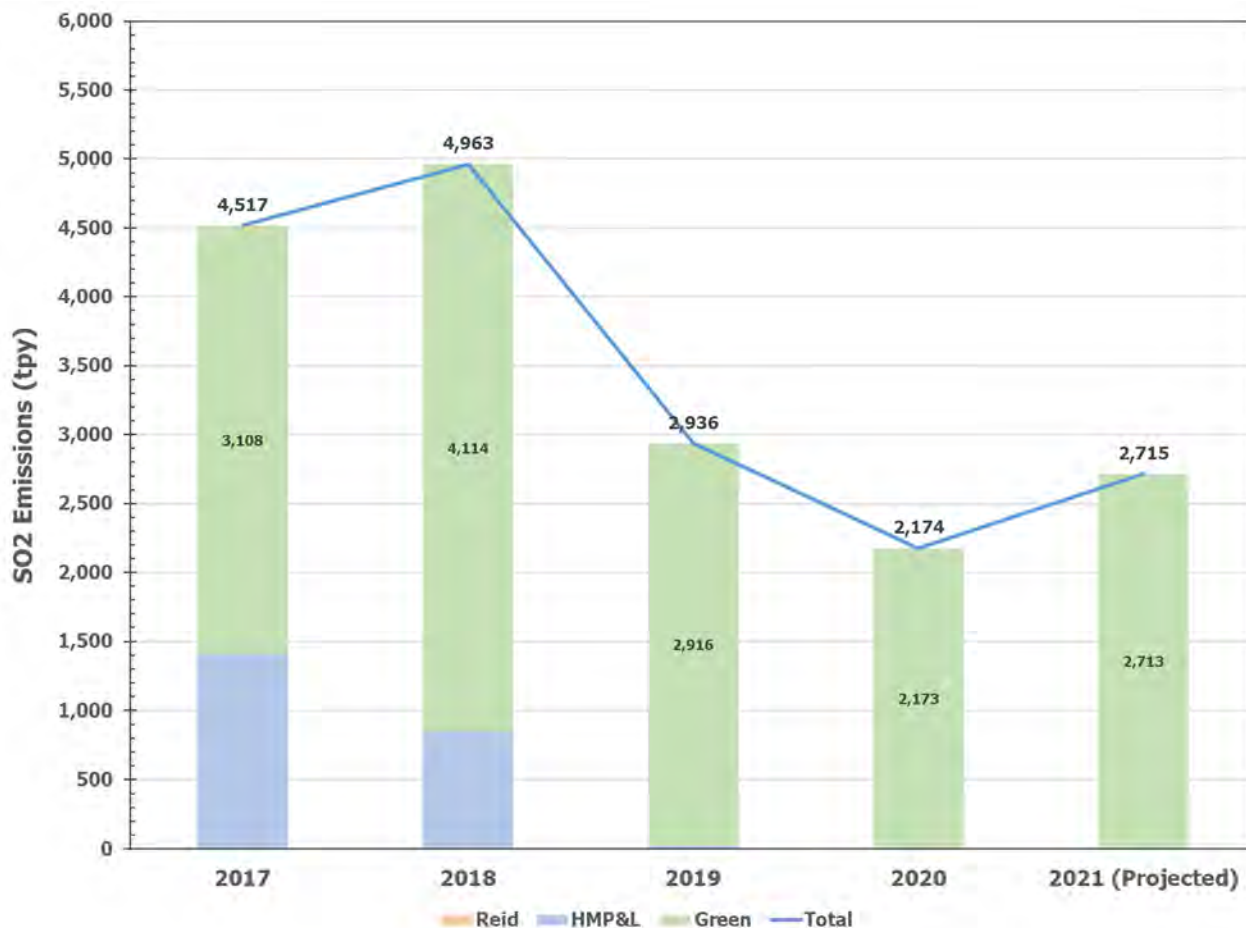
Actual SO₂ Emissions Trends at Big Rivers

Given its close proximity, SO₂ emissions from the adjacent Big Rivers Electric Corporation (BREC) facility south of the Century Sebree plant also contribute to impacts at the Sebree ambient monitor. As it is informative in reviewing the monitored SO₂ data trends discussed in the next section, a chart of actual SO₂ emissions from the BREC facility is also provided in Figure 2.

BREC owns and operates the Reid Station and operates the Henderson Station II in Henderson County, Kentucky, which is regulated under Title V permit V-11-003 R1. In 2015, Unit 1 at Reid Station, a coal-fired boiler, shut down. This station now consists only of a natural gas-fired combustion turbine with relatively insignificant SO₂ emissions.⁴ In 2019, Henderson Station II Units 1 and 2, both large coal-fired utility boilers, also shut down. The remaining R. D. Green Generating Station (Green Station) consists of two pulverized coal-fired boilers, Units 1 and 2. Both of the Green Station Units are being converted to natural gas. This conversion is scheduled to be completed by April 2022. At that time, there will be another roughly 2,500 tpy reduction in SO₂ emissions from the facility.

⁴ Emission Unit 06, Combustion Turbine at the Reid Station is permitted to use either natural gas or No. 2 fuel oil but typically only operates using natural gas.

Figure 2. Actual SO₂ Emissions from 2017-Present at the BREC Facility



CURRENT STATUS OF SO₂ MONITOR DESIGN VALUE

This and the following section of our response has been prepared in response to the Division's request for the following information:

- *"Analysis of modeled data vs. monitored data"*

As a foundation for discussing the air dispersion modeling work completed to-date, this initial section first presents a summary of the current SO₂ monitoring data.

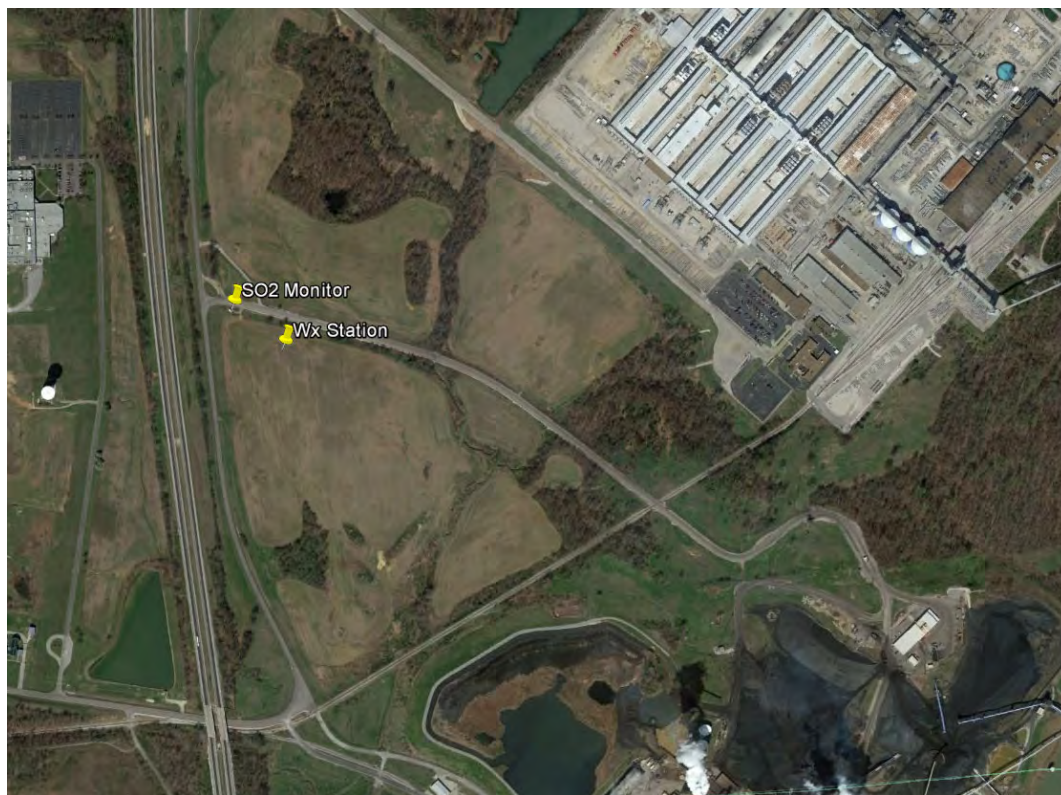
SO₂ Monitoring Station Location and Operation

Beginning in January 2017, 5-minute and 1-hour average SO₂ concentration data has been collected by the Division at the Sebree monitoring site (Site No. 21-101-1011), which is located on the Century Aluminum property at the southeast corner of the intersection of Alcan-Aluminum Road (State Route 2096) and the Big Rivers coal haul access road. Century reviews the SO₂ concentration data monthly as it is made available. The concentration data is analyzed in conjunction with the meteorological data from the co-located meteorological data station. Figures 3 and 4 show the location of the meteorological and SO₂ monitoring station locations in relation to the Century Aluminum Sebree Plant and the BREC Facility.

Figure 3. Area Surrounding the Century Sebree BREC Facilities



Figure 4. Close Up View of the Location of the Meteorological and SO₂ Monitoring Stations



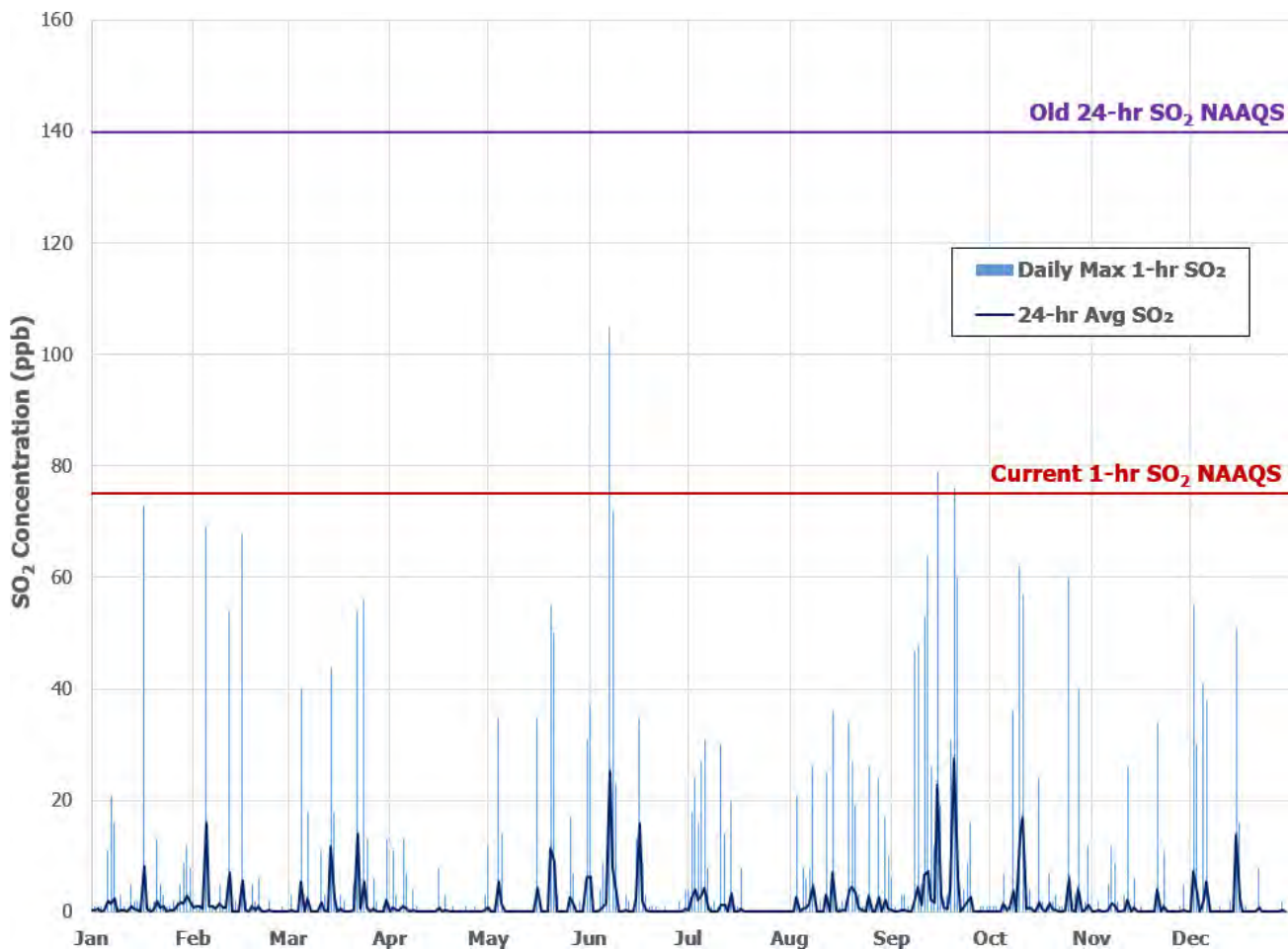
Summary of SO₂ Monitoring Data Collected Since 2017

1-hour Average and Daily Maximum SO₂ Data Trends

The existing SO₂ NAAQS, updated in 2010, is 75 ppb based on the 3-year average of the 99th percentile of the yearly distribution of 1-hour daily maximum concentrations. Each year, the set of 365 daily maximum 1-hour SO₂ concentrations are tabulated. Since the form of the standard considers the 99th percentile of these daily maximums, the 4th highest daily maximum value for the year is determined and this is averaged over 3 years to calculate the “design value” concentration that is compared to the NAAQS.

SO₂ concentrations measured at the Sebree monitor are on average extremely low. Since 2017, the average 1-hour concentration measured at the monitor is only **1.8 ppb** and the average daily maximum 1-hour concentration is only 10.3 ppb. To see this visually, a timeline series plot of the 1-hour daily maximum and 24-hour average SO₂ concentrations for the most recent full year of data, 2020, is shown in a timeline series plot in Figure 5.

Figure 5. SO₂ Concentrations for 2020 Compared to the Current 1-hour NAAQS and Prior 24-hr SO₂ NAAQS

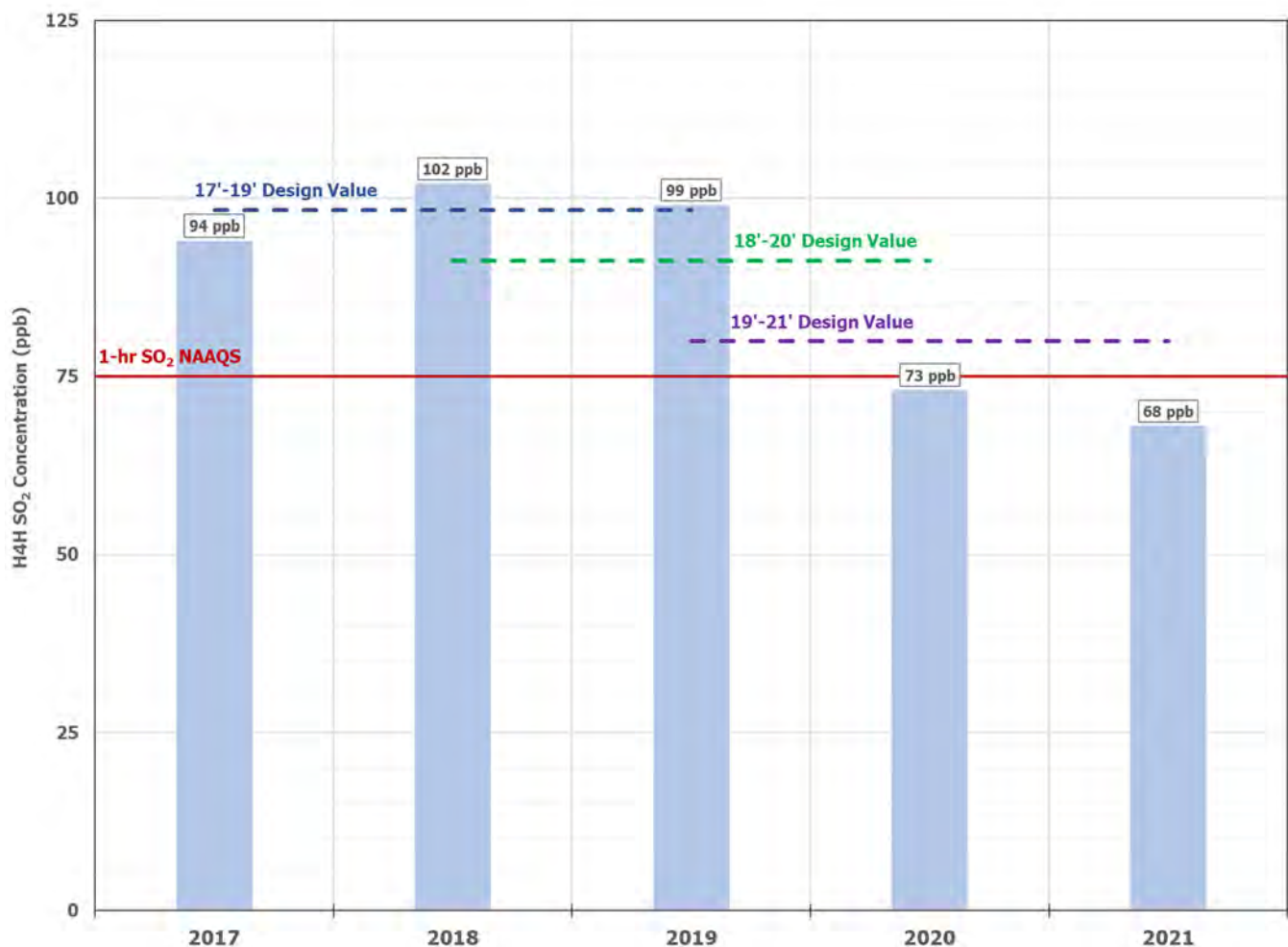


During 2020, there were only three 1-hour daily maximum values above 75 ppb and the average 1-hour daily maximum concentration was only 8.8 ppb. For context and comparison, the 24-hour average SO₂ concentrations are also shown in Figure 5 (dark blue line). For nearly 40 years, a 24-hour average SO₂ concentration below 140 ppb (one component of the prior SO₂ NAAQS) was considered protective of public health with a margin of safety. As noted in Figure 5, in 2020, the maximum 24-hour average at the monitor never exceeded 30 ppb, less than 22% of the prior NAAQS. The timeline series for the other years shows similar patterns and trends.

3-year Average SO₂ Design Value Concentrations at Monitor

Figure 6 summarizes the 4th highest daily maximum 1-hour SO₂ concentration each year since 2017 along with the available 3-year average design values. Only nine months of 2021 data are currently available for the Sebree monitor, thus, the final 4th highest concentration that will be used for the 2021 monitoring year cannot yet be determined. Year-to-date however, the 2021 4th highest daily maximum concentration is 68 ppb.

Figure 6. 4th-Highest Daily Maximum 1-hour SO₂ Concentrations at the Sebree Monitor*



* 2021 value is for year-to-date data through September 2021.

As revealed in Figure 6, due to the relatively high 4th highest concentration measured in 2019 (99 ppb), the calculated design value for the 2019-2021 period is currently above the 1-hour SO₂ NAAQS. However, this chart also shows that the 4th highest daily maximum concentrations have been trending down since 2018. The reduced 4th highest daily maximum values in 2020 and 2021 may be in part due to slightly lower SO₂ emissions from the Sebree Plant during 2020 and 2021, which were shown in Figure 1 combined with much lower SO₂ emissions from BREC shown in Figure 2. The differences may also reflect normal year-to-year variability in meteorological conditions. Regardless, if the current pattern of impacts continues in 2022, the design value concentration for the 2020-2022 period would be less than 75 ppb and showing attainment of the NAAQS. Even without any other actions being taken, a continued decrease in the design value is expected given the additional 2,500 tpy decrease in SO₂ that will occur by April 2022 from BREC when its Green Station coal-fired boilers convert to natural gas.

Additional Consideration of 5-Minute Peak SO₂ Data

When EPA updated the SO₂ NAAQS in 2010, the underlying basis for the new concentration value set was clinical human data studies aimed at documenting respiratory effects in people with asthma exposed to SO₂ for 5 to 10 minutes while breathing at elevated rates (i.e., exercising asthmatics). The human data studies cited by EPA established a 5-minute SO₂ concentration of 400 ppb, as “*the lowest concentration in free-breathing controlled human exposure studies of exercising people with asthma where moderate or greater lung function decrements occurred that were often statistically significant at the group mean level...*”.⁵ Because health effects (although less severe) were noted within a subset (8-9%) of the at-risk population at concentrations down to 200 ppb, this lower value was set as the basis for the new NAAQS to provide an even greater margin of safety. EPA then selected a 1-hour concentration of 75 ppb as statistically equivalent to and protective of a peak 5-minute 200 ppb concentration (on the assumption that in any hour where the concentration is less than 75 ppb, it is statistically unlikely for there to be a 5-minute peak concentration above 200 ppb).

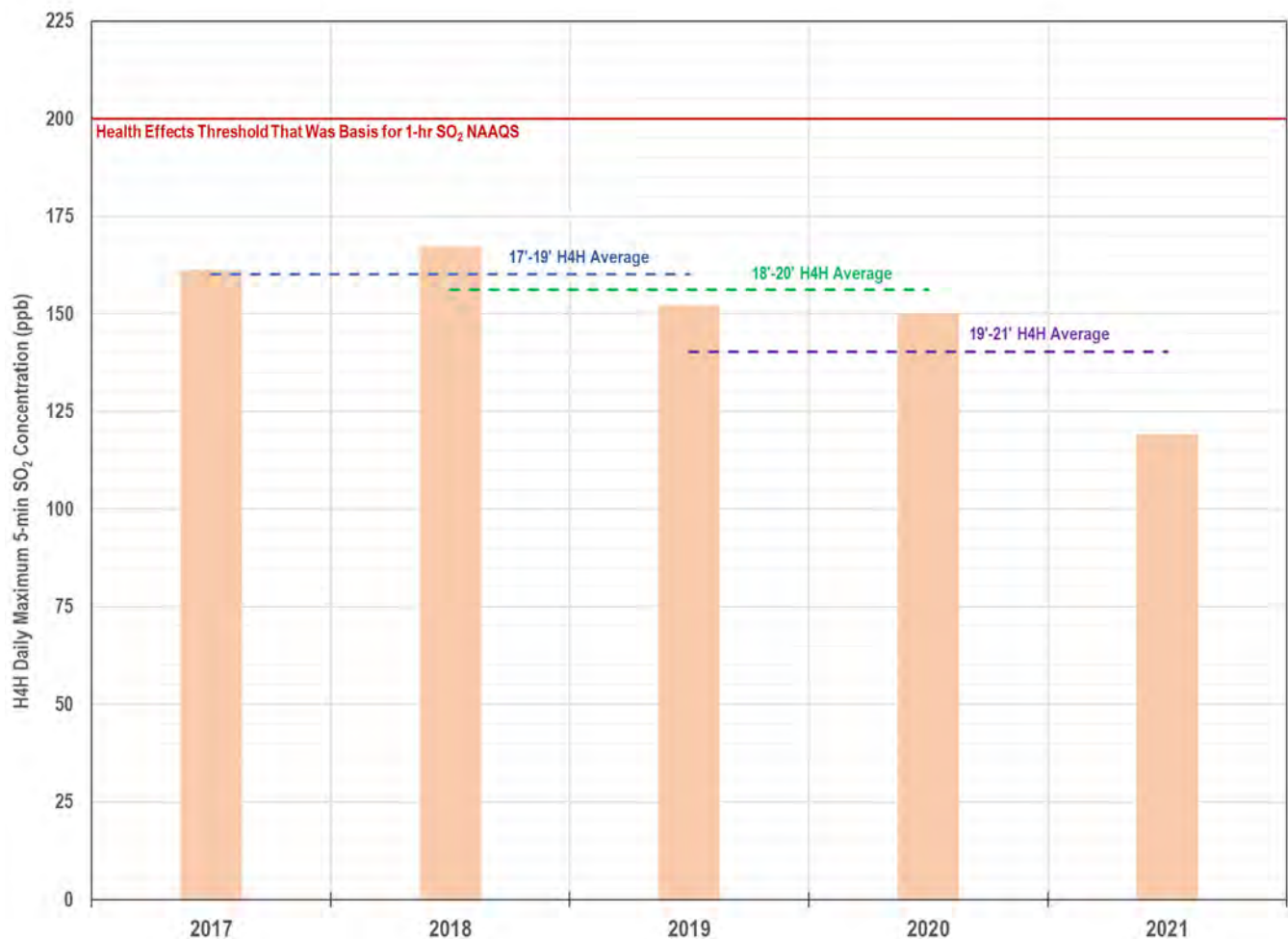
In 2018, Century conducted a detailed statistical analysis of the peak 5-minute to 1-hour SO₂ concentration relationship at both the Sebree monitor and 15 other SO₂ monitors in the U.S. located within 1 km of emission sources with greater than 4,000 tpy of SO₂. This analysis was summarized in comments Century submitted to EPA on August 8, 2018 as part of the SO₂ NAAQS review rulemaking.^{6,7} That analysis suggested that a 1-hour average of 125 ppb, rather than 75 ppb, was protective of a 5-minute 200 ppb concentration level. This conclusion is further buttressed from a more recent review of the data from the Sebree Monitor itself. Figure 7 plots the 4th highest (99th percentile) daily maximum 5-minute average SO₂ concentrations for the 2017 to 2021 period (through September 2021). As shown, the individual year and 3-year average 4th highest daily maximum 5-minute concentrations measured never exceeded 200 ppb (even though the 1-hour concentration did exceed 75 ppb in certain hours). Considering the underlying basis of the current NAAQS, this monitoring data provides strong evidence that there are no adverse health impacts from SO₂ occurring in the area surrounding the Sebree Plant.

⁵ Policy Assessment for the Review of the Primary National Ambient Air Quality Standard for Sulfur Oxides, Final. U.S. EPA Office of Air Quality Planning and Standards, Research Triangle Park, NC, EPA-452/R-18-002, May 2018, Section 3.2.2.1, pg 3-41.

⁶ 83 FR 26752, June 8, 2018, “*Review of the Primary National Ambient Air Quality Standards for Sulfur Oxides*”

⁷ Comment submitted by John Knight, Environmental Coordinator, Century Aluminum Sebree, LLC to Docket EPA-HQ-OAR-2013-0566-0198; <https://www.regulations.gov/comment/EPA-HQ-OAR-2013-0566-0198>

Figure 7. 4th-Highest Daily Maximum 5-minute SO₂ Concentrations at the Sebree Monitor*



* 2021 value is for year-to-date data through September 2021.

AIR DISPERSION MODELING TASKS

Since the call with the Division on October 6th, Century has engaged Trinity to re-establish and update the air dispersion modeling infrastructure that will be needed in working towards a model attainment demonstration. Trinity has additionally begun to consider and assess possible refinements to the modeling methodologies. The work completed to-date is summarized in this section.

Updates to AERMOD Modeling Infrastructure

The most recent SO₂ air dispersion modeling analyses conducted by Trinity were those completed in 2016 as part of the siting analysis for the existing SO₂ ambient monitoring station. Revisions to the AERMOD dispersion model and its component programs have been published by EPA since. To establish a new baseline model infrastructure, Trinity first reviewed the AERMOD files provided by the Division on October 12th, which the Division used in 2020 in working with EPA on the nonattainment boundary setting process. To ensure consistency with current operations, Trinity compared the emission unit source block information to Century's internal files and then reran these files to provide a baseline model scenario.

Comparisons of Modeled Actual SO₂ Impacts with Monitor Data

With the source and receptor information synced up between the Division's and Trinity's input data files, Trinity then compiled and processed the 2017 to 2020 meteorological data that has been collected at the meteorological data monitoring station Century installed adjacent to the SO₂ monitoring station shelter, covering the full-year periods SO₂ monitoring data has been collected thus far. Trinity also gathered and updated SO₂ background concentration data and regional source emissions inventory data. Finally, Trinity tabulated the actual SO₂ emissions data from 2017 to present from the Sebree Plant (resolvable to the month) and from the adjacent Big Rivers power stations (resolvable to the hour). With this updated "actual" emissions data set, Trinity conducted a set of air dispersion modeling runs to calculate modeled ambient concentrations for the nearby receptor grid, which also includes a receptor at the location of the monitoring station to compare modeled impacts with those the ambient monitor. As the AERMOD model system is not necessarily intended to be accurate in both space and time, both the highest modeled impacts (in the form of the NAAQS) at any off-site receptor and highest modeled impacts at the monitor location were both examined. Despite using accurate data on actual emissions, stack release parameters, and the on-site meteorological data, modeled concentrations exceeded monitored concentrations by a sizeable margin. Therefore, as a next step, Trinity initiated work on appropriate refinements that could be applied to the AERMOD modeling options that would yield more accurate estimates from the model.

Based on research into recent SO₂ modeling analyses completed for utilities and other large industry sites, including other primary aluminum smelters, Trinity has thus far identified two possible improvements to the modeling system that are being considered and assessed. Both of these improvements, incorporating options already built into the AERMOD program, were used in the SO₂ Data Requirement Rule analysis completed for Alcoa's Warrick, Indiana facility in 2017 and subsequently approved by the Indiana Department of Environmental Management (IDEM) and U.S. EPA.⁸ One improvement is to invoke the Urban option in AERMOD (as opposed to the Rural option that would otherwise be used by default for the Sebree area) to better account for enhanced nighttime turbulence generated by the heat released by operations at an aluminum smelter. Large industrial facilities, particularly those with considerable electricity usage, release heat into the environment. Therefore, the nighttime atmosphere over these areas behaves more like an urban area, with elevated heat release driven by surfaces that effectively absorb daytime solar radiation and then re-emit it at night more so than would be typical for a rural area. Trinity has reviewed satellite thermal images covering the Century Sebree plant and identified that a considerable (>10 °C) temperature difference exists between the plant and nearby areas.

Additionally, Trinity is considering revisions to some stack parameters to better reflect the enhanced plume rise resulting from merging of plumes emanating from the cluster stacks on the A-398 dry alumina scrubber reactors situated in close proximity to each other, as is illustrated in Figure 8. The combined air flow rate for the nearby stacks is conserved by holding the exit velocity input to the model constant while calculating an equivalent stack diameter that represents the combined air flow rate. Incorporation of both of the Urban and merged plume options has shown improved (although still not complete) alignment of modeled impacts from actual emissions using actual meteorological data with the corresponding actual SO₂ concentrations measured at the monitor.

⁸ Technical Support Document, Final Round 3 Area Designations for the 2010 1-Hour SO₂ Primary National Ambient Air Quality Standard for Indiana. <https://www.epa.gov/sites/default/files/2017-12/documents/13-in-so2-rd3-final.pdf>

Figure 8. Aerial Image of Potline 1 South A-398 Stack Configuration Showing Close Proximity of Stacks



Development of Modeling Protocol for Model Attainment Demonstration

Trinity is now in the process of running a permutation of AERMOD modeling scenarios considering SO₂ emissions at possible future potential emission levels (i.e., rather than actual emissions) and exploring refinements to emission rates and/or stack release parameters that may yield a forecast model impact that shows compliance with the 1-hr SO₂ NAAQS. This modeling work is being done in parallel and in conjunction with the work being completed on examining strategies to reduce SO₂ emissions and/or improve the stack configurations at the plant, which is discussed subsequently. Based on the accelerated work efforts completed in the past three weeks, Trinity expects to begin work on preparing a formal modeling protocol within the next week with an aim to submit the protocol to KDAQ in December. The modeling protocol will provide appropriate detail on the source data, meteorological data, and modeling methodology that will be employed, including a technical analysis and justification for the model options expected to be used. Upon review and comment on the modeling protocol, Trinity will then continue work towards developing a model attainment demonstration.

SO₂ CONTROLS STRATEGY ANALYSIS

This section of our response has been prepared in response to the Division's request for the following information:

- *“Control Strategy Analyses”*

Challenges Associated with Controlling SO₂ from Primary Aluminum Plants

As explained previously, the majority of the SO₂ emissions from the plant are related to anode production and consumption. The use of petroleum coke, which contains sulfur, in the generation of anodes is the primary cause of these emissions. The coke used by aluminum smelters is purchased from the refining industry, for which coke is a waste product. The refining industry tends to optimize the process in order to produce fuels of higher added value (with a low sulfur content), such as gasoline. This tendency increases the sulfur content in the waste products of the refining process, such as coke, which aluminum smelters use. Due to changes in the fossil fuel industry driven by changes in demand, both now and in the foreseeable future, there are other market forces that also severely constrain options to procure and use lower sulfur containing petroleum coke.

From an end-of-pipe controls strategy, the exhaust characteristics of potline gases make application of SO₂ control strategies typically used on other types of industrial sources and combustion units a challenge. First, due to the large volume of exhaust gas generated from the electrolytic process, the relative concentration of SO₂ in the exhaust gas (as compared to other types of industrial and utility combustion processes) is low. For example, in the last performance test conducted June 29-30, 2020, the SO₂ concentration in the Potline 3 exhaust gas averaged 82 ppm. This is an expected and typical concentration value for these sources. Similar SO₂ concentrations in the 80-100 ppm range have also been measured in prior tests. At such low concentrations (< 100 ppm), the mass transfer of SO₂ to a sorbent (in the case of a scrubber/adsorption type of control) is lower, resulting in reduced efficiencies at available residence times. The exhaust temperature downstream of the existing A-398 scrubbers is also relatively low (120 °F in the last stack test), which makes application of many dry and semi-dry scrubbing technologies infeasible. In general, the presence of other contaminants and impurities in the exhaust stream (fluorides) also requires that any control option for SO₂ work in conjunction with the existing dry alumina scrubbing system.

Background on Prior SO₂ Control Technology Reviews

A comprehensive investigation into the feasibility of controlling SO₂ emissions from the Sebree Plant by reducing the petroleum coke sulfur content and/or by installing SO₂ air pollution control systems was conducted in 2010 as part of the last PSD permit action (V-05-088 R2). That analysis resulted in a determination for SO₂ that management of raw materials and process variables with an emission limit of 5,853 tpy (12-month rolling total from the Potlines and Anode Bake Furnace) constituted the Best Available Control Technology (BACT). The sulfur content in the petroleum coke and pitch used in producing anodes was limited to **3 %** and **0.8 %**, respectively. This determination was approved by the Division, U.S. EPA Region 4, as well as the Mammoth Cave National Park Federal Land Manager. This conclusion was also consistent with other similar BACT and related control technology evaluations conducted at other primary aluminum plants in the U.S., including the Century Aluminum Hawesville, Kentucky plant, and the Alcoa Massena, New York plant. It is also consistent with Best Available Technology (BAT) determinations and Best Available Techniques Reference Documents (BREFs) in the European Union that were reviewed at that time.

The Division's 2010 BACT determination is also consistent with the fact that EPA has not established any SO₂ standards under the New Source Performance Standard (NSPS) for Primary Aluminum Reduction Plants (40 CFR 60, Subpart S). By definition, the NSPS represent,

"the emissions of air pollutants that reflect the degree of emission limitation achievable through the application of the best system of emissions reduction which (taking into account the cost of achieving such reduction and any non-air quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated."

The fact that U.S. EPA has not established SO₂ standards under Subpart S suggests that, at least at the time the NSPS was last reviewed, there was no demonstrated system of emissions reduction that was achievable. The Clean Air Act requires that NSPS be reviewed at least every eight years, yet EPA has not chosen to update Subpart S since 1997. The on-going lack of interest by EPA in evaluating or reconsidering changes to Subpart S may reflect the fact that conclusions of the review would be the same.

Since 2010, there have been no significant changes in primary aluminum production technologies, or substantive changes with regard to SO₂ air pollution control technologies that could be expected to change the determination made in 2010. Regardless, in light of the new SO₂ nonattainment designation and the drivers to find a workable solution, Century has initiated investigations into three potential strategies for reducing offsite SO₂ concentrations: (1) acquiring lower sulfur petroleum coke, (2) installing SO₂ emission controls on the ABF and/or Potlines, and (3) installing new stacks to improve dispersion and reduce building downwash impacts on exhaust plumes. Initial work on these studies completed in the past four weeks is summarized in the following sections.

Reduction in Petroleum Coke Sulfur Content

Petroleum coke and pitch are the two principle raw materials used in the production of green anodes. The petroleum coke from which anodes are formed is a byproduct of the oil refining industry. Pitch is produced by distilling crude tar, which is a byproduct of coking coal. Since SO₂ emissions from the Anode Bake Furnace and Potlines are a direct function of the coke and pitch sulfur content used in making the anodes, seeking to minimize the sulfur content of coke and pitch purchased for use in making anodes is an SO₂ pollution prevention method.

Petroleum coke that is available in the U.S. can be classified as either “anode grade” or “fuel grade”. Petroleum coke produced in a delayed coker that has a high carbon content and is low in metals such as vanadium, nickel and iron is suitable for making graphite anodes for the aluminum smelting industry. This “anode-grade” coke is generally processed in calciners and is then marketed to the aluminum industry. Conversely, coke with higher concentrations of metal is generally not suitable for use in making anodes. The sulfur and metal content of the petroleum coke are the primary parameters for determining grade and differential price. Overall, coke prices fluctuate with the price of crude oil.

The sulfur content of petroleum coke can be as high as 7.5%. Low sulfur petroleum coke has a sulfur content of 3% or less. Pitch and coke are raw materials that Century obtains from suppliers. It is not feasible for Century to produce lower sulfur pitch and coke directly through any on-site processing techniques. It is also not possible to reduce the quantity of sulfur in these materials after they are received. Thus, Century, like other primary aluminum plants, is at the mercy of the market when it comes to sulfur content of the raw materials. Still, through optimal selection and negotiation of contracts with potential suppliers, it might be possible to minimize the raw material sulfur contents. Whether this can be done reliably on a go-forward basis and/or in a manner that is economically feasible is highly unlikely. Century is currently undertaking a study to reexamine this question.

Currently, Sebree purchases coke from the Gulf Region of the U.S., with a maximum sulfur content specification of 3%, in compliance with the terms of the existing Title V permit. This is the standard sulfur content specification in the market for U.S. Gulf Region-sourced coke. To reduce the sulfur content below 3%, green cokes would need to be imported from South America and blended with U.S. cokes. Although this could result in achieving a lower sulfur content petroleum coke, there would be a significant increase in the overall environmental impact expected, including on greenhouse gas emissions, given the significantly increased transportation distances. Additionally, to achieve a sulfur content appreciably lower (e.g., in the 2% range) would cost roughly \$70-\$100 per metric ton (mt) more in the current market based on

preliminary research Century has conducted thus far. Due to shortages of these cokes, the price gap is expected to increase over the next ten years. Some coke experts believe the premiums will reach \$200-300/mt over the next ten years.

A forecasted \$100/mt increase in coke premiums for Sebree would translate into an additional cost of \$8,000,000 in annual costs at current production levels, or an estimated \$8,800,000 at capacity. A reduction in petroleum coke sulfur content from current levels to 2% would translate to a reduction in SO₂ emissions, all else being equal, of roughly 1,200 tpy. Without considering any other factors, this results in a calculated cost effectiveness of over \$6,900/ton of SO₂. This cost impact would jeopardize the economic sustainability of the Sebree Plant. Further, these are only estimated costs at this stage. Century is currently looking to engage a petroleum coke market expert to prepare a report that more fully presents an analysis on the viability of obtaining lower sulfur coke, and if this is determined to be feasible, to better define the costs. In subsequent communications with the Division, Century will provide further updates on the feasibility of reducing pet coke sulfur content as means to reduce SO₂ emissions and ambient impacts. However, we currently do not anticipate that this will be a viable or sustainable solution.

Evaluation of Possible SO₂ Air Pollution Control Systems

Consistent with the conclusions reached in the 2010 BACT analysis, there are no known instances where BACT for SO₂ on potlines was determined to be the use of wet scrubbing or other related end-of-pipe control technologies. Economic infeasibility is the primary explanation for this. Primary aluminum is a commodity business with product prices set on the London Metal Exchange (LME).⁹ It is well established that the incremental cost (\$/ton of aluminum) to install and operate any type of SO₂ end-of-pipe air pollution control system would make it infeasible to economically produce primary aluminum in the U.S. In likely recognition of this fact, there are no engineering companies in the U.S. that develop and market SO₂ control systems specifically for potlines in the primary aluminum industry. Nonetheless, Century is currently working to identify possible candidate air pollution control equipment/engineering firms that would be capable of and interested in helping Century evaluate possible control options. Century has reached out to six firms in the past four weeks with inquiries. Additional updates will be provided in subsequent communications with KDAQ.

Improvements to Design and Configuration of Stacks

The stacks on each of the reactors on the six A-398 dry alumina scrubber systems at the plant are the original installations in 1973 (for Potlines 1 and 2) and 1979 (for Potline 3). The release heights of the Potline 1 and 2 stacks are 80.6 ft from ground level, and the heights of the Potline 3 stacks are 104.9 ft from ground level. Given that the potroom buildings themselves are 48.5 ft high, the existing stacks are likely subject to building downwash effects under certain meteorological conditions. Similarly, the three stacks for the A-446 dry alumina scrubber reactors serving the Anode Bake Furnace are currently 70 ft above ground elevation, but only about 20 ft above the reactor structures. Thus, these stacks are also subject to building downwash impacts. To minimize these impacts, Century is exploring the feasibility of raising or building new stacks for the Potlines and/or Anode Bake Furnace. Another option being considered is the feasibility of re-ducting the existing A-446 dry alumina scrubber stacks serving the ABF into the original ABF stack (which existed prior to the installation of the current dry alumina scrubber control system). That original stack has a release height of 150.75 ft and is possibly capable of being raised an additional 25 ft based on its original design specifications.

⁹ <https://www.lme.com/en/Metals/Non-ferrous/LME-Aluminium#Price+graphs>

In the past 4 weeks since our initial call with the Division, Century has researched the market to identify prospective firms that could conduct an engineering study on possible revised stack configurations. To-date, six candidate firms have been identified, researched, and contacted, and Century is continuing work to identify other candidate firms. The status of these inquiries to-date is as follows:

- **Air Techniques** (Marietta, GA) – Have declined interest in conducting the engineering study.
- **Hamon Research-Cottrell** (Branchburg, NJ) – This firm previously conducted a limited engineering study considering the feasibility of re-configuring the A-398 stacks on Potlines 1 and 2 at the time of the 2010 permit action. Century solicited the firm again and at this time is awaiting a decision on whether they have availability or interest in performing the requested work.
- **Salas O'Brien** (formerly PCI Skanska, West Chester, OH) – After discussing the needs, this firm indicated that they were not interested in providing the necessary services.
- **EFI Group** (Pikesville, MD) – Century staff have to-date had multiple correspondences with representatives from this firm and they have expressed interest in the project. Century has engaged EFI for an initial consultation and representatives from EFI will be coming to the Sebree site this month to collect initial information on the current layout and locations of the existing stacks. Following the site meeting, EFI plans to formulate a cost for the front-end loading stage 2 (FEL-2) study. However, even if Century chooses to engage this firm, it likely will be several months before actionable decisions on whether a stack change project is feasible can be made.
- **Penta Engineering** (St. Louis, MO) – Century staff have had multiple conference calls and discussions with this firm. They have expressed interest, but the structural design division of the firm is currently very busy. Century is awaiting further information from Penta on whether they will be interested in bidding on the stack study and whether they could provide the services in the timeframe needed.
- **ICC Commonwealth** (Portsmouth, NH) – Century has reached out to this stack design/engineering firm and has had initial discussions. ICC has requested detailed information on the exhaust gas characteristics, some of which is not available. They are suggesting that the specific future stack configuration be defined (via the air dispersion models) before the engineering feasibility study is undertaken. Discussions on a possible engagement are continuing.

Century expects to be able to engage an engineering firm to conduct a study and prepare a report on the feasibility of reconfiguring stacks at the facility within the next 2-3 months. Subsequently, the results from this analysis should be available within 4-6 months and will provide information on both the costs and feasibility of candidate options. In parallel, Century will be working with Trinity to optimize these candidate stack reconfiguration options in defining a scenario that hopefully allows the facility to model attainment of the NAAQS. Century will keep the Division apprised of these efforts in the coming months.

Summary of Expected SO₂ Controls Options

As noted in EPA's Guidance for 1-Hour SO₂ Nonattainment SIP Submissions¹⁰, the emission reduction measures an air agency justifies as being most appropriate to implement for an area to attain the SO₂ NAAQS should be "*based on a variety of local factors such as population exposure, enforceability, and economic impact*". As noted earlier, the health effects basis of the SO₂ NAAQS is a 5-minute exposure

¹⁰ Memorandum from Mr. Stephen D. Page, Director, OAQPS, EPA, to Regional Air Division Directors, Regions 1 – 10, April 23, 2014, "Guidance for 1-Hour SO₂ Nonattainment SIP Submissions"; <https://www.epa.gov/so2-pollution/guidance-1-hour-sulfur-dioxide-so2-nonattainment-area-state-implementation-plans-sip>

above 200 ppb). Considering the fact that the 99th percentile daily maximum 5-minute concentrations at the Sebree monitor have never exceeded 200 ppb, it is reasonable to conclude that population exposure, at least to any possible adverse impacts of SO₂, is minimal. Century presumes that this condition will have significant influence on decisions about possible SO₂ emissions reduction strategies to implement.

With regard to the economic impact factor cited in EPA's SIP development guidance, based on the comprehensive analysis completed in 2010, Century expects that neither a strategy of reducing petroleum coke sulfur content nor installing SO₂ air pollution controls will be economically feasible. We will continue working over the next several months to obtain sufficient additional market, technical, and cost data to support that premise. Century however will continue its efforts to fully assess these options towards development of a report that can be used to support the nonattainment SIP. On the assumption that SO₂ controls will not be feasible, we expect to focus more of our efforts on determining the technical and cost feasibility of modifying the existing Potline or Anode Bake Furnace stacks. Additionally, even with or without these actions, the sizable reductions of SO₂ emissions occurring from the BREC facility in 2022 alone may, based on current monitor data trends, be sufficient to have the area attain the NAAQS.

NEXT ACTIONS

Century is committed to working cooperatively with the Division towards the development of the required SO₂ nonattainment SIP package. To ensure progress towards that goal is being attained, we aim to provide additional information and updates to the Division at least one per month, which can be through follow-up progress letters and/or conference calls with Division staff. Our next priority action item will be to complete and submit a modeling protocol for evaluation by the Division. We expect to be able to do this by the end of December.

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If you have any questions regarding the information provided thus far, or would like to set up a conference call to discuss progress on the actions being taken, please do not hesitate to contact me at 270-521-6215 or christopher.goddard@centuryaluminum.com.

Sincerely,

Chris Goddard
Environmental Manager

Attachments

cc: Mr. Levi Chaffin, Plant Manager, Century Aluminum
Mr. Paul J. Smith, P.E., Trinity Consultants
Mr. Tony Schroeder, CCM, QEP, Trinity Consultants

ATTACHMENT 1

Tabulation of 2017-September 2021 Actual SO₂ Emissions Data

Actual SO2 Emissions by Month (Based on SO2 Calculation Engine Data)

Month	Anode Bake Furnace SO2 Emissions							Potlines SO2 Emissions					
	Green Anodes Fed (ton/mo)	Baked Anodes Produced (ton/mo)	Packing Coke Consumed (ton/mo)	Green Anode Sulfur Content (%)	Baked Anode Sulfur Content (%)	Petroleum Coke & Packing Coke Sulfur Content (%)	ABF SO2 Emissions (ton/mo)	Potline Production (ton Al/mo)	Anode Consump Rate (ton/ton Al)	% Sulfur Emitted as COS	% SO2 Emitted as CPM	Total Potlines SO2 Emissions (ton/mo)	ABF + Potlines SO2 Emissions (ton/mo)
Jan 2017	12,916	12,354	185	2.20%	2.04%	2.79%	75.7	20,080	0.416	5%	0%	323.3	399.1
Feb 2017	10,818	10,372	156	2.07%	1.96%	2.86%	50.4	19,981	0.412	5%	0%	307.2	357.5
Mar 2017	12,238	11,712	176	2.00%	1.92%	2.89%	49.1	20,614	0.411	5%	0%	309.2	358.3
Apr 2017	13,035	12,497	187	2.16%	2.02%	2.81%	69.1	19,960	0.415	5%	0%	318.3	387.3
May 2017	12,696	12,282	184	2.27%	2.17%	2.90%	54.3	20,357	0.415	5%	0%	348.3	402.6
Jun 2017	10,838	10,433	157	2.21%	2.04%	2.79%	63.7	19,845	0.417	5%	0%	320.2	383.9
Jul 2017	12,161	11,640	175	2.23%	2.13%	2.83%	57.6	20,458	0.417	5%	0%	345.1	402.7
Aug 2017	12,037	11,551	173	2.25%	2.13%	2.75%	58.8	20,538	0.417	5%	0%	347.2	406.1
Sep 2017	11,046	10,642	160	2.24%	2.12%	2.60%	52.2	19,953	0.424	5%	0%	340.7	392.9
Oct 2017	12,466	11,998	180	2.17%	2.13%	2.67%	38.5	20,671	0.425	5%	0%	356.0	394.5
Nov 2017	12,692	12,182	183	2.17%	2.08%	2.80%	55.8	20,047	0.419	5%	0%	331.7	387.5
Dec 2017	11,442	10,964	164	2.30%	2.11%	2.89%	74.7	20,667	0.408	5%	0%	337.4	412.1
Jan 2018	11,928	11,373	171	2.28%	2.08%	2.80%	80.8	20,757	0.411	5%	0%	337.6	418.5
Feb 2018	11,031	10,453	157	2.25%	2.14%	2.84%	57.0	18,753	0.406	5%	0%	309.8	366.7
Mar 2018	11,805	11,228	168	2.19%	2.08%	2.68%	59.7	20,515	0.406	5%	0%	329.3	388.9
Apr 2018	11,614	11,125	167	2.22%	2.00%	2.85%	79.6	19,730	0.408	5%	0%	306.0	385.7
May 2018	12,049	11,418	171	2.19%	2.06%	2.83%	67.6	19,900	0.406	5%	0%	316.4	384.0
Jun 2018	8,330	8,062	121	2.22%	2.02%	2.77%	51.1	13,180	0.407	5%	0%	205.7	256.8
Jul 2018	6,419	6,085	91	2.18%	2.09%	2.73%	30.6	13,900	0.429	5%	0%	236.9	267.5
Aug 2018	7,933	7,498	112	2.17%	2.03%	2.84%	45.2	17,810	0.410	5%	0%	282.1	327.3
Sep 2018	11,440	10,857	163	2.20%	2.01%	2.91%	76.9	18,734	0.414	5%	0%	295.7	372.6
Oct 2018	13,218	12,573	189	2.18%	1.95%	2.84%	97.4	19,552	0.422	5%	0%	305.7	403.1
Nov 2018	10,196	9,722	146	2.12%	1.89%	2.81%	72.9	19,639	0.421	5%	0%	297.4	370.2
Dec 2018	12,317	14,112	173	2.06%	1.88%	2.82%	-15.4	20,563	0.425	5%	0%	312.8	297.3
Jan 2019	13,411	12,983	195	2.01%	1.90%	2.71%	57.9	20,576	0.425	5%	0%	315.4	373.3
Feb 2019	10,538	10,172	153	2.01%	1.94%	2.76%	37.5	18,712	0.425	5%	0%	293.6	331.2
Mar 2019	11,834	11,532	173	1.95%	1.91%	2.61%	30.0	20,415	0.432	5%	0%	319.8	349.8
Apr 2019	11,555	11,267	169	2.02%	1.83%	2.97%	64.4	19,698	0.436	5%	0%	298.6	363.0
May 2019	12,011	11,666	175	2.00%	1.89%	2.73%	49.9	20,412	0.439	5%	0%	321.5	371.4
Jun 2019	11,926	11,170	168	1.95%	1.84%	2.83%	65.3	19,774	0.411	5%	0%	283.4	348.7
Jul 2019	12,582	11,857	178	2.02%	1.89%	2.86%	69.2	20,310	0.425	5%	0%	310.2	379.4

Month	Anode Bake Furnace SO2 Emissions							Potlines SO2 Emissions					
	Green Anodes Fed (ton/mo)	Baked Anodes Produced (ton/mo)	Packing Coke Consumed (ton/mo)	Green Anode Sulfur Content (%)	Baked Anode Sulfur Content (%)	Petroleum Coke & Packing Coke Sulfur Content (%)	ABF SO2 Emissions (ton/mo)	Potline Production (ton Al/mo)	Anode Consump Rate (ton/ton Al)	% Sulfur Emitted as COS	% SO2 Emitted as CPM	Total Potlines SO2 Emissions (ton/mo)	ABF + Potlines SO2 Emissions (ton/mo)
Aug 2019	12,799	12,069	181	2.11%	1.97%	2.78%	76.3	20,352	0.418	5%	0%	318.2	394.5
Sep 2019	11,642	10,988	165	2.02%	1.96%	2.69%	47.6	19,425	0.423	5%	0%	306.4	354.0
Oct 2019	11,332	10,755	161	2.00%	1.93%	2.64%	46.5	20,128	0.413	5%	0%	305.1	351.7
Nov 2019	12,314	11,725	176	1.90%	1.92%	2.83%	28.1	19,466	0.419	5%	0%	297.0	325.2
Dec 2019	13,134	12,563	188	2.03%	1.88%	2.43%	69.9	20,393	0.414	5%	0%	302.2	372.1
Jan 2020	12,840	12,311	185	1.96%	1.92%	2.75%	41.7	20,100	0.404	5%	0%	295.6	337.2
Feb 2020	11,119	10,630	159	2.00%	1.82%	2.62%	66.4	18,964	0.412	5%	0%	270.7	337.1
Mar 2020	12,141	11,605	174	2.04%	1.84%	2.72%	77.6	19,941	0.411	5%	0%	286.8	364.4
Apr 2020	11,132	10,593	159	1.88%	1.80%	2.66%	46.0	18,570	0.415	5%	0%	262.9	308.9
May 2020	12,748	12,166	182	1.80%	1.85%	2.81%	18.8	19,181	0.414	5%	0%	279.3	298.1
Jun 2020	11,987	11,409	171	2.02%	1.83%	2.89%	76.6	18,342	0.419	5%	0%	266.8	343.3
Jul 2020	10,939	10,366	155	2.00%	1.80%	2.84%	73.2	17,864	0.439	5%	0%	268.2	341.4
Aug 2020	11,894	11,301	170	2.00%	1.88%	2.78%	60.1	17,742	0.424	5%	0%	268.8	328.9
Sep 2020	11,681	11,172	168	2.09%	1.96%	2.60%	58.4	17,252	0.439	5%	0%	282.3	340.7
Oct 2020	12,070	11,487	172	2.08%	1.94%	2.70%	65.8	18,192	0.424	5%	0%	284.6	350.5
Nov 2020	10,399	9,890	148	1.95%	1.86%	2.36%	44.6	18,447	0.423	5%	0%	276.0	320.6
Dec 2020	13,114	12,415	186	1.97%	1.72%	2.61%	99.6	18,898	0.413	5%	0%	255.4	354.9
Jan 2021	11,418	10,818	162	2.01%	1.77%	2.68%	84.3	19,675	0.433	5%	0%	286.4	370.7
Feb 2021	11,488	10,091	151	1.94%	1.81%	2.66%	87.1	17,859	0.430	5%	0%	264.8	351.8
Mar 2021	12,356	11,730	176	2.00%	1.79%	2.65%	83.2	19,543	0.433	5%	0%	287.7	370.9
Apr 2021	12,918	12,307	185	1.98%	1.79%	2.59%	81.1	18,588	0.419	5%	0%	264.7	345.7
May 2021	12,313	11,714	176	1.84%	1.73%	2.72%	56.6	19,292	0.438	5%	0%	277.9	334.5
Jun 2021	11,170	10,587	159	1.87%	1.66%	2.86%	75.6	18,335	0.431	5%	0%	249.8	325.4
Jul 2021	11,972	11,390	171	1.85%	1.64%	2.79%	78.0	18,791	0.436	5%	0%	255.3	333.3
Aug 2021	11,924	11,371	171	1.90%	1.65%	2.74%	85.5	18,708	0.448	5%	0%	263.2	348.6

Sample Calculations (Using August 2021 Data as Example)

ABF SO2 Emissions (ton/month) = [(11,924 GA ton/mo x 1.90%) + (171 PC ton/mo x 2.74%) - (11,371 BA ton/mo x 1.65%)] x 64 ton SO2/32 ton S = 85.5 tons SO2/month

Potlines SO2 Emissions (ton/month) = 18,708 ton Al/mo x 0.448 ton anode/ton Al x 1.65% x (1-5%) x (1-0%) x 64 ton SO2/32 ton S = 263.2 tons SO2/month

Total ABF + Potline SO2 Emissions (ton/month) = 85.5 ABF SO2 tons/month + 263.2 Potline SO2 tons/month = 348.6 tons SO2/month

For the Potlines SO2 calculation, although 2% of the sulfur can be expected to be emitted as sulfate compounds in the form of CPM, for these actual emission tallies, Century has conservatively used a 0% value, which results in a higher SO2 emissions estimate.

When more baked anodes are pulled than set in the ABF, a negative emission rate may be calculated for that month. This is an artifact of the mass balance method.

However, the combined ABF and Potline emissions are still considered accurate.

Totals by Year

Year	Anode Bake Furnace SO2 Emissions					Potlines SO2 Emissions			
	Green Anodes Fed (ton/yr)	Baked Anodes Produced (ton/yr)	Packing Coke Consumed (ton/yr)	Petroleum Coke & Packing Coke Sulfur Content (Avg %)	ABF SO2 Emissions (tpy)	Potline Production (ton Al/yr)	Anode Consump Rate (Average) (ton/ton Al)	Total Potlines SO2 Emissions (tpy)	ABF + Potlines SO2 Emissions (tpy)
2017	144,385	138,626	2,079	2.80%	699.9	243,170	0.416	3,984.6	4,684.5
2018	128,280	124,506	1,830	2.81%	703.3	223,033	0.414	3,535.4	4,238.7
2019	145,077	138,747	2,083	2.74%	642.8	239,661	0.423	3,671.4	4,314.2
2020	142,065	135,345	2,030	2.70%	728.7	223,494	0.420	3,297.4	4,026.1
2021	143,337	135,012	2,025	2.71%	946.9	226,187	0.434	3,224.6	4,171.5

Capacity 145,720

253,531

2021 values are projections based on Jan-Aug data.

Hourly Average Actual SO2 Emissions by Month For Each Potline and ABF Emission Point

				Potline Stack + Roof			Potline A-398 Stack Only			Potline Roof Only			ABF	Total
	Potline 1 % of Total Production	Potline 2 % of Total Production	Potline 3 % of Total Production	Potline 1 SO2 Emissions (lb/hr)	Potline 2 SO2 Emissions (lb/hr)	Potline 3 SO2 Emissions (lb/hr)	Potline 1 Stack SO2 Emissions (lb/hr)	Potline 2 Stack SO2 Emissions (lb/hr)	Potline 3 Stack SO2 Emissions (lb/hr)	Potline 1 Roof SO2 Emissions (lb/hr)	Potline 2 Roof SO2 Emissions (lb/hr)	Potline 3 Roof SO2 Emissions (lb/hr)	ABF SO2 Emissions (lb/hr)	ABF + Potlines SO2 Emissions (lb/hr)
Month														
Jan 2017	33.3%	33.4%	33.3%	289.6	290.1	289.5	283.8	284.3	283.7	5.8	5.8	5.8	203.6	1,072.8
Feb 2017	33.1%	33.3%	33.6%	302.3	304.8	307.0	296.2	298.7	300.9	6.0	6.1	6.1	149.9	1,064.0
Mar 2017	33.2%	33.6%	33.2%	276.3	279.0	275.8	270.8	273.4	270.3	5.5	5.6	5.5	132.0	963.1
Apr 2017	33.2%	33.4%	33.4%	293.2	295.4	295.5	287.4	289.5	289.6	5.9	5.9	5.9	191.8	1,075.9
May 2017	33.2%	33.3%	33.6%	310.5	311.5	314.4	304.3	305.2	308.1	6.2	6.2	6.3	146.0	1,082.4
Jun 2017	33.3%	33.3%	33.5%	295.8	296.0	297.6	289.9	290.1	291.6	5.9	5.9	6.0	177.1	1,066.5
Jul 2017	33.5%	33.3%	33.1%	311.1	309.4	307.3	304.9	303.2	301.1	6.2	6.2	6.1	154.7	1,082.5
Aug 2017	33.6%	33.4%	33.0%	313.4	312.2	307.9	307.1	305.9	301.7	6.3	6.2	6.2	158.2	1,091.6
Sep 2017	33.8%	33.5%	32.7%	319.5	317.2	309.6	313.2	310.9	303.4	6.4	6.3	6.2	145.1	1,091.4
Oct 2017	33.1%	33.4%	33.5%	316.9	320.1	320.2	310.5	313.7	313.8	6.3	6.4	6.4	103.5	1,060.6
Nov 2017	33.3%	33.5%	33.2%	307.1	308.7	305.5	301.0	302.6	299.4	6.1	6.2	6.1	155.0	1,076.3
Dec 2017	34.0%	33.4%	32.6%	308.4	302.5	296.1	302.2	296.5	290.1	6.2	6.1	5.9	200.7	1,107.7
Jan 2018	33.5%	33.2%	33.3%	304.3	301.3	302.0	298.2	295.3	296.0	6.1	6.0	6.0	217.3	1,125.0
Feb 2018	33.4%	33.6%	33.0%	307.6	309.6	304.6	301.5	303.5	298.5	6.2	6.2	6.1	169.6	1,091.5
Mar 2018	33.5%	33.1%	33.4%	296.5	292.9	295.7	290.6	287.0	289.8	5.9	5.9	5.9	160.4	1,045.6
Apr 2018	33.4%	33.6%	33.0%	284.2	285.6	280.3	278.5	279.9	274.6	5.7	5.7	5.6	221.2	1,071.3
May 2018	34.5%	34.4%	31.1%	293.4	292.5	264.8	287.5	286.6	259.5	5.9	5.8	5.3	181.6	1,032.3
Jun 2018	50.4%	49.6%	0.0%	288.2	283.2	0.0	282.5	277.6	0.0	5.8	5.7	0.0	141.9	713.3
Jul 2018	48.7%	48.2%	3.1%	310.1	307.0	19.8	303.9	300.9	19.4	6.2	6.1	0.4	82.2	719.1
Aug 2018	37.7%	38.2%	24.1%	285.6	290.0	182.6	279.9	284.2	179.0	5.7	5.8	3.7	121.5	879.7
Sep 2018	35.6%	34.8%	29.6%	292.6	285.9	243.0	286.8	280.2	238.1	5.9	5.7	4.9	213.6	1,035.1
Oct 2018	33.9%	33.8%	32.3%	278.2	277.9	265.6	272.6	272.3	260.3	5.6	5.6	5.3	261.9	1,083.6
Nov 2018	33.5%	33.4%	33.1%	276.7	276.2	273.2	271.1	270.6	267.7	5.5	5.5	5.5	202.4	1,028.4
Dec 2018	33.4%	33.1%	33.5%	280.7	278.6	281.5	275.1	273.0	275.9	5.6	5.6	5.6	-41.5	799.3
Jan 2019	33.3%	33.6%	33.1%	282.6	284.7	280.4	276.9	279.0	274.8	5.7	5.7	5.6	155.8	1,003.5
Feb 2019	33.0%	33.2%	33.8%	288.3	290.4	295.2	282.5	284.6	289.3	5.8	5.8	5.9	111.7	985.6
Mar 2019	33.6%	33.0%	33.4%	289.1	283.8	286.8	283.4	278.2	281.0	5.8	5.7	5.7	80.7	940.5
Apr 2019	32.9%	33.3%	33.8%	272.7	276.3	280.4	267.3	270.8	274.7	5.5	5.5	5.6	179.0	1,008.3
May 2019	32.8%	33.4%	33.9%	283.1	288.4	292.7	277.5	282.6	286.9	5.7	5.8	5.9	134.1	998.4
Jun 2019	33.5%	32.7%	33.7%	264.0	257.6	265.5	258.7	252.4	260.2	5.3	5.2	5.3	181.4	968.5
Jul 2019	33.3%	32.9%	33.8%	277.5	274.5	281.9	271.9	269.0	276.3	5.5	5.5	5.6	185.9	1,019.8

				Potline Stack + Roof			Potline A-398 Stack Only			Potline Roof Only			ABF	Total
	Potline 1 % of Total Production	Potline 2 % of Total Production	Potline 3 % of Total Production	Potline 1 SO2 Emissions (lb/hr)	Potline 2 SO2 Emissions (lb/hr)	Potline 3 SO2 Emissions (lb/hr)	Potline 1 Stack SO2 Emissions (lb/hr)	Potline 2 Stack SO2 Emissions (lb/hr)	Potline 3 Stack SO2 Emissions (lb/hr)	Potline 1 Roof SO2 Emissions (lb/hr)	Potline 2 Roof SO2 Emissions (lb/hr)	Potline 3 Roof SO2 Emissions (lb/hr)	ABF SO2 Emissions (lb/hr)	ABF + Potlines SO2 Emissions (lb/hr)
Aug 2019	33.7%	32.8%	33.5%	287.9	280.6	286.7	282.2	275.0	281.0	5.8	5.6	5.7	205.2	1,060.4
Sep 2019	33.8%	32.9%	33.2%	288.0	280.2	282.8	282.3	274.6	277.2	5.8	5.6	5.7	132.3	983.3
Oct 2019	34.1%	33.5%	32.3%	280.1	274.9	265.3	274.5	269.4	260.0	5.6	5.5	5.3	125.1	945.4
Nov 2019	33.5%	33.7%	32.8%	276.2	278.3	270.6	270.7	272.7	265.2	5.5	5.6	5.4	78.2	903.3
Dec 2019	33.2%	32.7%	34.1%	269.4	266.0	277.0	264.0	260.7	271.5	5.4	5.3	5.5	187.8	1,000.3
Jan 2020	33.8%	33.1%	33.1%	268.4	263.2	263.0	263.0	257.9	257.7	5.4	5.3	5.3	112.0	906.5
Feb 2020	33.7%	33.4%	32.9%	262.2	259.8	255.8	256.9	254.6	250.7	5.2	5.2	5.1	190.9	968.7
Mar 2020	33.3%	33.3%	33.4%	256.5	256.6	257.9	251.4	251.5	252.7	5.1	5.1	5.2	208.5	979.5
Apr 2020	32.0%	33.3%	34.7%	234.0	242.9	253.3	229.3	238.1	248.2	4.7	4.9	5.1	127.9	858.1
May 2020	32.6%	32.2%	35.2%	244.8	241.6	264.3	239.9	236.8	259.0	4.9	4.8	5.3	50.5	801.3
Jun 2020	33.2%	32.4%	34.4%	246.1	240.4	254.6	241.2	235.6	249.5	4.9	4.8	5.1	212.7	953.7
Jul 2020	32.8%	32.8%	34.4%	236.6	236.5	247.9	231.9	231.8	242.9	4.7	4.7	5.0	196.9	917.9
Aug 2020	34.0%	33.2%	32.9%	245.4	239.8	237.5	240.5	235.0	232.7	4.9	4.8	4.7	161.5	884.2
Sep 2020	34.2%	32.9%	32.9%	268.2	257.8	258.2	262.9	252.7	253.0	5.4	5.2	5.2	162.1	946.3
Oct 2020	34.1%	31.3%	34.6%	260.9	239.8	264.4	255.7	235.1	259.1	5.2	4.8	5.3	177.0	942.2
Nov 2020	33.2%	32.5%	34.3%	254.8	249.2	262.8	249.7	244.2	257.5	5.1	5.0	5.3	123.8	890.5
Dec 2020	33.5%	33.1%	33.3%	230.3	227.3	228.9	225.7	222.7	224.3	4.6	4.5	4.6	267.7	954.1
Jan 2021	34.1%	32.3%	33.6%	262.4	249.0	258.6	257.1	244.0	253.4	5.2	5.0	5.2	226.7	996.6
Feb 2021	33.9%	32.5%	33.6%	267.3	256.0	264.6	262.0	250.9	259.3	5.3	5.1	5.3	259.1	1,047.1
Mar 2021	33.5%	32.5%	34.0%	259.3	251.5	262.6	254.1	246.4	257.4	5.2	5.0	5.3	223.5	996.9
Apr 2021	34.3%	32.4%	33.4%	252.0	237.9	245.2	247.0	233.1	240.3	5.0	4.8	4.9	225.2	960.4
May 2021	33.7%	32.1%	34.2%	252.0	239.8	255.2	247.0	235.0	250.1	5.0	4.8	5.1	152.1	899.1
Jun 2021	33.2%	32.2%	34.6%	230.3	223.1	240.3	225.7	218.7	235.5	4.6	4.5	4.8	210.0	903.8
Jul 2021	32.3%	32.9%	34.8%	221.7	225.5	239.1	217.3	221.0	234.3	4.4	4.5	4.8	209.7	896.1
Aug 2021	33.1%	32.7%	34.3%	233.8	231.3	242.4	229.1	226.6	237.5	4.7	4.6	4.8	229.7	937.2

Sample Calculations (Using August 2021 Data as Example)

Potline 1 SO2 Emissions (lb/hr) = 263.2 tons SO2/month / 31 days/month / 24 hr/day x 2000 lb/ton x 33.1% of total potline production (for Potline 1) = 233.8 lb/hr

Potline 1 A-398 Stack SO2 Emissions (lb/hr) = 233.8 lb/hr x 98% capture = 229.1 lb/hr

Potline 1 Roof SO2 Emissions (lb/hr) = 233.8 lb/hr x (1-98% capture) = 4.7 lb/hr

ABF SO2 Emissions (lb/hr) = 85.5 tons SO2/month / 31 days/month / 24 hr/day x 2000 lb/ton = 229.7 lb/hr

Total ABF + Potlines SO2 Emissions (lb/hr) = 233.8 + 231.3 + 242.4 + 229.7 lb/hr = 937.2 lb/hr

APPENDIX H

Century Aluminum Response to Information Request, 2025

December 8, 2025

Ms. Cassandra Jobe
Program Planning & Administration Branch
Kentucky Division for Air Quality
300 Sower Blvd, 2nd Floor
Frankfort, KY 40601

*RE: Response to Request for Information
Henderson-Webster Nonattainment Area SIP for 1-hour SO₂ NAAQS*

Dear Ms. Jobe:

Century Aluminum Sebree, LLC (Century) owns and operates a primary aluminum production facility in Robards, Kentucky near the town of Sebree (Sebree Plant). Century is a U.S.-based producer of primary aluminum that owns and operates two of the four remaining operating aluminum smelters in the United States. Century's two operating U.S. locations are in Sebree, Kentucky and Mt. Holly, South Carolina. Century Sebree's aluminum production in 2024 of 216,333 metric tons accounted for approximately one-third of the entire U.S. output.¹ The U.S. primary aluminum industry operates within a low-margin, commodity-driven international market and faces intense competition from international producers, often under less stringent regulatory conditions. U.S. primary aluminum production has fallen to just 0.9% of global output as compared to 33% of global output in 1980.²

From August 15, 2024 to September 20, 2024, the Kentucky Division for Air Quality (Division) held a public comment period on a proposed State Implementation Plan (SIP) revision for the Henderson-Webster County 1-hour SO₂ National Ambient Air Quality Standard (NAAQS) nonattainment area. On September 15, 2025, via email, the Division solicited Century's input in providing information on several items to assist the agency in preparing responses to comments that were received during the public comment period. During a subsequent November 10, 2025 meeting, the Division further clarified the additional information being sought.

In this letter, the numbered items in the Division's September 15, 2025 email are restated in blue font followed by information Century has compiled to help support the preparation of a response to the Attainment Demonstration SIP comments. Additional information on the cost of Continuous Emission Monitoring Systems (CEMS), not specifically requested in the September 15th letter but discussed in the November 10, 2025 meeting, is provided in the eighth numbered item below.

¹ Total U.S. primary aluminum figure from USGS Mineral Industry Surveys, December 2024. <https://d9-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/s3fs-public/media/files/mis-202412-alumi.pdf>

² <https://www.voroniapp.com/economy/-The-Rise-and-Fall-of-US-Primary-Aluminum-Production-1900-2024-1681>

1. Documentation/information on the lack of cost-effective control measures for the facility.

The exhaust characteristics of potline gases make application of SO₂ control strategies typically used on other types of industrial sources and combustion units a challenge. First, due to the large volume of exhaust gas generated from the electrolytic process, the relative concentration of SO₂ in the exhaust gas (as compared to other types of industrial and utility combustion processes) is low. For example, in the last performance test conducted June 29-30, 2020, the SO₂ concentration in the Potline 3 exhaust gas averaged 82 ppm. This is an expected and typical concentration value for these sources. Similar SO₂ concentrations in the 80-100 ppm range have also been measured in prior tests. At such low concentrations (< 100 ppm), the mass transfer of SO₂ to a sorbent (in the case of a scrubber/adsorption type of control) is lower, resulting in reduced efficiencies at available residence times. The exhaust temperature downstream of the existing A-398 scrubbers is also relatively low (120 °F in the last stack test), which makes application of many dry and semi-dry scrubbing technologies infeasible. In general, the presence of other contaminants and impurities in the exhaust stream (fluorides) also requires that any control option for SO₂ work in conjunction with the existing dry alumina scrubbing system.

Control Measures Cost Analysis Considerations

In March 2009, the former owner of the Sebree Plant applied for a Prevention of Significant Deterioration (PSD) air permit to authorize the implementation of a new technology for delivering amperage to the potline pots and thereby increasing the plant's aluminum production capacity. Permit V-05-088 R2 was issued in October 2010 after the Division completed their review of the application. As part of that application, a Best Available Control Technology (BACT) analysis was completed for SO₂ emissions from the Sebree Plant that included an evaluation of the feasibility of installing various SO₂ controls. Beyond management of raw materials, which was ultimately chosen as BACT, the only technically feasible add-on control option was determined to be the installation and operation of a wet scrubber system.

In the BACT analysis completed as part of the 2010 PSD permitting process, the total capital costs to install a wet scrubber, comprised of the direct and indirect installation costs derived as a function of the total purchased equipment costs, were determined. The total annualized cost, a function of the depreciated capital costs and ongoing annual operating costs, was then calculated to determine the cost effectiveness of the control measure in dollars per ton of SO₂ removed. From these analyses, the total annualized cost to install and operate a wet scrubber calculated in the BACT analysis ranged from \$25 million/year to \$50 million **per year** (in 2008 dollars) depending on the scrubbing material analyzed. Adjusting these costs for inflation yields an estimated annualized cost of \$39 million/year to \$76 million/year in August 2025 dollars.³ The source-wide SO₂ limit proposed by Century in its August 14, 2024 Title V permit revision application, consistent with the values used for the SO₂ Nonattainment SIP modeling demonstration analysis, is 4,946 tpy, of which 4,256 tpy is attributable to the potlines. A properly designed and operated wet scrubber control system should yield a control efficiency of 90%. Assuming that 98% of SO₂ emissions generated in the potlines are captured and directed to the hypothetical control system, the potential reduction in SO₂ achievable with a wet scrubber control system is approximately 3,754 tpy. Dividing the annualized cost by the reduction in emissions yields a cost effectiveness range of \$10,350 per ton to \$20,442 per ton. In terms of both absolute dollars (\$39 to \$76 million per year) and dollars per ton of SO₂ removal, these values are well above levels that would be considered cost effective for Reasonably Available Control Technology (RACT).

Furthermore, the estimated costs from the 2009 air permit application are likely underestimates of the true cost as they do not include the cost of installing and operating a wastewater treatment plant (WWTP) to

³ According to the Bureau of Labor Statistics Consumer Price Index (CPI) Inflation Calculator (https://www.bls.gov/data/inflation_calculator.htm) \$1 in January 2008 is equivalent to \$1.53 in August 2025.

treat wet scrubber wastewater. A preliminary estimate of an additional \$2,000/ton of SO₂ removed was referenced in the 2009 air permit application. Adding this to the cost calculated above, even without an adjustment for inflation, yields a cost estimate at the low end of over \$12,000/ton of SO₂ removed.

In 2024, Century Sebree produced 216,333 metric tons of aluminum. Dividing the annualized cost estimate for a wet scrubber system (not including wastewater treatment plant) provided above by the 2024 production yields an additional cost \$180 to \$355 per metric ton of aluminum produced. To put this in perspective, the average price for aluminum over the most recent three-year period of 2023 to 2025 was \$2,434 per metric ton, not including the Midwest premium.^{4,5} Thus, the annualized cost for a wet scrubber system alone would amount to 15% of the market price of aluminum. In the low-margin, commodity-based market Century Aluminum operates within, the plant could not sustainably operate under this cost burden and if these costs were applied, the plant would invariably cease operation. Thus, use of a wet scrubbing control technology clearly does not qualify as RACT on the basis of economic infeasibility alone.

Intalco Shut Down Further Affirms the Cost Infeasibility of an SO₂ Wet Scrubber System

Alcoa previously operated a primary aluminum smelter in Ferndale, Washington as a subsidiary known as Intalco. In the Washington Department of Ecology's (Ecology) November 2022 Sulfur Dioxide Attainment Plan, Ecology required installation of a new wet limestone-gypsum scrubber on Intalco's "Center 1" potline as part of its SO₂ control strategy. This attainment plan was developed in response to an April 2021 nonattainment designation with respect to the 1-hour SO₂ NAAQS for the small area located around the Intalco smelter. A 2007 pre-feasibility study for the wet scrubber estimated a total annualized cost of the control strategy to be \$46.8 million per year, which equated to approximately \$7,500 per ton of SO₂ controlled (approximately \$11,590 per ton adjusted for inflation).⁶ In 2019, the Washington Department of Ecology and Alcoa negotiated an agreed order that included a requirement for the plant to install the scrubber. Then, in 2020, operations at the Intalco smelter were curtailed. Subsequently, on March 16, 2023, Alcoa announced the permanent closure of the smelter, citing uncompetitive economic conditions. This highlights the significant challenge in implementing such controls at U.S. facilities, where the cost-effectiveness of wet scrubbing remains well above levels typically considered reasonable, and where market pressures limit the feasibility of adopting costly emissions reduction technologies.

Other Energy and Environmental Disbenefits of Wet Scrubbing

In addition to being economically infeasible, the application of wet scrubbing technology to the Century Sebree Plant potlines for SO₂ control would also cause other adverse energy and environmental impacts. The wet scrubber would consume fresh water and would create a new wastewater and solid waste stream. The generation of a new wastewater stream would result in additional discharges of wastewater to the environment.⁷ Wet scrubbing technologies are also energy intensive. Energy would be expended to operate the fans and pumps for the scrubber and treatment plant, and to transport, treat and dispose the waste generated. There would be additional sources of particulate matter emissions created associated with the storage and handling of the reagent material resulting in increased collateral emissions. Aside from the

⁴ https://ycharts.com/indicators/aluminum_price

⁵ The price quoted is the London Metal Exchange price. Aluminum sold to the market by Century also would include a Midwest premium added. However, this premium can significantly fluctuate from year to year and is currently unusually elevated due to the tariffs on aluminum imports put in place by the Trump Administration.

⁶ U.S. Bureau of Labor Statistics, CPI Inflation Calculator adjusted November 2007 dollars to September 2025. (https://www.bls.gov/data/inflation_calculator.htm)

⁷ Dal Pozzo, A. et al, "Wastewater Management of Wet Scrubbers in Waste-To-Energy Facilities: a Life Cycle Analysis", Chemical Engineering Transactions, Vol. 86, April 23, 2021, <https://www.cetjournal.it/cet/21/86/104.pdf>

direct environmental impacts of the scrubber, there would also be increased emissions from secondary sources that would have to mine, process and transport the reagent materials used by the scrubber. There also would be increased secondary emissions, including greenhouse gas emissions, associated with producing the increased electricity consumed by the scrubber and treatment system. Thus, in addition to the cost considerations, the energy and environmental disbenefits of applying wet scrubber technology to the Century Sebree Plant supports a determination that it does not qualify as RACT.

2. Any information/documentation/analysis on control measures including the installation of a wet scrubber and the usage of low sulfur coke.

Century's Title V Permit Already Requires Use of Low Sulfur Coke

As mentioned in Item 1 above, a comprehensive BACT analysis was completed in March 2009 as part of the Production Increase Project PSD Application. This analysis evaluated a range of control technologies for SO₂ emissions from the potlines, including wet scrubbing systems (e.g., sodium-based, dual alkali, lime/limestone), dry and semi-dry scrubbing, and pollution prevention strategies such as raw material management. The analysis concluded that wet scrubbing technologies were not technically or economically feasible for potline applications due to low inlet SO₂ concentrations, high capital and operating costs, and adverse environmental impacts including wastewater generation and increased energy consumption. Updated cost-effectiveness values for wet scrubbers are detailed in Item 1 above.

The BACT determination concluded that the continued use of pollution prevention methods, specifically, the management of raw materials and process variables to minimize SO₂ emissions, constituted BACT. Petroleum coke and pitch are the two principle raw materials used in the production of green anodes. The petroleum coke from which anodes are formed is a byproduct of the oil refining industry. Pitch is produced by distilling crude tar, which is a byproduct of coking coal. Since SO₂ emissions from the Anode Bake Furnace and Potlines are a direct function of the coke and pitch sulfur content used in making the anodes, seeking to minimize the sulfur content of coke and pitch purchased for use in making anodes is an SO₂ pollution prevention method.

Petroleum coke that is available in the U.S. can be classified as either "anode grade" or "fuel grade". Petroleum coke produced in a delayed coker that has a high carbon content and is low in metals such as vanadium, nickel and iron is suitable for making graphite anodes for the aluminum smelting industry. This "anode-grade" coke is generally processed in calciners and is then marketed to the aluminum industry. Conversely, coke with higher concentrations of metal is generally not suitable for use in making anodes. The sulfur and metal content of the petroleum coke are the primary parameters for determining grade and differential price. Overall, coke prices fluctuate with the price of crude oil.

The sulfur content of petroleum coke can be as high as 7.5%. Low sulfur petroleum coke, which is the type procured by Century, has a sulfur content of 3% or less. It is not feasible for Century to produce lower sulfur pitch and coke directly through any on-site processing techniques. It is also not possible to reduce the quantity of sulfur in these materials after they are received. Thus, Century, like other primary aluminum plants, is at the mercy of the market regarding sulfur content of the raw materials.

In the form of an operating limit, the BACT determination previously made by KDAQ was applied via an operating limit in Century's Title V air permit that required the company to only procure and use petroleum coke with a sulfur content less than or equal to 3% (i.e., "low sulfur" coke) in the production of green anodes. The sulfur content of the binding pitch was also limited to 0.8% sulfur. Thus, the plant is already utilizing what the market classifies as low sulfur coke.

Viability and Economic Feasibility of Using Very Low Sulfur Coke

Although Century's current low sulfur pet coke limit restricts sulfur content to a maximum of 3%, through optimal selection and negotiation of contracts with potential suppliers, Century has and will continue to source petroleum coke and pitch with even lower sulfur contents when available, and where economically feasible and still meeting other property specifications needed for producing quality anodes. The long-term availability of this very low sulfur petroleum coke remains uncertain. Market analyses conducted by industry experts and aluminum producers have consistently indicated that sulfur content in petroleum coke is trending upward due to refining practices and global supply constraints. Additionally, the use of very low sulfur coke can adversely affect anode quality, which in turn impacts potline performance and overall emissions. For example, use of anodes with low sulfur levels results in increased air reactivity of the anodes. This is because the sulfur in the anodes helps reduce sodium compounds originating in the electrolyte bath from migrating into the anodes, which otherwise would increase the reactivity. Increased anode reactivity means that the anodes react more easily with air and CO₂, which creates carbon dust inside the pots. This dust lowers the efficiency of aluminum production, increases power consumptions, and can increase the total mass of anode carbon consumed in the reduction process. All these adverse effects directly lead to higher CO₂ emissions from the process..

Currently, Sebree purchases coke from the Gulf Region of the U.S., with a maximum sulfur content specification of 3%, in compliance with the terms of the existing Title V permit. This is the standard sulfur content specification in the market for U.S. Gulf Region-sourced coke. The pricing for anode grade petroleum coke fluctuates and is influenced by changes in the price of crude oil. Sulfur content levels directly drive the cost of anode grade coke. Even in the present period of relatively low crude oil prices, the incremental cost of anode grade coke is \$10.38 per metric ton for each 0.1% reduction in coke sulfur content, as of November 2025. Thus, procuring 2.5% sulfur content pet coke at current prices adds \$51.90/mt to the price of the coke (i.e., 5×10.38 for a 0.5% reduction in sulfur from 3% to 2.5%). Based on petroleum coke consumption rates relative to aluminum production, this would translate into an additional annual cost of approximately \$5,200,000 at plant capacity, equivalent to \$22.6/mt of aluminum production (given a plant capacity of 230,000 mt/yr).

A reduction in petroleum coke sulfur content from 3% to 2.5% would yield a reduction in SO₂ emissions, all else being equal, of 824 tpy. Without considering any other factors, this results in a calculated cost effectiveness of over \$6,300/ton of SO₂. Of more relevance, the \$22.6/mt of aluminum production in incremental cost represents just under 1% of the three-year average London Metal Exchange price of aluminum (\$2,434/mt). That additional cost burden would impose significant economic challenges for the facility particularly during potential future periods of lower LME pricing, higher base anode coke prices or higher costs for other key inputs like alumina and electricity. Further, as noted previously, there is uncertainty whether very low sulfur content supplies could be reliably and consistently obtained in the future. As availability of these very low sulfur coke diminishes, the price gap could substantially increase.

Given the technical challenges and increased CO₂ emissions that come with use of very low sulfur anode cokes, the economically infeasible cost burdens, and the uncertainty of a reliable and consistent supply in the future, procurement of low sulfur anode grade coke with a sulfur content of 3% or less continues to represent BACT (and by extension RACT) as a raw materials control measure for SO₂.

To validate that the conclusions of the prior BACT determination remains current, the RBLC (RACT/BACT/LAER Clearinghouse) was reviewed again in September 2025. The search confirmed that there have been no updates or changes to the control technologies listed for primary aluminum plant operations since the original 2009 evaluation. The RBLC continues to reflect that low sulfur coke and process optimization remain the prevailing BACT determinations for SO₂ control in this sector. Based on the updated RBLC review and prevailing market conditions, the conclusions of the March 2009 BACT analysis remain

valid. The use of wet scrubbers is not feasible for potline SO₂ control, and the most effective and achievable control strategy continues to be the management of raw materials and process variables (i.e., the use of low sulfur [$<3\%$] petroleum coke).

3. Documentation/information of all security protocols at the facility's perimeter and assurance that the public does not have access to facility property (including any information previously provided to EPA on this subject).

Figure 2-6 in the SIP Modeling Demonstration Report that Century submitted to the Division on August 7, 2024 illustrated the ambient air boundary used in the dispersion modeling analysis. This figure is carried forward to this letter as Figure 1 below to provide an overall map of the property. With reference to this overall map, the Sebree Plant property's security infrastructure and protocols are as follows.

The surrounding area of the Sebree Plant is rural, and the population density is very low. Access to the Sebree Plant property is physically restricted by fencing and vegetation/terrain features that preclude access by the general public. Referring to Figure 1, approximately mid-way down the western side of the property line is a private back entrance to the plant via Moss and Moss Road. An existing fence was already in place from Moss and Moss Road heading south down the western property boundary to the main plant entrance (shown in orange on Figure 2). In October 2024, Century completed a project to install new fencing from this point all the way down the remaining western property boundary to the southernmost point (shown in yellow on Figure 2). A new rolling gate, shown in Figure 3, was also installed at the old Big Rivers coal truck access road. Pictures of this section of new fencing are provided in Figures 4 and 5.

From the southernmost tip on the western boundary, the new fencing then was extended heading north-northeast along the north edge of the rail spur link approximately 580 feet to the edge of a stream. Here, there is a deep gully that provides a barrier to entering the property. A picture of this section of new fencing is shown in Figure 6. Along either side of the rail spur to the interior of the plant are dense stands of tree growth that inhibit accessibility into the property. Buttressing this wooded area, the interior portions of the Big Rivers property surrounding the coal pile are also fenced. Thus, between the stream and the Green River, there is no access point to the property except via the Big Rivers coal truck access road entrance on the western property edge, which is now gated.

The southeast side of the Century property is adjacent to the Green River, which precludes access to the property. The entire northeast side of the plant boundary is not accessible via any road or path. The only road entrances at the east end of Moss and Moss Rd and off S Pleasant Valley Rd on the northeast edge of the property (historically used to access an old ambient monitoring station) are both gated, as shown in Figures 7 and 8. Access by the general public to these areas of the plant boundary is also precluded by thick vegetation, brush, and trees. A deep gully and thick brush also run along the northern side of the plant boundary from Moss and Moss Road to the northern property corner that precludes access to this area of the property.

In addition to the physical barriers, "No Trespassing" signs such as shown in Figure 9 are posted at strategic locations around the perimeter of the property. There are presently 18 "No Trespassing" signs around the outer perimeter of the property and an additional 18 signs at various interior points of the northern section of property, primarily along Moss and Moss Rd. Plant personnel also routinely complete drive-around patrols within the interior of the property where there is accessibility via plant roads or paths as part of normal job functions (e.g., to collect samples, inspect monitoring wells and equipment, etc.). The security department has live TV monitor feeds to cameras situated around the property that are pointing to key locations such as access roads, gates, the river unloading area, and the open property areas between the main plant and the

southwest area of the property. Along with the physical barriers, these monitored camera feeds help ensure that there is no trespassing taking place within the property boundaries.

According to the EPA's "Revised Policy on Exclusions from "Ambient Air"⁸, the EPA applies a "rule of reason" in evaluating whether the measures (physical or not) proposed by a source to define the ambient air boundary are effective in precluding public access under the circumstances presented. Relevant factors for the evaluation include "the nature of the measure used (e.g., physical or non-physical), source location, type and size of source and property to be excluded, surrounding area (including the proximity, nature, and size of the population in the area), and other factors affecting whether members of the general public would readily be able to trespass upon or otherwise have access to the source's property." The EPA has retained since 1980 that natural barriers (e.g., steep cliffs, rugged terrain, or dense vegetation) can be sufficient in the absence of man-made barriers (e.g., walls or fences) to prevent access by the general public. Consistent with past representations of the ambient air boundary for the Sebree Plant used in prior air dispersion modeling analyses (e.g., Prevention of Significant Deterioration triggering permit actions completed in 2008 and 2010), and in the context of EPA's guidance, it is reasonable to conclude that the terrain features in place combined with the signage and overall surveillance operations of the plant sufficiently preclude access of the general public to the unfenced northern and northeastern boundaries of the Sebree Plant property.

⁸ Memorandum from Mr. Andrew R. Wheeler, U.S. EPA Administrator to Regional Administrators, *Revised Policy on Exclusions from "Ambient Air"*, December 2, 2019, https://www.epa.gov/sites/default/files/2019-12/documents/revised_policy_on_exclusions_from_ambient_air.pdf

Figure 1 Ambient Air Boundary View of Receptor Grid and Property

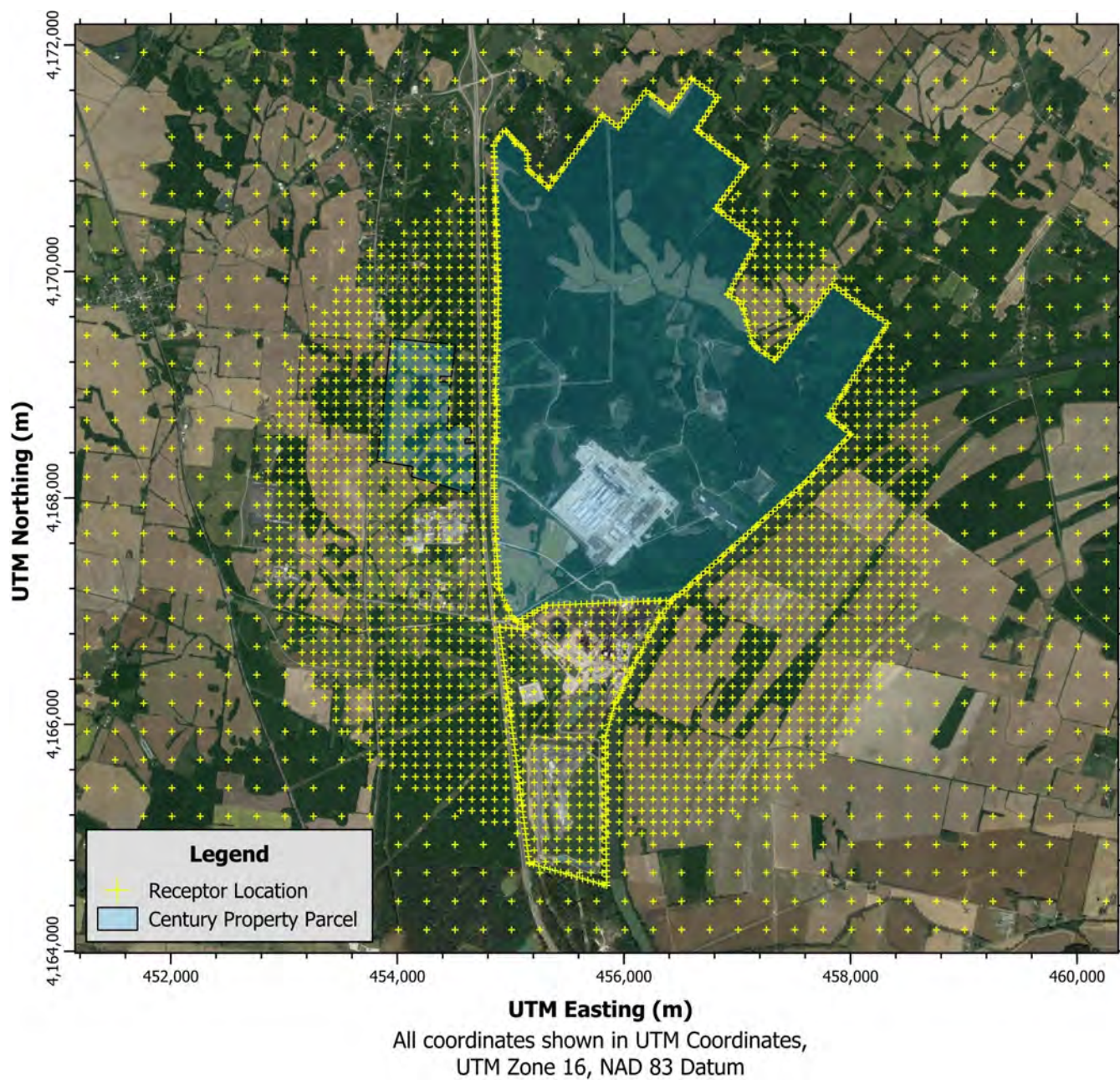


Figure 2 Illustration of New Fencing Installed October 2024



Figure 3 Rolling Gate at the Old Coal Truck Access Road Entrance



Figure 4 New Fencing on Western Boundary and at Southernmost Corner



Figure 5 New Fencing at Southernmost Property Corner



Figure 6 New Fencing Along Rail Spur Up to Stream Gully

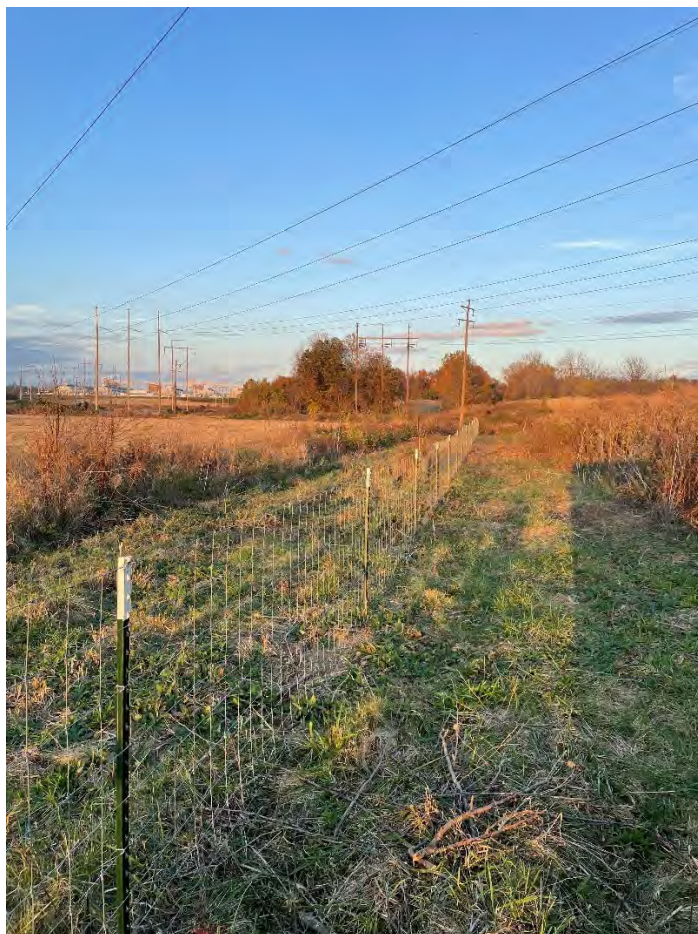


Figure 7 Gated Entrance on East Edge of Property at Moss and Moss Rd



Figure 8 Gated Entrance Off S Pleasant Valley Rd on Northeast Property Boundary



Figure 9 Examples of No Trespassing Signage on Property Boundaries



4. Statement/explanation of chosen modeling parameters and the appropriateness of such (in response to the expert testimony provided in the comments from NGO's about cost effectiveness of various control options and objections raised to modeling parameters).

Comments on the proposed Kentucky SIP relating to modeling parameters are found in Appendix C to the September 20, 2024 letter from Kentucky Resources Council, Environmental Integrity Project, and Sierra Club ("NGO Comment Letter"). Appendix C contains a memorandum from Dr. H. Andrew Gray to Sanghyun Lee of Environmental Integrity Project. The section of Dr. Gray's memorandum titled "Source Data" contains comments on modeling parameters used in the SO₂ SIP modeling, which was described in an August 7, 2024 report from Trinity Consultants (Trinity). Each of the subsections within the "Source Data" section of Dr. Gray's memorandum are discussed below.

Anode Bake Furnace

Dr. Gray indicates that the replacement of the existing anode bake furnace stacks with a new, taller stack would result in considerable reductions in modeled SO₂ concentrations from the anode bake furnace. Dr. Gray's comment does not request additional information on the stack parameters used for the proposed anode bake furnace stack. Century agrees that the installation of a taller stack will yield reductions in SO₂ concentrations in ambient air, which is why it is being proposed (along with establishment of new SO₂ limits) as the primary measure to reduce ambient SO₂ concentrations around the Sebree Plant as discussed in Section 2.8.2 of Trinity's modeling report.

Potline Roof Vents

The buoyancy parameter used for the Sebree Plant roof vents, which were represented by BUOYLINE sources in AERMOD, was derived from data collected at the plant. As discussed in Section 2.8.3 of Trinity's modeling report:

Periodic performance testing of the roof vents is required under Century's current Title V air permit. Potline roof vent parameters were derived from performance tests conducted during the three-year period modeled (i.e., 2020-2022). Although the buoyancy parameter for the roof vents would be subject to seasonal variations, the performance tests on the roof vents are conducted semi-annually at regular intervals. As such, insufficient data was available to derive a monthly or seasonally varying buoyancy parameter, so an annual average buoyancy parameter was selected for the modeling analysis. Physical dimensions of the roof vents and potroom buildings were taken from the design drawings and the average separation between buildings was measured from aerial imagery.

A total of 86 emission test runs were completed during the 2020-2022 time period for the potline roof vents. The data from these test runs were averaged across the three potlines to yield an average exit velocity (0.84 m/s), average exit temperature (299.61 K), and average source-ambient temperature difference (13.28 K). Dr. Gray's estimated exit velocity of 0.1 m/s was over 8 times too low, and his average temperature difference (12 K) was also low, resulting in his calculated buoyancy parameter ($33.5 \text{ m}^4/\text{s}^3$) being approximately 10 times lower than that calculated using site-specific data ($330 \text{ m}^4/\text{s}^3$).

Dr. Gray also mentioned in a footnote that the buoyancy parameter is a function of the line source length, rather than the potline building length, which was used in calculation of the buoyancy parameter for Trinity's modeling analysis. But Section 3.3.2.11 of the AERMOD User Guide, in which BUOYLINE source inputs in AERMOD are discussed, is not conclusive about whether the potline building length or line source length is the variable to use, likely because for most potlines, including those at Sebree, the difference is small.⁹ On Page 3-79 of the AERMOD User Guide, different parameters that are necessary to model a BUOYLINE source are specified. Blavgblen (L) is defined as the "average building length" and Blavgfprm (FPRIME) is defined as the "average buoyancy parameter" in this list of parameters. On Page 3-80 of the AERMOD User Guide, additional information is given on the calculation of FPRIME, as follows: "The FPRIME parameter is dependent on BUOYLINE parameters listed above and additional source parameters that are not input to AERMOD such as the line source exit velocity and difference in exit and ambient temperatures." The list of parameters then specifies that L is the "line source length". The same variable identifier, "L", is used in the equation for FPRIME as used for the average building length on Page 3-79. Also, the text on Page 3-80 only refers to the exit velocity and temperatures as data that are used in addition to the building parameters discussed on Page 3-79. This review of the text in the AERMOD User Guide indicates that the "L" used in the FPRIME equation should equal the average building length also input to AERMOD for the BUOYLINE source type.

Regardless, using the potline line source length provided in Dr. Gray's memorandum would have a minimal impact on the buoyancy parameter. Using Dr. Gray's suggested potline line source length of 352 meters in the buoyancy parameter calculation would result in a decrease in the value from $330 \text{ m}^4/\text{s}^3$ used in Trinity's modeling report to $310 \text{ m}^4/\text{s}^3$. Rerunning AERMOD for the SIP Base case presented in Table 3-1 of Trinity's modeling report with the revised buoyancy parameter changes the modeled design concentration from $222.3 \text{ } \mu\text{g}/\text{m}^3$ to $222.5 \text{ } \mu\text{g}/\text{m}^3$, which is a negligible 0.09% increase in modeled design concentration.

⁹ https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/aermod_userguide.pdf

Merged Potline Stacks

Information to justify the consideration of merged plumes from the Potline 1 and 2 A-398 alumina fluidized bed dry scrubbers was provided in Section 2.8.4 and Appendix A of Trinity's modeling report. Dr. Gray's memorandum and the NGO Comment Letter did not provide comments on the technical merits of the merged plume approach for modeling the A-398s, but rather only pointed out that modeled concentrations using this approach were lower than modeled concentrations if each stack were modeled as a separate plume in AERMOD. In addition to the technical discussion in Section 2.8.4 of Trinity's modeling report, Appendix A provides a model performance evaluation that shows that consideration of the merged plumes yields results that are closer to, but still greater than SO₂ concentration data gathered at the SO₂ monitor located near the Sebree Plant. The results from this analysis further support the validity and appropriateness of using merged stacks for Potlines 1 and 2.

Fugitive Potline Roof Emissions

A hooding and duct system is used to capture the majority of emissions generated at the pots inside the potroom buildings of each potline. This capture system then routes these "primary emissions" to an alumina dry scrubber system and then out to the atmosphere via stacks. Emissions generated at the pots that are not captured in the control system are released into the potroom building air space and eventually emanate to the atmosphere through the centerline roof vents as "secondary emissions". Dr. Gray's memorandum correctly noted that SO₂ modeling conducted assumes that the secondary emissions from the potline roof vents will be 2% of the total, meaning that an assumption has been made that the capture and control systems at the Sebree Plant potlines will capture 98% or more of the emissions. This assumption is consistent with capture efficiencies commonly used in emission calculations for primary aluminum plants for appropriately designed and maintained potline hooding systems.

Dr. Gray notes that SO₂ emissions inventory data for 2017-2019 reflects a capture efficiency of roughly 96% rather than 98%. However, SO₂ emissions reported for emissions inventory purposes are determined on a mass balance basis and because Century pays the same emissions fee regardless of where the SO₂ emissions emanate, the plant has been conservative in the past when estimating the secondary emissions portion of SO₂ from the potlines for emission inventory purposes. However, Century believes that a 98% capture efficiency assumption is a more accurate and appropriate assumption. Although there are no recent SO₂ emissions data collected simultaneously at the potline stacks and roof vents by which the actual capture efficiency could be calculated, the plant did conduct CO emissions testing at the stacks and roof vent of Potline 3 on back-to-back days in January 2024. Although CO and SO₂ have different densities, it would be reasonable to assume that the potline capture efficiency achieved for CO would be roughly the same as for SO₂. The measured CO emission rate from the Potroom Building 6 downcomer on January 9, 2024 was 3.43 lb/hr, corresponding to a total Potline 3 roof vent emission rate of 13.72 lb/hr. The measured CO emission rate from the Potline 3 South A-398 scrubber stacks was 827.2 lb/hr, corresponding to a total Potline 3 stack emission rate of 1,654.4 lb/hr. In this case, the stack CO emissions comprised **99.2%** of the total (i.e., 1,654.4 / 1,668.1), which is greater than the 98% capture efficiency assumed for SO₂.

Emission Scenarios

Dr. Gray laid out the scenarios, discussed in Section 2.8.6 of Trinity's modeling report, which included emission rates representative of future allowable SO₂ emission rates. There was no specific comment on the emission rate scenarios in this section and therefore no additional information is provided with this letter regarding these modeling parameters.

5. Statement on monitored exceedances during recent years and any explanatory information deemed relevant by the facility.

Collection of SO₂ concentration data at the Sebree ambient monitoring station commenced in January 2017. At the time of writing this letter, validated SO₂ data is available through June 2025. During the initial design value period (2017 through 2019), the Sebree SO₂ monitor recorded a small number of 1-hour daily maximum SO₂ concentrations in exceedance of the magnitude of the 1-hour SO₂ NAAQS. These events are summarized for each year during the period of record available for the Sebree SO₂ monitor in Table 1 below. The frequency of these events fell drastically in 2020, and the trend of fewer exceeding events were generally observed in subsequent years. The reduced frequencies of monitored exceedances can be attributed in part by reductions in actual SO₂ emissions from the Sebree Plant, which fell from an average of roughly 4,500 tons per year (tpy) from 2016 to 2019 to roughly 4,000 tpy in 2020 and 2021. These reductions were associated with a reduction in average sulfur content in the pet coke as well as overall potline production output. Additionally, all four of the remaining coal-fired utility boilers at Big Rivers Electric Corporation (BREC) shutdown or converted to natural gas in 2019 and 2022 removing nearly 5,000 tpy of SO₂ emissions from the immediate vicinity. In recent years, Century has maintained a focused procurement strategy aimed at sourcing the lowest sulfur pet coke consistently available in an effort to mitigate elevated SO₂ concentrations.

Table 1. Historical Hourly Data Counts for Sebree SO₂ Monitor through June 2025

Year	Count of Max 1-hour Daily Concentrations	
	< 75 ppb	≥ 75 ppb
2017	358	7
2018	354	11
2019	355	10
2020	363	3
2021	363	2
2022	362	3
2023	354	11
2024	362	4
2025	179	2

As indicated in Table 1, the frequency of measured SO₂ concentrations greater than the magnitude of the 1-hour SO₂ NAAQS has been generally trending down since 2017. One short-term exception to this trend is the higher frequency of elevated SO₂ concentrations observed in the first half of 2023. There are numerous factors that could potentially influence measured SO₂ concentrations year by year, including variations in operational parameters at the Sebree Plant, actual emissions at the Sebree Plant and nearby sources, wind frequencies, and other meteorological parameters. Regardless, Century has reviewed operational data for 2023 to seek an explanation for the elevated SO₂ concentrations measured in the first half of the year. Based on this review, Century determined that the likely reason for the elevated SO₂ concentrations was the overall environmentally beneficial plan to recycle and use of anode material from the Century Hawesville Plant (which was idled in June 2022) in the production of anodes at the Sebree Plant. The recycled anode material from the Hawesville Plant may have inadvertently elevated the SO₂ content in the green anodes since it displaced recycled anode material from the Sebree potlines, which generally has lower sulfur content. The elevated SO₂ content relates to higher SO₂ emissions and in turn elevated SO₂ concentrations at the Sebree monitor during the first half of 2023. Although Century originally sought to recover additional material from the Hawesville Plant, the processing of recycled anode material ceased in June 2023. Since

that time, relatively few maximum daily concentrations have been measured above the magnitude of the 1-hour SO₂ NAAQS.

It is also important to note that meteorological conditions play a significant role in the frequency and magnitude of elevated SO₂ concentrations at the Sebree monitor. Variables such as wind speed, wind direction, and ambient temperature can influence the transport and dispersion of emissions. When conditions favor limited atmospheric mixing and direct transport from the Sebree Plant to the monitoring station, elevated concentrations are more likely to be observed. The frequency of such meteorological scenarios varies year to year and contributes to the variability reflected in Table 1.

6. Timeline for engineering and construction of the stack, including anticipated operational date; as well as permitting timeline.

The current remaining timeline for the steps involved in the final design engineering, zoning and other permitting approvals, construction, and operation activities for the new stack for the Anode Bake Furnace is summarized in Table 2. As of the date of this letter, the current projected date for final tie-in and commencement of operation with the new stack is **June 8, 2026**.

The permit application covering the stack addition was previously submitted to KDAQ on August 14, 2024 and is currently under review by the agency.

Table 2. Anode Bake Furnace Stack Timeline

Activity	Projected Start	Target End	Work Days	Status	% Complete
FAA Obstruction/Airport Air Space Analysis (OE/AAA)	3/5/2025	4/14/2025	41	Complete	100%
Kentucky Airport Zoning Commission (KAZC) Approval	4/14/2025	10/9/2025	179	Complete	100%
Board of Zoning Adjustment (BOZA) Approval	4/14/2025	10/13/2025	183	Complete	100%
Henderson City-County Planning Commission (HCCPC) Approval	4/14/2025	10/14/2025	184	Complete	100%
Final Design Engineering	9/26/2025	12/31/2025	97	In Progress	99%
Fabrication and Delivery to Sebree Plant Site; Setting Concrete; Erecting Steelwork	11/19/2025	2/18/2026	92	In Progress	25%
A-446 Reactor Maintenance and Operations Testing	2/18/2026	3/12/2026	23	Not Started	0%
Manifold Trunk Line and Stack Installation	3/12/2026	5/6/2026	56	Not Started	0%
Tie in A-446 Reactors and Commencement of Operation	5/6/2026	6/8/2026	34	Not Started	0%

By comparison, the timeline to design, permit, install, and begin operation of a wet scrubber system and associated wastewater treatment system is considerably longer than the timeline to install the new ABF stack. Century is currently working with an engineering contractor to obtain an estimate of the timeline to

achieve operation of a wet scrubber system. However, it is clear the installation of a new stack to reduce ground level concentrations of SO₂ will allow compliance to be achieved with the SO₂ NAAQS more expeditiously than installation of a wet scrubber system.

7. Any files left out of the initial modeling package.

General Comment 4 in EPA Region 4's comment letter dated September 20, 2024 indicated that the Building Profile Input Program (BPIP) files included with Trinity's modeling report did not include the new stack for the Anode Bake Furnace (Model ID N2_213). After additional review, Trinity determined that the BPIP files provided with the modeling report included the sources from the performance evaluation that was discussed in Appendix A to the modeling report. The models for the SIP analysis discussed in Sections 3 and 4 of the modeling report included additional Sebree Plant sources, including N2_213. The BPIP files associated with the Current Stack Configuration and Future Stack Configuration scenarios for the SIP modeling analysis are being submitted electronically with this letter.

8. Information on the cost to implement CEMS and what additional testing would be needed outside of CEMs and any associated costs.

The feasibility of installing SO₂ continuous emissions monitoring systems (CEMS) at the Sebree Plant is complicated by the unique potline control system and stack configurations. Century operates three potlines, each consisting of 128 reduction cells split between two potroom buildings. The emissions from the reduction cells in each potroom building are captured through hooding systems and are sent to two Alcoa A-398 alumina fluidized bed dry scrubbers, each of which has five reactor modules. Thus, for three potlines, there are a total of six alumina fluidized bed dry scrubbers with each one serving half of the pots on a potline.

In the case of Potlines #1 and #2, there are two exhaust stacks per reactor. For Potline #3, each set of five reactors is exhausted to an individual rectangular duct within a single stack. Even if a short stack extension could be configured on the existing Potline 3 multi-vane stack to aggregate the emissions from all five scrubber reactors, this still means that there would be 42 discrete exhaust points for the potlines (20 each for Potlines #1 and #2, and 2 for Potline #3). Any attempt to install CEMS would require either duplicating monitors across numerous stacks or constructing new manifolded stacks to consolidate exhaust flows. Both options represent significant capital costs, compounded by the ongoing burden of calibration, maintenance, and data management across multiple systems. An estimated cost to install CEMS on the A-398s associated with one potline (assuming the use of 10 CEMS for potline with the implementation of time sharing monitors for adjacent stacks and 20 pitot flow meters with one for each stack) is **\$2.6 million**. Equipment associated with the CEMS includes items such as new buildings to house equipment, analyzers, probes, regulators, flow meters, cabling, and Data Acquisition and Handling Systems (DAHS). This estimate also includes labor costs associated with installation, testing, and commissioning. An estimate of annual operating costs is \$350,000 including cylinder gas audits, annual Relative Accuracy Test Audits (RATAs), gases, filters, tubing, and lamps. This operating cost does not include the cost of internal labor hours.

The use of CEMS for the Anode Bake Furnace (ABF) is less complicated technically because there will be a single stack through which ABF emissions will be ducted. However, the cost to install a CEMS for the ABF stack, estimated at **\$350,000**, is still significant. The annual cost to operate a CEMS system for the ABF, not including the cost of internal labor, is estimated at \$35,000 per year. From a regulatory and technical perspective, the use of CEMS is not justified given the availability of a reliable mass-balance methodology for quantifying SO₂ emissions. The mass-balance approach, implemented through conditions in the plant's

Title V permit, provides a consistent and defensible means of estimating emissions based on raw material inputs. This methodology avoids the impracticality of stack-by-stack monitoring and supports the rationale for a 30-day average limit, which accounts for operational variability across the potlines and ensures compliance can be demonstrated over a representative period. In contrast, CEMS would impose disproportionate costs without yielding meaningful improvements in emissions accuracy or regulatory assurance.

~ ~ ~ ~ ~

If you have any questions on the information provided in this letter, please do not hesitate to contact me at 270-570-6592, christopher.house@centuryaluminum.com.

Sincerely,

A handwritten signature in black ink, appearing to be 'CH', with a long horizontal line extending to the right.

Chris House
Environmental, Health, and Safety Manager

cc: Mr. Henk De Coning, Plant Manager, Century
Mr. Tony Schroeder, CCM, QEP, Trinity Consultants
Mr. Paul J. Smith, P.E., Trinity Consultants

APPENDIX I

BACT Analysis from Rio Tinto Alcan

March 10, 2009

Mr. Ralph Gosney
Division for Air Quality, Permit Review Branch
Kentucky Department for Environmental Protection
200 Fair Oaks Lane, First Floor
Frankfort, Kentucky 40601-1403

*RE: PSD and Title V Permit Revision Application
Rio Tinto Alcan – Robards, Kentucky
Facility I.D. # 21-101-0029; Title V Permit Number V-05-088 R1*

Dear Mr. Gosney:

On behalf of Rio Tinto Alcan, please find enclosed a Prevention of Significant Deterioration (PSD) and Title V revision application for the primary aluminum production facility located near Robards, Kentucky (Sebree Works). The application is organized in two volumes. Volume 1 contains an application report, application forms, emission calculations, and the Best Available Control Technology analysis. Volume 2 contains the Class I and II area dispersion modeling analyses, as well as the PSD additional impacts analysis.

In accordance with 401 KAR 52:020, Section 4, one original and two copies of the application package are enclosed. Also, in response to previous suggestions from Ms. Mary Hawkins in the Permit Support Section, an electronic copy of the entire application package (in PDF form) is also enclosed on a CD to save the agency the task of having to scan the hard-copy of the application.

We look forward to working in cooperation with KDAQ to help ensure the timely and successful completion of this permit action. Please contact Mr. Ghassan Dughaish of Rio Tinto Alcan at (270) 521-7452 or me at (859) 341-8100 if you have any questions.

Sincerely,

TRINITY CONSULTANTS



Paul J. Smith, P.E.
Principal Consultant

Enclosures

cc: Mr. Ghassan Dughaish, Rio Tinto Alcan
Mr. Amiel Boullemant, Rio Tinto Alcan
Ms. Mary Hawkins, Division for Air Quality (without enclosures)

**PSD AND TITLE V PERMIT REVISION APPLICATION
RIO TINTO ALCAN ■ SEBREE, KENTUCKY**

PRODUCTION INCREASE PROJECT

**Volume 1 of 2
PROJECT DESCRIPTION, BACT ANALYSIS, AND DEP7007 FORMS**

Prepared by:

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March 10, 2009

RioTintoAlcan

Trinity
Consultants

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1. INTRODUCTION

Rio Tinto Alcan (RTA) owns and operates a primary aluminum production facility near Robards, Kentucky (Sebree Works). The facility is a major source under the Title V operating permit program and currently operates in accordance with Title V operating permit V-05-088 R1, issued on March 26, 2008 by the Kentucky Division for Air Quality (KDAQ). The facility is also a major source under the Prevention of Significant Deterioration (PSD) permitting program.

1.1 PROJECT DESCRIPTION AND AIR PERMITTING REQUIREMENTS

Through this application, RTA is seeking a modification to its existing Title V permit, in accordance with 401 KAR 52:020, authorizing an increase in plant-wide production at Sebree Works. The increase in production will be accomplished through the implementation of a technology package, developed by RTA's Arvida Research and Development Center, which will result in physical changes to the potlines and to certain non-emitting operations in the Electrode Department.

The project will result in a significant net emissions increase of sulfur dioxide (SO₂), particulate matter less than 10 microns in diameter (PM₁₀) and less than 2.5 microns in diameter (PM_{2.5}), carbon monoxide (CO), and fluorides, as determined in accordance with Kentucky's PSD regulations (401 KAR 51:017). The required elements of a PSD permit application are therefore included in this application for these pollutants, including a Best Available Control Technology (BACT) analysis (Section 6) and air quality analysis (Volume 2). Through the air quality modeling analysis, RTA has demonstrated that the Sebree Works will not cause or significantly contribute to a violation of any National Ambient Air Quality Standards (NAAQS) or cause ambient concentrations that exceed allowable PSD Increments.

Aside from SO₂, PM₁₀, PM_{2.5}, CO, and fluorides, the project will result in an increase in emissions of other regulated pollutants; however, these increases will not be significant with respect to the PSD program. Emission increases of all PSD regulated pollutants for which PSD will not be triggered fall well below the triggering thresholds and thus limits on these pollutants are unnecessary.

The potlines are an affected source under the applicable provisions of the *National Emission Standards for Hazardous Air Pollutants (NESHAP) for Primary Aluminum Reduction Plants* (40 CFR § 63, Subpart LL, also known as "PMACT"). The existing potlines are classified as existing sources under PMACT. As the proposed project will not constitute reconstruction of potlines, as defined in the NESHAP regulations, the potlines will continue to be regulated as existing sources following this project. Other generally applicable Kentucky air regulations apply to the potlines as well. The air permitting requirements triggered by the project and applicable state and federal regulations are discussed in Section 5 of the application.

1.2 TITLE V PERMIT REVISION AND TIMELINE

Pursuant to 401 KAR 52:020, Section 16(1)(b) and Section 14(1)(e), because the proposed project is subject to PSD review, this permit action will be processed as a significant revision to the existing Title V permit. An appropriate set of Kentucky's DEP7007 application forms, covering the proposed project, is provided in Appendix A. Under separate cover, RTA plans to submit a copy of the existing Title V permit with suggested revisions that would be necessary to accommodate the proposed project along with a proposed Statement of Basis report. These will be provided to facilitate KDAQ's review and processing of this application.

RTA plans to begin construction on this change in technology upon issuance of the proposed permit, with operation of the first group of modified reduction cells beginning six months thereafter. It is imperative that RTA proceed with this project as soon as possible to ensure the long-term viability of Sebree Works.

2. DESCRIPTION OF FACILITY AND CURRENT OPERATIONS

2.1 FACILITY LOCATION

Sebree Works is located off of State Highway 2096, to the west of Robards, Kentucky in Henderson County. The facility is bordered by Highway 41 to the west, a Western Kentucky Energy (WKE) coal-fired electric utility plant to the south, and rural undeveloped tracts of land in all other directions. Figures 2-1 and 2-2 show the facility property and the surrounding area on a topographical and aerial map, respectively. The area map shows the location of the facility relative to predominant geographical features such as nearby highways, railroads, streams, and rivers. As shown in Figure 2-1, the coordinates of the center of the property, represented in the Universal Transverse Mercator (UTM) coordinate system, are approximately 456.2 km East, 4,168.9 km North. Process operations, which are located on the southern portion of the property, are centered at coordinates 455.8 km East, 4,168.0 km North. A site plan showing the location of existing potlines and all other major buildings at the Sebree Works is provided in Figure 3-5 of Volume 2.

2.2 FACILITY ENVIRONMENTAL CONTACTS

The primary contacts at the facility for this application are (1) Mr. Ghassan Dughais, Environmental Supervisor (270-521-7452), and (2) Mr. Stephane LeBlanc, Sebree Works Manager. A Certificate of Authority for the plant is currently on file with the KDAQ.

2.3 CURRENT PLANT OPERATIONS SUMMARY

At Sebree Works, RTA produces primary aluminum from raw alumina (Al_2O_3) by applying electric current to the alumina in vessels termed reduction cells or pots. The pots are constructed to form an electrolytic cell with an anode, cathode, and electrolyte.

The exterior of the pots consists of a rectangular steel shell lined with refractory thermal insulation. Within the pot is an inner lining of carbon (the cathode). Carbon anode blocks are placed just below the surface of a fluoride electrolyte (cryolite) to complete the reaction circuit. A current is applied to metal rods attached to the anode blocks, which passes thorough the molten bath (molten aluminum, cryolite, and alumina) and the carbon cathode lining and then to current collector bars. The molten aluminum formed in the reduction cells (as it is liberated from alumina with oxygen) settles between the anode and cathode where it accumulates. The oxygen liberated reacts with the carbon anode blocks forming carbon dioxide. The accumulated molten metal is siphoned from the pots into crucibles each day. The anode blocks, which are gradually consumed by the reaction in the pots, last a few weeks before they must be replaced with new anodes.

RTA operates three nearly identical potlines. Each potline is composed of two potrooms that each contain 64 reductions cells for a total of 128 cells per potline. The emissions from the reduction cells in each potline are captured through hooding systems and are sent to two Alcoa A-398 alumina fluidized bed dry scrubbers, each of which has 5 reactors. Any fugitive emissions not caught by the hooding system are vented through the roof of each potline.

To provide baked carbon anodes to the reduction cells, RTA operates an anode paste mixing and forming operation and an anode bake furnace, in which the “green anodes” are baked. The green anodes are formed from petroleum coke, recycled spent anode material, and coal tar pitch, which serves as a binder. The formed anodes are compressed and placed within the bake furnace, where they are baked to remove volatiles, leaving a solid carbon block. The emissions from the paste mixing and anode forming units are vented to a common control device, a Procedair dry coke scrubber. The emissions from the anode bake furnace are sent to an Alcoa A-446 alumina fluidized bed scrubber.

The molten aluminum produced by the reduction cells from all three potlines is sent to the casthouse to be formed into billets, ingots, and t-bars, along with other products. The casthouse utilizes natural gas-fired holding furnaces to condition molten aluminum and homogenizing furnaces to condition the aluminum billets.

FIGURE 2-1. AREA MAP

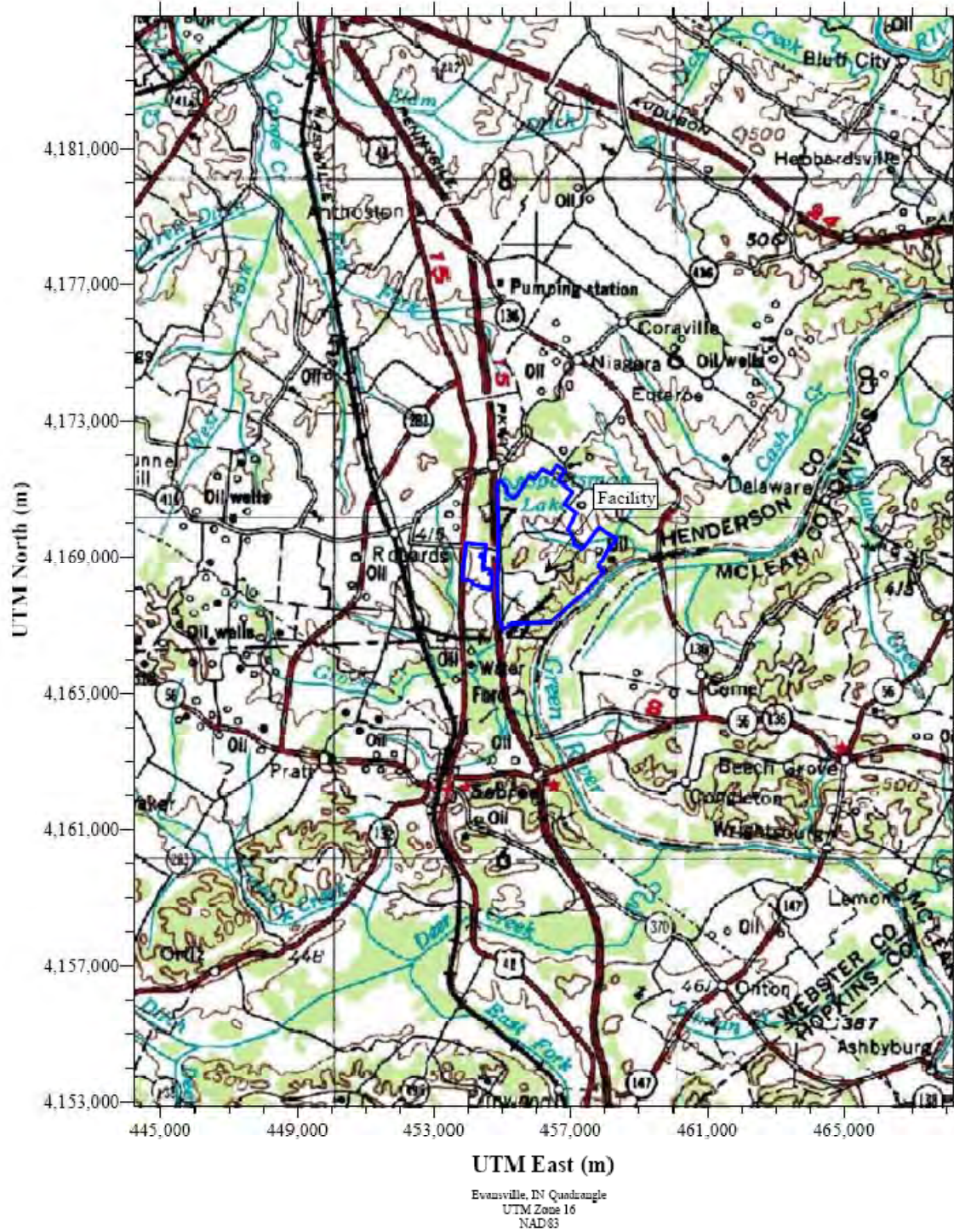
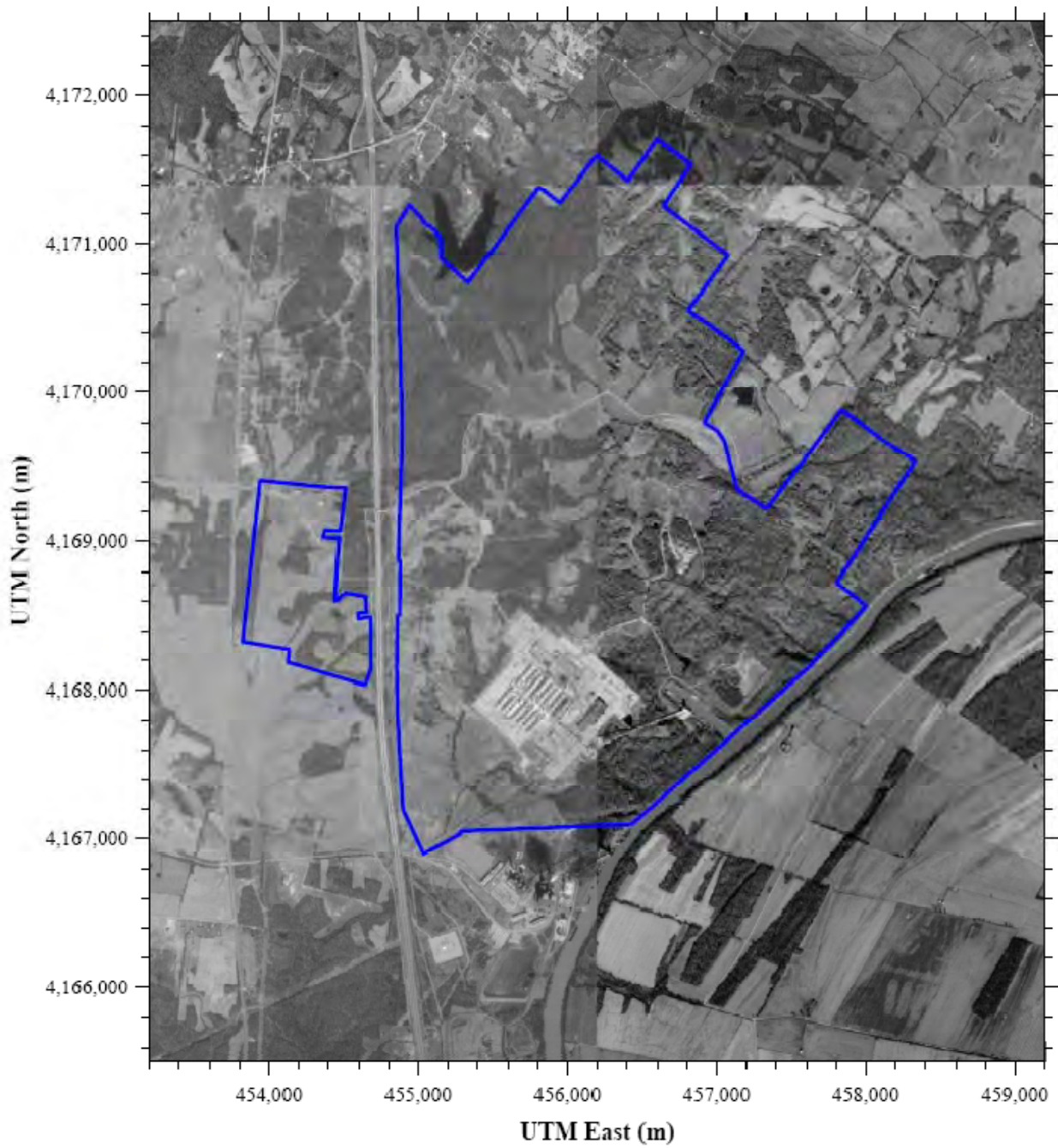


FIGURE 2-2. AERIAL MAP



3. PROPOSED PROJECT

The proposed project involves the implementation of a new technology package on the aluminum reduction pots in the existing potlines at Sebree Works. No new emission units are being constructed as part of this project. The potlines are the only existing emission units at the facility that will be physically modified.¹ Because aluminum production will increase, other emission units at the facility will experience a utilization increase attributable to the project, along with an associated emissions increase.

The following sections of this report provide a detailed description of the proposed project covered by this permit action. This description is accompanied by process flow diagrams provided in Appendix C. The nomenclature for each emission point represented on the process flow diagram follows that used in the Title V permit and the PSD air quality analysis.

3.1 POTLINE OPERATIONS

The potlines are the central part of the aluminum reduction process. It is in the individual pots that alumina is reduced to molten aluminum in the presence of the carbon anode and cathode and the molten fluoride electrolyte. Operations at the facility upstream of the potlines prepare the raw materials for use in the pots and those downstream of the potlines further process the molten aluminum into easily transportable forms.

3.1.1 HISTORY OF OPERATIONS AT SEBREE WORKS

Two (2) of the existing potlines in operation at Sebree Works (termed the Potlines 1 and 2) were constructed with the original plant in the early 1970s. In 1979, a third potline (Potline 3) was constructed. The remainder of the plant, including the anode bake furnace, was initially constructed in the early 1970s and then was upgraded as part of the Potline 3 installation in 1979.

3.1.2 POTLINE POLLUTION CONTROL EQUIPMENT AND STACK CONFIGURATION

The A-398 reactors serving each potroom are pollution control devices, each of which consists of a dry scrubbing system operated in series with a baghouse. These systems provide greater than 99% control efficiency for particulate matter and fluorides. The A-398 scrubber systems are not designed to control any other pollutant.

In each A-398, the exhaust gas from a potroom section passes through a fluidized bed of alumina, which absorbs fluoride compounds released in the electrolysis reaction in the pots. The exhaust gas then passes to a baghouse where the alumina (along with the absorbed pollutants and other particulate matter) is captured. The alumina is then

¹ Certain equipment in the Electrode Department that are not emission sources will also be modified as part of the project. These include equipment in the rodding and butt cleaning shops.

conveyed to the potlines (along with a supplemental supply of unreacted alumina) as the primary raw material used to produce aluminum. Here, the fluoride captured on the alumina is liberated in the cryolite bath.

There are two A-398 scrubber systems, each consisting of five reactors, associated with each of the three potlines at Sebree Works. For the A-398s associated with Potlines 1 and 2, each reactor has two stacks. Thus, for Potlines 1 and 2 there are ten emission points associated with each A-398 system, with two A-398 systems on each potline (i.e., ten emission points for the North A-398 and ten emission points for the South A-398). For the Potline 3 A-398s, there is a single stack exhausting emissions from five reactors. Thus, there is one emission point associated with each A-398 system on Potline 3. The existing A-398 scrubber systems will not require modification to accommodate the increase in aluminum production in the existing potlines. However, the heat generated from the pots will increase slightly so that the exhaust temperature of gases from the A-398 scrubber stacks increase at the higher production rates.

3.2 PLANNED PRODUCTION INCREASE PROJECT

RTA is currently planning to initiate the production increase project immediately upon receipt of a Proposed Permit for this project from KDAQ. Modifications will be made to each potline reduction cell individually, so after this construction project commences, production will gradually increase as more reduction cells are equipped with the new technology. Once the new technology is installed on all reduction cells, the facility-wide metal production rate will increase from 199,580 metric tons of aluminum per year (mt/yr) (219,999 short tons per year [tpy]) to 230,000 mt/yr (253,531 tpy).

3.2.1 IMPACT OF PROJECT ON UPSTREAM AND DOWNSTREAM PROCESSES

The current constraint on facility-wide production is the capacity of the three existing potlines. After completion of this project, the actual throughput for other process units at the facility is expected to increase proportionally with the increase in metal production at the potlines. RTA has completed an analysis of all other existing emission units at the facility and determined that they will be able to accommodate the increase in throughput without any physical modifications and within all currently applicable permit limitations. Therefore, the associated increases in emissions at upstream and downstream emission units at the facility are included in the PSD applicability calculations for this project. However, the only physically modified emission units for which a BACT review is completed for PSD triggering pollutants are the three potlines.

3.2.2 RELATIONSHIP TO RECENT ANODE BAKE FURNACE REFURBISHMENT PERMIT APPLICATION

A final PSD permit was issued to Sebree Works in March 2008 for a project involving maintenance and refurbishment of the existing 261 anode bake furnace. The anode bake furnace project, for which construction is on-going, only affected the anode bake furnace. That project is independent and separate from the current production increase project. The furnace refurbishment project was necessary to avoid the risk of failure of key equipment

components, which if they occurred would prevent the facility from producing anodes necessary to sustain production in the potlines.

As discussed in detail in the previous PSD permit application, submitted in August 2007, although a capacity increase was authorized in the PSD permit action for the anode bake furnace, that increase only resulted from the need to continue operation of the furnace during the refurbishment activity. To accomplish this, a previously decommissioned section of the furnace was rebuilt first so that only one third of the furnace had to be taken off line at any time to complete the refurbishments in series. Once all the refurbishments are completed, the overall capacity of the furnace will be greater. This increased capacity could be utilized if RTA were to import green anodes from other facilities to bake in the furnace and then ship the baked anodes back to these same facilities. Even in that case however, there would still be no impact on upstream or downstream operations at Sebree Works specifically. Therefore, the current production increase project and the previous anode bake furnace project are correctly treated as independent projects for the purpose of PSD applicability emission calculations, presented in Section 4.

4. AIR EMISSIONS QUANTIFICATION

The potlines at Sebree Works are a source of SO₂, CO, PM, and fluorides emissions. The emissions from the potlines are captured through hooding systems and are sent to two Alcoa A-398 alumina fluidized bed dry scrubbers, which each have 5 reactors. Any fugitive emissions not caught by the hooding systems are vented through the roof of each potline. Other emission sources at Sebree Works include the anode bake furnace, various natural gas combustion equipment, and raw and finished material handling and processing equipment. The methodologies for calculating emissions increases associated with the proposed production increase project are summarized in this section of the application. Supporting documentation for the emissions calculations, including assumptions, input data, and sample calculations, is provided in Appendix B to the application.

4.1 OVERALL EMISSION CALCULATION METHODOLOGY

As is subsequently discussed in Section 5.1, Sebree Works is an existing major source under the PSD permitting regulations. As such, the proposed project must be evaluated as to whether PSD permitting requirements are triggered and for which pollutants. To evaluate whether the proposed project will be subject to PSD requirements, the annual emission increases of regulated pollutants caused by the project are compared with the major modification thresholds. The major modification thresholds for an existing major source, termed the PSD Significant Emission Rates (SERs) and defined at 401 KAR 51:001 Section 1 (222)(a), are listed in Table 4-1. For those pollutants whose project emission increases exceed the major modification thresholds, the net emission increase can be calculated taking into account creditable emission increases and decreases that occurred over a 5-year contemporaneous period. PSD permitting requirements are avoided if either the project emissions increase or net emissions increase are less than the major modification thresholds.²

² 401 KAR 51:017, Section 1 (4).

TABLE 4-1. PSD SIGNIFICANT EMISSION RATES

Pollutant ¹	PSD Significant Emission Rate (tpy) ²
SO ₂	40
CO	100
PM ₁₀	15
PM _{2.5} ³	10
NO _x	40
VOC	40
Fluorides (excluding HF)	3

1. Only those regulated PSD pollutants for which quantifiable emissions increases are expected due to this project are listed.
2. 401 KAR 51:001, Section 1 (222)(a).
3. The SER for PM_{2.5} was recently established by EPA. (73 FR 28321, May 16, 2008)

Annual emission increases from the project under review are calculated for new, modified and affected emission units. The proposed project covered by this application will involve a physical modification to the existing potlines, but physical modifications to other emission generating units at Sebree Works will not be required. Because the facility-wide aluminum production will increase, the indirectly affected upstream and downstream emissions sources at the facility (i.e., the “associated emission units”) will experience an emissions increase attributable to the project due to increased use of raw material, increased anode production, and increased aluminum production. The emission calculation methods for the potlines and for associated emission units at the facility are described in this section.

4.1.1 METHODOLOGY FOR BASELINE EMISSIONS

To evaluate emissions increases associated with the proposed project, both the baseline actual emissions from the potlines in their current configuration and all other emission units at the facility have been tabulated. As documented further with respect to each pollutant in particular, with the exception of SO₂, baseline emissions have been quantified based on stack test data (where available) or published reference emission factors, combined with the maximum 24-month average annual production rates that have occurred in the past 2 years.³ For SO₂, baseline emissions are based on a mass balance approach and historical production records.

³ RTA chose not to consider historical data beyond 2 years since, per EPA Region 4 guidance, the production rates in the most recent two years must be used when determining baseline emissions for the significance modeling analysis. The production rates from the most recent two year period are used, so that two sets of emission calculations do not need to be presented in this application (i.e., one for PSD applicability and one for modeling). Note that the maximum production rate at Sebree Works in the last 10 years occurred prior to the most recent two year period, so this is a conservative method for determining PSD applicability. Regardless, PSD is not triggered for additional pollutants using this conservative method compared with using the period of maximum production from the previous 10 year period.

4.1.2 METHODOLOGY FOR FUTURE EMISSIONS

Under Kentucky's PSD regulations, applicability is based on the difference between projected actual emissions following the project and baseline actual emissions. However, production levels within the next 10 years will conceivably reach capacity, and thus there would be no substantive difference in the projected actual emissions level and future potential emissions level for the potlines. However, other emissions units at the facility are not expected to reach their maximum capacities as a result of the facility-wide production increase and projected actual emissions are calculated for associated emissions increases for use in the PSD applicability determination. Thus, for the potlines, RTA is utilizing its option under 401 KAR 51:001 Section 1 (203)(b)(2) to evaluate PSD applicability based on future potential emissions, thereby simplifying the calculations and future compliance demonstration methods.

4.1.3 TREATMENT OF FUGITIVE EMISSIONS

Since Sebree Works belongs to one of the specifically defined source categories in 401 KAR 51:017 Section 7(1)(c), fugitive emissions should be included in the annual emissions total used for making a PSD applicability determination. As discussed in Section 4.7 however, only negligible increases in fugitive emissions may occur as result of the project, and the inclusion of fugitive emissions in the project emissions totals would not affect any PSD applicability determinations made in this application (e.g., for PM₁₀, PSD is triggered regardless of whether fugitive emissions are quantified).

The specific methodology utilized for each pollutant to calculate the project emissions increases for PSD applicability purposes is summarized in the following sections. A summary of the PSD applicability analysis and requirements is discussed subsequently in Section 5.2 of the application.

4.2 SO₂ EMISSIONS

Emissions of SO₂ at Sebree Works result from operation of the potlines, anode bake furnace, and, to a lesser extent, miscellaneous natural gas combustion equipment. The methods by which baseline actual and future emissions are calculated for each of these units are described in this section.

4.2.1 POTLINES

The baked anodes used to form one part of the electrolytic cell in the potlines contain sulfur, which can be volatilized and oxidized to form SO₂ as the baked anodes are heated in the potlines. The emissions of SO₂ from the potlines are highly variable on a short-term basis due to changes in the sulfur content of the baked anodes, which depends on the properties of the raw materials used to produce the baked anodes in the anode bake furnace.

RTA utilizes a mass balance approach to quantify and track facility-wide SO₂ emissions from the potlines and the bake furnace on a monthly basis. This involves taking multiple sulfur content samples of green anodes, baked anodes, and packing coke during a month and tracking other process variables such as green anode mass, baked anode mass, packing

code usage rate, and carbon consumption at the potlines. The mass balance approach, encompassed in what is termed the “SO₂ Calculation Engine”, is utilized at RTA primary aluminum plants worldwide. The SO₂ Engine has previously been reviewed and approved by KDAQ and is currently the stipulated method within RTA’s Title V permit for calculating 12-month rolling average SO₂ emissions to demonstrate compliance with the existing SO₂ emission cap and anode bake furnace SO₂ BACT limit.

One portion of the SO₂ Engine mass balance is used to quantify SO₂ emissions from the bake furnace. In this mass balance for the anode bake furnace, the sulfur input to the furnace is calculated based on (1) the sulfur content and throughput of green anodes and (2) the sulfur content and usage rate of packing coke. The sulfur output from the furnace is based on the sulfur content and production rate of baked anodes. The difference between the sulfur input to the furnace and sulfur leaving the furnace represents the net sulfur released to the A-446 scrubber. The SO₂ emission rate is then calculated by conservatively assuming that all sulfur released from the furnace is emitted as SO₂. The sulfur that is retained in the baked anodes is assumed to be emitted at the potlines, after correcting for sulfur that is emitted as carbonyl sulfide (COS) and condensable particulate matter.

RTA tracks the monthly throughputs of green anodes and baked anodes by weighing each anode loaded and unloaded in the pits during a given month. Monthly packing coke usage is tracked based on the make-up supply added each month. Samples of green anodes and bake anodes are tested multiple times per month to measure sulfur contents. Samples of packing coke are also tested periodically to measure sulfur content. The samples within a month are then aggregated to define the monthly average sulfur contents for each of the three materials (green anodes, packing coke, and baked anodes), which are then input into the SO₂ Engine.

4.2.1.1 BASELINE ACTUAL SO₂ EMISSIONS

The SO₂ Engine data were collected for the most recent 24-month period for which production data were available at the time this permitting project was initiated. This period is from August 2006 to July 2008, when SO₂ emissions from the potlines totaled **3,860 tpy**. (This value takes into account the assumption that 5% of the sulfur in the baked anodes is emitted as COS and 2% of the remaining sulfur (i.e., 1.9% of total sulfur) is emitted as condensable particulate matter.) As SO₂ emissions during this period were compliant with applicable SO₂ emission limits, no adjustments to this actual calculated emissions level are necessary. A more detailed derivation of the baseline emissions is provided in Appendix B.

4.2.1.2 FUTURE POTENTIAL SO₂ EMISSIONS

As subsequently discussed in Section 6.3.6, RTA is proposing that BACT for the potlines for SO₂ is achieved through application of the current pollution prevention method of managing raw materials and process variables. RTA is proposing to revise the existing SO₂ emissions limit, which applies to the potlines and anode bake furnace combined, to account for the increase in baked

anode usage in the potlines associated with the increased rate of aluminum production. The revised limit will reflect the BACT emission rate achievable with this pollution prevention method.

The existing SO₂ emission limit, 5,262.3 tpy (12-month rolling average), was imposed on RTA by KDAQ as part of the initial Title V permit action, which concluded in April 2007. The limit was established to provide an administratively streamlined method of demonstrating that no activities engaged in by the facility since 1982 had triggered PSD review. (1982 was the year when the last operating permit had been issued.) RTA conducted a historical review of process variables and sulfur content data and a forward-looking assessment of future raw material characteristics to determine what level of SO₂ emissions could be achieved by the existing plant operations. Based on this assessment, a set of assumptions for the future SO₂ Engine input variables were defined, from which the total combined emission rate of 5,262.3 tpy for the potlines and anode bake furnace was calculated. RTA then showed that the difference between this projected SO₂ emission rate and estimated actual SO₂ emissions level in 1982 fell below the SO₂ PSD Significant Emission Rate of 40 tpy, thereby providing a simplified means for KDAQ to confirm with reasonable probability that the facility had not triggered PSD permitting requirements during the period in question.

As the name implies, the existing SO₂ “cap” applies to the potlines and anode bake furnace combined, reflecting the fact that the SO₂ emissions from the potlines and anode bake furnace are interrelated and the SO₂ Engine is intended to accurately quantify total SO₂ emissions. Even still, using the default set of input variable assumptions for the development of the cap, the contributing portion of the cap from the potlines and anode bake furnace can be calculated, as shown in Appendix B. In the Title V permit revision that KDAQ issued to approve the recent anode bake furnace refurbishment project, a second limit was also imposed on SO₂ emissions from the anode bake furnace.⁴ The new SO₂ limit that was imposed on the anode bake furnace alone, which essentially fixed its apportionment under the previous cap value, represents only one of many permutations of SO₂ Engine input variables possible. The actual emission rates for the anode bake furnace and the potlines under the cap are variable and flexibility to manage combined SO₂ emissions under a single emissions cap is needed. This is why the SO₂ limit was instituted as a cap originally, and why RTA is seeking through this application to re-establish a single emission cap for the potlines and anode bake furnace, instead of imposing a new separate emission limit on the potlines alone. This single cap approach is further justified because after the production increase project is

⁴ The limit of 521 tpy of SO₂ is contained in Condition B.2.c.i of Sebree Works’ revised Title V permit (V-05-088 R1) issued on March 26, 2008.

complete, both the potlines and anode bake furnace will have recently been subjected to PSD review for SO₂.

To satisfy the requirement to implement BACT for SO₂ on the potlines as part of this PSD permit action and the 2007 Anode Bake Furnace permit action, RTA re-examined the historical data for the key input variables utilized in the SO₂ Engine. Specifically, historical trends of sulfur contents for the principal raw materials, and for the other process variable inputs were reviewed. RTA also conducted an exhaustive review of the current and projected future market for the raw materials and most importantly, how sulfur contents are trending. As further documented in Section 6.3.6, the sulfur content of petroleum coke, the key raw material used in making anodes, is expected to measurably increase over the next 5 years. In addition, other elements in the coke are approaching and exceeding current quality specification limits (e.g., vanadium, nickel) posing challenges for maintaining anode quality.

The underlying assumptions used in the SO₂ Engine to calculate the newly proposed cap are the same as those presented in the 2007 Anode Bake Furnace application, except that the aluminum production rate for the potlines has been increased to reflect the newly proposed potline project. Upon issuance of a revised Title V permit authorizing the proposed modifications and increase in facility-wide aluminum production capacity, the previously established cap should be replaced by a new facility-wide SO₂ emissions cap of 6,326 tpy, based on the new aluminum production capacity of 230,000 mt/yr. This new emission rate represents BACT for both the potlines and anode bake furnace. Note that the total emissions under this cap attributable to the anode bake furnace (521 tpy) under a base set of raw material properties, is the same as that presented in the 2007 Anode Bake Furnace application. The anode bake furnace will still have the capacity to produce more baked anodes than can be accommodated in the potlines, even at the increased production levels. This added capacity could be realized in the event that market conditions make it viable to RTA to import green anodes from other facilities for processing through the anode bake furnace and export the baked anodes back to the suppliers.

A summary of the SO₂ Engine input variables and the corresponding sample calculations completed to arrive at the 6,326 tpy SO₂ emission level for the potlines and anode bake furnace are provided in the following subsections.

4.2.1.2.1 SO₂ ENGINE SAMPLE CALCULATIONS – SULFUR CONTENTS

The sulfur content of the baked anodes is one of the key inputs used in the SO₂ Engine to calculate SO₂ emissions from the potlines. The calculation of the sulfur content in the baked anodes used in the potlines is identical to that presented in the

2007 Anode Bake Furnace application and is summarized briefly here.

Green Anode Sulfur Content. Green anodes are formed from a mixture of petroleum coke, pitch, and recycled butts material.⁵ Under the green anode recipe that is expected to produce the highest emissions of SO₂, the green anode is comprised of 85% paste (coke and pitch) and 15% recycled butts material. The pitch in turn makes up 15% of the paste. The resulting composition of the green anodes (for these calculations) is thus:

Petroleum Coke:	72.25%
Pitch:	12.75%
Anode Butts Material:	15%

Based on a detailed assessment of the future market for petroleum coke, the sulfur content for the coke has been set to 3.3% for the default SO₂ Engine calculation. (Refer to Section 6.3.6 for additional discussion on this variable.) The pitch sulfur content is set to 0.8%. The sulfur content of the recycled butts material is set to 2.3%, corresponding to historical averages. Under this default set of sulfur content assumptions, the green anode sulfur content can then be estimated to be **2.83%** based on its composition:

Baked Anode Sulfur Content. Although sulfur is released from the green anodes during baking, because the mass of the baked anodes is less than of the green anodes, on a percentage basis, the sulfur content of the baked anodes will actually be slightly higher than the sulfur content of the green anodes. Based on a review of historical actual sulfur content measurements, the minimum ratio of sulfur contents (baked to green) is approximately 102%. Thus, if future green anode sulfur contents are calculated to be 2.83%, the future baked anode sulfur content can be estimated to be approximately **2.89%** (i.e., 102% of 2.83%).

4.2.1.2.2 SAMPLE CALCULATIONS – SO₂ ENGINE EMISSIONS ESTIMATE

The SO₂ Engine uses three key inputs to calculate emissions from the potlines-the aluminum production rate, the baked anode sulfur content, and the anode consumption rate in the pots. The potential aluminum production rate and baked anode sulfur

⁵ Recycled butts material is anode material recovered from the copper rods of spent anodes at both Seabree Works and from outside suppliers.

content have already been discussed above. For the purpose of calculating potential SO₂ emissions, the future anode consumption rate is estimated based on historical Seabree Works records.⁶ Using these inputs, the total sulfur balance for the potlines is calculated as follows:⁷

$$S \text{ Input (tpy)} = \text{Anode Consumption Rate} \\ \times \text{Aluminum Production Rate} \times \text{Baked Anode S Content}$$

$$S \text{ Input (tpy)} = 0.426 \text{ ton} \frac{\text{ton anode}}{\text{ton Al}} \times 253,531 \text{ ton} \frac{\text{Al}}{\text{yr}} \times 2.89\% S \\ = 3,117.9 \text{ ton S/yr}$$

Approximately 5% of the sulfur in the baked anodes is known to be emitted as COS and 2% of the remaining sulfur is emitted as condensable particulate matter. Thus, of the 3,117.9 tpy of sulfur released in the potlines, 2,903 tpy is emitted from the potlines in the form of SO₂. Total SO₂ emissions are calculated based on the ratio of the molecular weights of SO₂ to S, using the fact that each molecule of S forms one molecule of SO₂.

$$SO_2 \text{ Emissions (tpy)} = \left(\frac{2,903 \text{ ton S}}{\text{yr}} \right) \left(\frac{64 \text{ ton } SO_2}{32 \text{ ton S}} \right) = 5,806 \text{ tpy}$$

Thus, the total potline SO₂ emissions following completion of the planned production increase project are calculated to be **5,806 tpy**. This value is used as the future potential SO₂ emissions for the potlines for the purposes of completing the PSD applicability analysis. This value is also used in the air quality modeling analyses presented in Volume 2 of the application. As discussed in Section 6.3.6 however, RTA is not proposing to establish a unit-specific SO₂ emission rate for the potlines and instead, a combined potline and anode bake furnace BACT limit is proposed.

4.2.1.3 PROJECT EMISSION INCREASES FROM POTLINES

The SO₂ emissions increase from the potlines associated with the production increase project is calculated based on the difference between the future potential emissions (from the potlines portion of the new SO₂ cap) and the

⁶ The potential anode consumption rate of 0.426 tons of anode per ton of aluminum produced is the same as that used in the potential emission calculations for the 2007 Anode Bake Furnace application.

⁷ Note that throughout the text of this report, the calculated values in the sample calculations reflect a greater number of significant figures in the input variables than is shown. The calculated values match those presented in Appendix B, where additional significant figures are retained in the calculations.

baseline emissions. For this project, the emission increase is **1,946 tpy**. Detailed emission calculations are presented in Appendix B.

4.2.2 PROJECT EMISSIONS INCREASES FROM ASSOCIATED UNITS

The majority of all SO₂ emissions at Sebree Works (approximately 91.8%) result from operation of the potlines, with approximately 8.2% from the anode bake furnace and less than 0.1% from all other sources. As discussed in Section 4.1, emissions of SO₂ from units other than the potlines will increase when comparing baseline actual emissions to projected emissions and must be taken into consideration when determining PSD applicability. Past actual emissions for these units were estimated based on the most recent emission factors available for each emission unit and process throughput data submitted by RTA to KDAQ in the 2007 KyEIS report. The 2007 production rates were scaled by the ratio of annual average aluminum production in the 24-month baseline period (August 2006 to July 2008) to the 2007 KyEIS reported aluminum production. Projected future emissions were estimated by multiplying the baseline actual emissions by the ratio of the future potential facility-wide aluminum production to the aluminum production in the 2-year baseline period, based on the fact that emissions for SO₂ emission units at the facility are proportional to the facility-wide aluminum production rate. The facility-wide associated emissions increase for SO₂ was then calculated as the difference between projected future emissions and past actual emissions. For this project, the associated emission increase is **56.3 tpy**. This associated emission increase is added to the potlines emission increase for comparison against the PSD significant emission rate (SER) thresholds, as shown in Section 4.8. A detailed summary of these calculations is presented in Appendix B.

4.3 CO EMISSIONS

Emissions of CO at Sebree Works result from operation of the potlines, anode bake furnace, and, to a lesser extent, miscellaneous natural gas combustion equipment. The methods by which baseline actual and future emissions are calculated for each of these units are described in this section.

4.3.1 POTLINES

In the overall reaction occurring in the reduction cells, molten aluminum is produced at the cathode, and oxygen, released at the anode, reacts with carbon to form carbon dioxide.⁸ CO emissions from the potlines are generated primarily through the re-oxidation of aluminum in the presence of CO₂ back to alumina. Since this re-oxidation is detrimental to the potline production efficiency, RTA makes every effort to maximize the potline efficiency by minimizing the occurrence of re-oxidation.

⁸ Air & Waste Management Association, 1992: Air Pollution Engineering Manual, Van Nostrand Reinhold, New York. P. 593.

4.3.1.1 BASELINE ACTUAL CO EMISSIONS

While extensive reference data is available for estimating CO emissions from natural gas combustion, an exhaustive review of literature conducted for this project revealed no suitable factors for estimating the CO emissions from the potlines. For example, Chapter 12.1 in U.S. EPA's AP-42 document, which covers primary aluminum, contains no CO emissions information. Although RTA has not been required to characterize the CO emissions from the potlines as part of previous air permit actions, RTA has data from an internal stack test study in which CO was measured from a potline A-398 reactor stack. The test was completed in February 2005. The February 2005 test was conducted primarily to quantify carbonyl sulfide (COS) emissions as part of an internal research study being completed by RTA. However, CO was also measured during this test series.

In the absence of having any CO emissions data for potlines from other published reference documents, a CO emission factor has been derived from the 2005 internal stack test completed by RTA. The February 2005 test consisted of a three test runs on one reactor on the A-398 reactor controlling the north half of Potline 2. Each test run lasted approximately one hour and thirty minutes. The average emission factor for the A-398 reactors calculated from these stack test runs is 195.9 lb CO/ton aluminum. CO emissions from the potroom roof vents are estimated to be 1% of total CO emissions from the potlines or 1.98 lb/ton.

The period from August 2006 to July 2008 was chosen as the baseline period for CO, during which the annual aluminum production was 213,326 ton aluminum/yr. By multiplying the stack-test derived emission factor by the production rate during the baseline period, a baseline actual annual average CO emission rate of **21,102 tpy** is calculated.

4.3.1.2 FUTURE POTENTIAL CO EMISSIONS

The future potential CO emissions for the potlines used for purposes of the PSD applicability analysis and modeling analysis are defined by the BACT determination. As discussed in Section 6.5.5, BACT is determined to be no additional add-on controls. The proposed BACT emission rate was calculated based on the 90th upper confidence level (UCL) from the three stack test data points to account for the expected short-term variability in CO emissions and the limited amount of data available. This emission factor is **233.6 lb/ton Al**. Based on this factor and the future production capacity of the furnace, the potential CO emissions are calculated to be **29,613 tpy**. (Refer to Appendix B for further information on these calculations).

4.3.1.3 PROJECT EMISSION INCREASES FROM POTLINES

The CO emissions increase from the potlines associated with the production increase project is calculated based on the difference between the future potential emissions and the baseline emissions. For this project, the emission increase is **8,511 tpy**. Detailed emission calculations are presented in Appendix B.

4.3.2 PROJECT EMISSIONS INCREASES FROM ASSOCIATED UNITS

The majority of all CO emissions at Sebree Works (approximately 97.6%) result from operation of the potlines, with approximately 2.1% from the anode bake furnace and less than 0.3% from all other sources. As discussed in Section 4.1, emissions of CO from units other than the potlines will increase when comparing baseline actual emissions to projected emissions and must be taken into consideration when determining PSD applicability. Past actual emissions for these units were estimated based on the most recent emission factors available for each emission unit and process throughput data submitted by RTA to KDAQ in the 2007 KyEIS report. The 2007 production rates were scaled by the ratio of annual average aluminum production in the 24-month baseline period (August 2006 to July 2008) to the 2007 KyEIS reported aluminum production. Projected future emissions were estimated by multiplying the baseline actual emissions by the ratio of the future potential facility-wide aluminum production to the aluminum production in the 2-year baseline period, based on the fact that emissions for CO emission units at the facility are proportional to the facility-wide aluminum production rate. The facility-wide associated emissions increase for CO was then calculated as the difference between projected future emissions and past actual emissions. For this project, the associated emission increase is **105.4 tpy**. This associated emission increase is added to the potlines emission increase for comparison against the PSD SER thresholds, as shown in Section 4.8. A detailed summary of these calculations is presented in Appendix B.

4.4 PARTICULATE MATTER EMISSIONS (PM₁₀/PM_{2.5})

Emissions of PM₁₀ and PM_{2.5} at Sebree Works result from operation of the potlines, anode bake furnace, material handling and processing equipment, and to a lesser extent, miscellaneous natural gas combustion equipment. The methods by which baseline actual and future emissions are calculated for each of these categories of units are described in this section.

4.4.1 POTLINES

Particulate matter emissions from the potlines consist largely of particulate fluoride, carbon dust, and alumina. The majority of the particulate matter emitted from the potlines is captured via a hooding system and is routed to the A-398 scrubbers. The A-398 scrubbers provide upwards of 99% control of particulate matter for the captured exhaust stream.

4.4.1.1 BASELINE ACTUAL PM₁₀ AND PM_{2.5} EMISSIONS

As part of its effort to characterize PM emissions to complete a Best Available Retrofit Technology (BART) applicability analysis, RTA completed a stack test study of the PM emissions from the potline A-398 reactors and roof vents in June and July 2006. The A-398 reactor tests consisted of a series of 4 test runs each lasting approximately 12 hours from June 5-8, 2006. The quantities of both filterable and condensable PM emitted from a single reactor stack on the south A-398 controlling Potline 3 were measured. The roof vent tests consisted of a series of 9 valid test runs, each lasting approximately 24 hours from July 10-22, 2006. The quantities of filterable and condensable PM emitted from the M-14 downcomer, which consists of a sampling manifold of eight 15-inch ducts positioned above the potlines located in the south end of Building 106 (Potline 3) were measured. The stack test results revealed that the majority of PM emitted from the potlines roof vents and A-398 scrubbers is less than 10 µm in size. Thus, PM₁₀ emissions are assumed to be representative of total PM emissions. The fraction of total PM₁₀ made up by PM less than 2.5 µm in size (PM_{2.5}) was also measured in this stack test.

Using PM₁₀ and PM_{2.5} emission factors derived from the June and July 2006 stack test data and actual monthly production data from the SO₂ Engine, for the 24-month period August 2006 through July 2008, the baseline actual annual PM₁₀ emission rate for the potlines was calculated to be **197 tpy** and the baseline actual annual PM_{2.5} emission rate was **155 tpy** (refer also to Appendix B).

4.4.1.2 FUTURE POTENTIAL PM₁₀ AND PM_{2.5} EMISSIONS

The future potential PM₁₀ and PM_{2.5} emissions for the potlines used for purposes of the PSD applicability analysis and modeling analysis are defined by the BACT determination. As discussed in Section 6.4.5, BACT is determined to be no additional add-on controls, beyond the existing A-398 scrubbers. The proposed BACT emission rate was calculated based on the 90th upper confidence level (UCL) from the stack test data points to account for the expected short-term variability in PM₁₀ and PM_{2.5} emissions and the limited amount of data available. This emission factor is 2.27 lb/ton Al for PM₁₀ and 1.73 lb/ton Al for PM_{2.5}. Based on this factor and the future production capacity of the potlines, the potential PM₁₀ emissions are calculated to be **288 tpy** and the potential PM_{2.5} emissions are **219 tpy**. (Refer to Appendix B for further information on these calculations).

4.4.1.3 PROJECT EMISSION INCREASES FROM POTLINES

The PM₁₀ and PM_{2.5} emissions increases from the potlines associated with the production increase project is calculated based on the difference between the future potential emissions and the baseline emissions. For this project, the

emission increase is **90.2 tpy** for PM₁₀ and **63.9 tpy** for PM_{2.5}. Detailed emission calculations are presented in Appendix B.

4.4.2 PROJECT EMISSIONS INCREASES FROM ASSOCIATED UNITS

Most emission units at the facility are a source of PM₁₀ and PM_{2.5} emissions. These units include the anode bake furnace, raw material (alumina, pet coke, pitch) storage and processing operations, and finished material (aluminum casthouse) operations. Emissions from material handling units are generally controlled using baghouses. The emissions from the anode bake furnace controlled by an A-446 scrubber/baghouse system. Emissions from natural gas combustion equipment, due to their relatively small magnitude, are uncontrolled.

Past actual emissions for natural gas combustion units and uncontrolled material handling units were estimated based on the most recent emission factors available for each emission unit and process throughput data submitted by RTA to KDAQ in the 2007 KyEIS report. The 2007 production rates were scaled by the ratio of annual average aluminum production in the 24-month baseline period (August 2006 to July 2008) to the 2007 KyEIS reported aluminum production. For the anode bake furnace, the emission factor used in the 2007 PSD application (0.131 lb/ton of baked anodes produced), which is based on June 2006 stack test data, was used with the baseline period baked anode production rate to estimate baseline actual emissions. For all controlled material handling units, updated production-based PM₁₀ and PM_{2.5} emission factors have been derived as part of this application based on the maximum air flow rate through each baghouse, the maximum processing rate, and an estimated outlet grain loading of 0.01 grains per dry standard cubic foot (gr/dscf). Actual baseline emissions for controlled material handling emission units were then calculated using the unit-specific baseline production rate and the updated production-based emission factors.

Projected future emissions were estimated by multiplying the baseline actual emissions by the ratio of the future potential facility-wide aluminum production to aluminum production in the 2-year baseline period, based on the fact that emissions for PM₁₀/PM_{2.5} emission units at the facility are proportional to the facility-wide aluminum production rate. The facility-wide associated emissions increase for PM₁₀ and PM_{2.5} were then calculated as difference between projected future emissions and past actual emissions. For this project, the associated emission increase for PM₁₀ and PM_{2.5} is **20.1 tpy**. This associated emission increase is added to the potlines emission increase for comparison against the PSD SER thresholds, as shown in Section 4.8. A detailed summary of these calculations is presented in Appendix B.

4.5 FLUORIDE EMISSIONS

Emissions of fluorides at Sebree Works result from operation of the potlines, anode bake furnace, and ingot casting/dross loading operations. The methods by which baseline actual and future emissions are calculated for each of these units are described in this section.

4.5.1 POTLINES

Each aluminum reduction cell contains a molten cryolite (Na_3AlF_6) bath that acts as both a solvent and electrolyte in the electrolytic cell through which molten aluminum is produced. Emissions of fluoride-containing compounds from potlines occur in the form of hydrogen fluoride (HF) and particulate fluorides. The HF gas is produced by the hydrolysis of fluoride compounds in the cryolite bath in the pots. Particulate fluoride results from the vaporization of fluoride compounds from the molten bath and subsequent condensation in the cooler zone above the pot.⁹

4.5.1.1 BASELINE ACTUAL FLUORIDE EMISSIONS

In Condition B.4 of the potlines section of Sebree Works' current Title V permit (V-05-088 R1), RTA is required to monitor total fluoride (TF) emissions from the primary control system (A-398 scrubbers) on an annual basis and from the secondary emissions (roof vents) on a monthly basis. Therefore, site-specific TF emission rates for the potlines can be calculated based on the data generated by these monitoring activities. Note that although PSD applies to only non-HF fluorides, the underlying federal regulation (P-MACT) that requires the fluorides monitoring applies to total fluorides, including HF. For conservatism, no attempt was made to subtract out the non-HF fraction of the total fluorides determined using stack test results.

The period from August 2006 to July 2008 was chosen as the baseline period for fluorides, during which the annual aluminum production was 213,326 ton aluminum/yr. To calculate baseline fluorides emissions from the potlines for this period, the average monthly fluorides emission rate from roof vent monitoring for the 24-month period ending July 2008 was combined with the annual average fluorides emission rate for the A-398 scrubbers in 2007 and 2008, and multiplied by the baseline aluminum production rate. Using these data, the baseline actual annual fluoride emission rate for the potlines was calculated to be **82 tpy** (refer also to Appendix B).

4.5.1.2 FUTURE POTENTIAL FLUORIDE EMISSIONS

The future potential fluoride emissions for the potlines used for purposes of the PSD applicability analysis and modeling analysis are defined by the BACT determination. As discussed in Section 6.4.5, BACT is determined to be continued operation of the A-398 scrubber system and an emission rate of 1.9 lb/ton. Based on this factor and the future production capacity of the potlines, the potential fluoride emissions are calculated to be **241 tpy**. (Refer to Appendix B for further information on these calculations).

⁹ Air & Waste Management Association, 1992: Air Pollution Engineering Manual, Van Nostrand Reinhold, New York. P. 593.

4.5.1.3 PROJECT EMISSION INCREASES FROM POTLINES

The fluoride emissions increases from the potlines associated with the production increase project is calculated based on the difference between the future potential emissions and the baseline emissions. For this project, the emission increase is **159.2 tpy**. Detailed emission calculations are presented in Appendix B.

4.5.2 PROJECT EMISSIONS INCREASES FROM ASSOCIATED UNITS

The majority of all fluoride emissions at Sebree Works (approximately 99.5%) result from operation of the potlines, the remaining 0.5% almost evenly divided between the anode bake furnace and ingot casting dross loading operations. As discussed in Section 4.1, emissions of fluoride from units other than the potlines will increase when comparing baseline actual emissions to projected emissions and must be taken into consideration when determining PSD applicability. Past actual emissions for these units were estimated based on the most recent emission factors available for each emission unit and process throughput data submitted by RTA to KDAQ in the 2007 KyEIS report. The 2007 production rates were scaled by the ratio of annual average aluminum production in the 24-month baseline period (August 2006 to July 2008) to the 2007 KyEIS reported aluminum production. Projected future emissions were estimated by multiplying the baseline actual emissions by the ratio of the future potential facility-wide aluminum production to the aluminum production in the 24-month baseline period, based on the fact that emissions for fluorides emission units at the facility are proportional to the facility-wide aluminum production rate. The facility-wide associated emissions increase for fluorides was then calculated as the difference between projected future emissions and past actual emissions. For this project, the associated emission increase is **0.02 tpy**. This associated emission increase is added to the potlines emission increase for comparison against the PSD SER thresholds, as shown in Section 4.8. A detailed summary of these calculations is presented in Appendix B.

4.6 NO_x AND VOC EMISSIONS

Operation of the potlines results in SO₂, CO, PM₁₀, PM_{2.5}, and fluorides emissions, as discussed in the previous sections. However, because the energy used in the electrolysis process in the potlines is added by electricity and not by combustion processes, emissions of NO_x and VOC from the potlines are negligible and not quantifiable. NO_x and VOC emissions increases as a result of the production increase project will be limited to those from associated emission units, including the anode bake furnace and natural gas combustion equipment.

Past actual emissions for associated emission units were estimated based on the most recent emission factors available for each emission unit and process throughput data submitted by RTA to KDAQ in the 2007 KyEIS report. The 2007 production rates were scaled by the ratio of annual average aluminum production in the 24-month baseline period (August 2006 to July 2008) to the 2007 KyEIS reported aluminum production. Projected future emissions were estimated by multiplying the reported baseline emissions by the ratio of the future potential facility-wide aluminum production to the aluminum production in the 24-month baseline period, based on the fact that emissions for these

emission units are proportional to the facility-wide aluminum production rate. The facility-wide associated emissions increase for NO_x and VOC was then calculated as difference between projected future emissions and past actual emissions. For this project, the associated emission increase for NO_x is **23.9 tpy** and the associated emission increase for VOC is **4.5 tpy**. The associated emission increases are compared against the PSD SER thresholds, as shown in Section 4.8. A detailed summary of these calculations is presented in Appendix B.

4.7 OTHER FUGITIVE EMISSIONS

The only potential source of increased fugitive emissions that could be tied to the proposed project would be those from paved and unpaved roads. Paved roads at the plant could be travelled by more trucks due to the increase in shipments of finished aluminum products associated with the facility-wide increase in aluminum production. However, even assuming a conservatively high number of 1,000 incremental vehicle loads traveling 2 miles per trip within the plant site, the estimated PM₁₀ emissions increases using the AP-42 methodology for paved road emissions, would be less than 0.03 tpy.¹⁰ Unpaved roads at the plant are primarily travelled by trucks transporting waste products from the main production area of the facility to the on-site landfill. Waste products shipped to the landfill are primarily made up of spent potliners, which cannot be recovered for re-use at the facility. However, RTA does not expect that the number of spent potliners will increase significantly due to the production increase project, and PM₁₀ emissions from unpaved roads should not increase appreciably. Also, any incremental increase in truck traffic at the facility due to external anode deliveries and pickups would be more than offset by the contemporaneous emission reductions that occurred due to a voluntary initiative undertaken by RTA to reduce the internal vehicle fleet of Sebree Works. Based on the most recent fuel usage records, RTA has reduced its internal vehicle fleet by 19% since 2001. Because the impact of the proposed project on fugitive emissions is negligible and their inclusion would none the less not change the PSD applicability conclusions, no further efforts were made to quantify fugitive emission changes.

4.8 PROJECT EMISSIONS SUMMARY

Based on the emission calculation methodologies described, and as documented in the supporting calculations provided in Appendix B, Table 4-2 provides a summary of the emission increases from the potlines and associated emission units, and the resulting total project-related emissions increase. An assessment of permitting requirements in light of these emissions totals, is discussed in Section 5.2.

¹⁰ U.S. EPA, AP-42 Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Source, March 2006, Section 13.2.1.

TABLE 4-2. SUMMARY OF EMISSION INCREASES FOR THE PROPOSED PROJECT

Source of Emissions	PM (tpy)	PM₁₀ (tpy)	PM_{2.5} (tpy)	NO_x (tpy)	CO (tpy)	VOC (tpy)	SO₂ (tpy)	Fluorides (tpy)
Potline Emissions Increase	90.2	90.2	63.9	-	8,511.2	-	1,945.6	159.2
Associated Emissions Increase	20.4	20.1	20.1	23.9	105.4	4.5	56.3	0.0
Total Project-Related Emissions Increase	110.7	110.4	84.1	23.9	8,616.6	4.5	2,001.9	159.3
PSD Significant Emission Rate	-	15	10	40	100	40	40	3
PSD Triggered?	NA	Y	Y	N	Y	N	Y	Y

5. AIR PERMITTING AND REGULATORY REQUIREMENTS

The potlines at the Sebree Works are subject or potentially subject to certain federal and state air quality regulations. This section of the permit application summarizes the air permitting requirements and the key air quality regulations that apply to the proposed project to supplement the information provided on DEP7007 series application forms in Appendix A. This review is completed only with respect to the potlines, the only emission units being physically modified as part of the proposed project.

5.1 SOURCE CLASSIFICATION

5.1.1 PSD PERMITTING PROGRAM

RTA's Sebree Works is located in Henderson County, which has been designated by U.S. EPA as unclassified/attainment for all criteria pollutants.¹¹ Therefore, with respect to the federal New Source Review permitting program, only Prevention of Significant Deterioration (PSD) requirements could potentially apply to the proposed project.

Kentucky has incorporated the requirements of the PSD permitting program into its State Implementation Plan (SIP) at 401 KAR 51:017.¹² These PSD regulations specifically define 28 industrial source categories for which the "major" source threshold is 100 tpy of any regulated pollutant.¹³ The major source threshold for facilities not on this "List of 28" is 250 tpy. As presented in Section 2.3, the primary function of Sebree Works is to produce primary aluminum from raw alumina. As such, Sebree Works is classified under SIC 3334 (Primary Production of Aluminum). This facility classification is included on the "List of 28" source categories. Thus, the major source threshold under the PSD program for the facility is 100 tpy of a regulated pollutant.

Since the potential emissions of at least one regulated air pollutant [e.g., SO₂] currently exceeds 100 tpy, Sebree Works is classified as an existing major source under the PSD program.

5.1.2 TITLE V PERMITTING PROGRAM

40 CFR Part 70 contains the regulations implementing the federal Title V operating permit program. Kentucky has incorporated the provisions of this federal program in its Title V operating program at 401 KAR 52:020. As specified in 401 KAR 52:001, Section 1(46), a major source with respect to the Title V regulations encompasses facilities with potential emissions of 100 tpy of any regulated pollutant, 10 tpy of any single HAP and/or 25 tpy of

¹¹ 401 KAR 51:010.

¹² 40 CFR 52.931.

¹³ 401 KAR 51:001, Section 1 (120)(a)(1)(b)

any combination of HAPs. Sebree Works is an existing major source and is currently operating under a Title V operating permit V-05-088 R1, issued March 26, 2008.

5.1.3 HAZARDOUS AIR POLLUTANT PROGRAMS

A major source of HAP is one with potential emissions in excess of 25 tpy for total HAPs and/or potential emissions in excess of 10 tpy for any individual HAP. As existing potential emissions of POM and total fluorides collectively exceed 25 tpy, Sebree Works is classified as an existing major source of HAPs.

5.2 PSD APPLICABILITY ASSESSMENT

As an existing major source under the PSD program, the emissions increases from the proposed production increase project were evaluated to determine whether PSD permitting requirements would apply and for which pollutants. The methodology for calculating the emissions increase associated with this proposed project, and the resulting values were discussed in Section 4 of the application. In Table 5-1 below, the emission increases calculated are compiled and compared against the PSD Significant Emission Rates.

TABLE 5-1. PROPOSED PROJECT EMISSIONS INCREASES COMPARED WITH PSD SIGNIFICANT EMISSION RATES

Pollutant ¹	Project Emissions Increase (tpy)	PSD Significant Emission Rate (tpy) ²	PSD Triggered?
SO ₂	2,001.9	40	Yes
CO	8,616.6	100	Yes
PM ₁₀	110.4	15	Yes
PM _{2.5} ³	84.1	10	Yes
NO _x	23.9	40	No
VOC	4.5	40	No
Fluorides	159.3	3	Yes

1. Only those regulated PSD pollutants for which quantifiable emissions increases are expected due to this project are listed.

2. 401 KAR 51:001, Section 1 (222)(a).

3. The SER for PM_{2.5} was recently established by EPA. (73 FR 28321, May 16, 2008)

As shown in Table 5-1, the potential emissions increases of SO₂, CO, PM₁₀, PM_{2.5}, and fluorides from the proposed project are greater than their respective PSD Significant Emission Rates, and thus creditable emission increases and decreases within a 5-year contemporaneous period are also evaluated. Potential emission increases of all other NSR regulated pollutants are well below their corresponding PSD Significant Emission Rates. Therefore, this permit action does not trigger PSD permitting requirements for these pollutants and no new emission limits are proposed or anticipated.

Pursuant to 401 KAR 51:001 Section 1 (146)(b)(2), the contemporaneous period begins 5 years prior to the anticipated start of construction and runs through the start of operations. The start of construction will depend on when the Proposed Permit is issued by KDAQ. For purposes of establishing the contemporaneous period, a start date of December 2009 is used. In this case, the

contemporaneous period would run from December 2004 through commencement of operation. RTA has conducted a review of all projects (i.e., physical changes or changes in the method of operation) completed within this period. Two projects for which a permit action was required occurred during the contemporaneous period. The first project involved the installation of a new electric induction furnace, the installation of a new baghouse to accommodate emissions from the new furnace, and the decommissioning of an electric arc furnace that was replaced by the new induction furnace. A complete air permit application for the electric induction furnace project was submitted on November 28, 2005 to KDAQ. As documented in the application package, the induction furnace (which uses only electrical power to supply heat to the furnace) is a source of particulate matter emissions. The second project completed within the contemporaneous emission period is the anode bake furnace refurbishment project discussed previously, for which a complete air permit application was submitted on August 9, 2007, and on which construction is ongoing. The anode bake furnace is a source of particulate matter, NO_x, SO₂, CO, and VOC emissions. The anode bake furnace project triggered PSD review for SO₂ and CO, and thus emissions of those pollutants are not creditable. The increase in PM₁₀ emissions from the anode bake furnace would be creditable. There are no creditable emission reductions in PM₁₀ in the period. Thus, there is no opportunity to net out of PSD review.

Since the emission increases of SO₂, CO, PM₁₀, PM_{2.5}, and fluorides from the project exceed the PSD Significant Emission Rates, PSD permitting requirements for these pollutants are addressed in this application.¹⁴ These include the completion of a Best Available Control Technology (BACT) analysis, which is presented in Section 6, and a PSD Air Quality Analysis and Additional Impacts Analysis, which are presented in Volume 2.

5.3 NATIONAL EMISSIONS STANDARDS FOR HAZARDOUS AIR POLLUTANTS

National Emission Standards for Hazardous Air Pollutants (NESHAPs), located in 40 CFR Part 63 are applicable to major sources of HAPs and certain designated area sources of HAPs. Emissions and operational limitations provided in the NESHAPs are established on the basis of a Maximum Achievable Control Technology (MACT) determination for a particular major source category.

The NESHAP for Primary Aluminum Reduction Plants, also referred to as the “PMACT” (40 CFR Part 63, Subpart LL) was proposed on September 26, 1996 and promulgated on October 7, 1997.¹⁵ As an existing major source of HAPs, certain existing affected sources at Sebree Works are regulated under the PMACT. 401 KAR 63:002 incorporates the PMACT by reference. Therefore, KDAQ retains the enforcement authority for this rule except for the provisions specified in 40 CFR 63.853(c). There are no other NESHAP from 40 CFR Part 63 that are potentially applicable to the proposed project.

Potlines 1, 2, and 3 are each classified as an existing “center-worked prebake one (CWPB1)” “potline” under § 63.842 as they were constructed prior to the date the PMACT regulations were proposed, use the prebake process, and are not defined as center-worked prebake two or three

¹⁴ 401 KAR 51:017 Section 1 (2) and (3)

¹⁵ 61 FR 50586, September 26, 1996; 62 FR 52407, October 7, 1997.

processes. Applicable emission limits for TF for existing CWPB1 potlines, as stated in § 63.843(a)(1), and other requirements, are already reflected in RTA's Title V permit.

Pursuant to § 63.5(b)(1), upon *reconstruction*, an affected source previously subject to the standards for existing sources becomes subject to the standards for new sources. As defined at § 63.2, the first qualifier in determining whether reconstruction has occurred is to determine whether the fixed capital cost of the new and/or replaced components of an affected source exceed 50 percent of the fixed capital cost that would be required to construct a comparable new source. RTA has evaluated whether the proposed installation of the new technology package on the existing pots would qualify as reconstruction under the PMACT. The estimated cost for this project is relatively small compared with the cost to build an entirely new aluminum plant equivalent to Sebree Works. Therefore, the project does not constitute reconstruction, as defined in the NESHAP, and the potlines will continue to be subject to the same emission limits for existing sources. As a result, the conditions in the current Title V permit applicable to the potlines that are derived from PMACT will not change.

5.4 NEW SOURCE PERFORMANCE STANDARDS (NSPS)

NSPS require new, modified, or reconstructed sources in applicable source categories to control emissions to the level achievable by the best demonstrated technology as specified in the applicable provisions. Any source subject to an NSPS is also subject to the general provisions of NSPS Subpart A, except as noted.

Applicability of a NSPS can generally be inferred by the industry or equipment classification designated in its title. The only NSPS that addresses sources related to the equipment associated with the proposed project is 40 CFR Part 60, Subpart S, *Standards of Performance for Primary Aluminum Reduction Plants*. Pursuant to § 63.840(c), an owner or operator of a potroom group subject to the applicability criteria of Subpart S in § 60.190 may elect to comply with the applicable provisions of the PMACT rather than Subpart S. RTA has chosen to utilize this compliance option, and therefore, the provisions of Subpart S are not applicable to the existing potlines or the potlines as modified. There are no other NSPS standards that are potentially applicable to equipment associated with the proposed project.

5.5 SIP AND TITLE V OPERATING PERMIT PROGRAM

Sebree Works is an existing major source under the Title V operating permit program. Pursuant to 401 KAR 52:020, Section 3, a major source shall not construct, reconstruct, or modify without a permit or permit revision, except as provided for administrative revisions, minor revisions, off-permit changes, or 502(b)(10) changes. Because the project is subject to PSD permitting requirements for SO₂, CO, PM₁₀, PM_{2.5}, and fluorides, the proposed project will require a "significant permit revision" in accordance with 401 KAR 52:020, Section 16. This application package provides information required under 401 KAR 52:020, Section 4 and 5 for this purpose. Completed DEP 7007 series application forms for the proposed project are provided in Appendix A of the application package.

5.6 COMPLIANCE ASSURANCE MONITORING (40 CFR PART 64)

Under 40 CFR Part 64, the Compliance Assurance Monitoring (CAM) regulations, facilities are required to prepare and submit monitoring plans for certain emission units with a Title V application. The CAM plans provide on-going and reasonable assurance of compliance with emission limits. The CAM regulations apply to a pollutant-specific emissions unit (PSEU), as defined in 40 CFR Part 64.1, at a major Title V source if the PSEU is subject to an emission limitation, uses a control device as defined in § 64.1 to comply with that emission limitation, and has a potential to emit before controls equal to or greater than a Title V major source threshold.

The potlines are currently subject to the following emission limits: the combined SO₂ cap of 5,262 tpy (12-month rolling average) the potlines and bake furnace, the potline PMACT limits for total fluorides, and the process weight rule PM emission limit (401 KAR 59:010). Following implementation of the proposed project, the potlines will also be subject to new BACT limits for SO₂, PM₁₀, CO, and fluorides. Since the A-398 scrubbers are not regulated as control devices for SO₂, no CAM plans will be required for SO₂. The A-398 scrubbers are control devices for PM/PM₁₀/PM_{2.5} and fluorides. However, emission standards proposed and promulgated by EPA after November 15, 1990 pursuant to section 111 or 112 of the Clean Air Act are exempt from the requirements of the CAM rule.¹⁶ Thus, a CAM plan is not required for fluorides. With respect to PM/PM₁₀/PM_{2.5}, the post-controlled emissions for each potline A-398 scrubber are less than 100 tpy and each potline is thus classified under the CAM rules as a “small” PSEU for PM/PM₁₀/PM_{2.5}. Pursuant to 40 CFR Part 64.5(b), a CAM plan is not required for small PSEUs until the renewal of a Title V operating permit. Based on this analysis, no CAM plans were prepared or are included with this application package.

5.7 KENTUCKY SIP REGULATIONS

Emissions from modified equipment associated with the proposed project are also potentially subject to Kentucky Administrative Regulations (401 KAR). Applicability to selected SIP regulations worth noting is discussed in the following subsections.

5.7.1 401 KAR 50:012 – GENERAL APPLICATION

Pursuant to 401 KAR 50:012, Section 1(2), all major air contaminant sources shall as a minimum apply control procedures that are reasonable, available, and practical, in the absence of a standard specified in Kentucky’s Administrative Regulations. Sebree Works is a major air pollution source for Title V purposes. However, the modified potlines and the A-398 scrubbers are subject to 401 KAR 59:010 (PM), 63:002 (fluorides), and 51:017 (SO₂, PM₁₀, CO, and fluorides). Therefore, the provisions of 50:012 would not apply for these pollutants. With respect to NO_x and VOC, the potlines are relatively small sources of emissions. In the existing Title V permit, KDAQ has not identified 50:012 as an applicable requirement for the potlines.

¹⁶ 40 CFR Part 64.2 (b)(1)(i)

5.7.2 401 KAR 53:010 – KENTUCKY AMBIENT STANDARDS FOR FLUORIDES

401 KAR 53:010 establishes ambient air quality standards for hydrogen fluoride (HF) and total fluorides for the state of Kentucky. Total fluoride standards are expressed as a dry weight measure of fluoride ion in and on forage for consumption by grazing ruminants. Concentrations are assessed on a one month, two month, and growing season average basis. Gaseous fluoride standards are expressed as ambient concentration limits of HF for both short-term and annual averaging periods. The fluoride standards apply generally to all sources, but typically are only addressed in applications from sources with expected or measurable fluoride emissions. The regulatory text in 53:010 does not specify when or how a source has to evaluate compliance with the ambient standards for fluorides.

Based on past ambient monitoring measurements, air concentrations of gaseous HF and total fluorides in the area surrounding Sebree Works are less than the ambient air quality standards for HF and total fluorides. The points presented below provide basis for concluding that no additional compliance demonstration actions are necessary as a result of the proposed potline production increase project. Accordingly, in the PSD air quality modeling protocol submitted on February 17, 2009, RTA indicated that a modeling analysis to assess compliance with the ambient fluoride standards would not be completed for this permit action.

1. As required by condition B.1.d for the three potlines in the current Title V permit for Sebree Works, RTA conducts ambient monitoring for gaseous fluorides at a station located 2.2 miles North-Northeast (at a heading of 9 degrees) of the facility. The station utilizes a RAC Dual Tape Sampler to collect two consecutive 12-hour block samples weekly (expressed in $\mu\text{g}/\text{m}^3$ of gaseous fluorides as HF). The day of the week during which the samples are taken varies from week to week (i.e., 1st week on Monday, 2nd week on Tuesday, etc.). The 12-hour concentrations are evaluated against the 12-hour secondary standard. The two 12-hour block average concentrations are then averaged to determine the 24-hour concentration which is compared to the primary and secondary 24-hour standards. Due to the low monitored gaseous fluoride concentrations for the short term averaging periods, compliance with the long term averages (weekly, monthly, and annual) is evaluated using the short term average results. No exceedances of either the primary or secondary AAQS for gaseous fluorides occurred in 2008, and the highest single 12-hour measured concentration of $0.215 \mu\text{g}/\text{m}^3$ represents only 5.8% of the secondary 12-hour standard. Results of gaseous fluoride ambient monitoring have been and will continue to be submitted to the KDAQ Owensboro Regional Office on a quarterly basis.
2. While it is not required in the current Title V permit for Sebree Works, RTA previously conducted monthly vegetation analyses for total fluorides. Vegetation samples were taken monthly during the growing season (April-September) at eight locations surrounding Sebree Works. The type of vegetation chosen to be representative for monitoring was fescue, a genus of tufted perennial grasses that is the most common forage consumed by livestock in the area. Results of vegetation analyses over the period during which monitoring was conducted showed no exceedances of the secondary AAQS.

3. Previous fluoride modeling analyses completed using the Industrial Source Complex (ISC) dispersion model as part of a permitting project initiated in 2000 (that was later abandoned) showed impacts that were well below the primary and secondary AAQS for fluoride for all averaging periods.

5.7.3 401 KAR 61:165 – EXISTING PRIMARY ALUMINUM REDUCTION PLANTS

Pursuant to 401 KAR 61:165, Section 1(1), this regulation applies to each potroom group within a primary aluminum reduction plant for which operation commenced before the classification date of October 23, 1974. At Sebree Works, Potlines 1 and 2 commenced operation before this date, but Potline 3 after. Therefore, the requirements of this regulation apply only to Potlines 1 and 2.

The majority of the requirements in this subpart are also contained in NESHAP Subpart LL. One notable exception is the allowance in 401 KAR 61:165, Section 3(2) for opacity up to 40 percent from potroom roof monitor sections directly above sick cells or start-up cells. Conditions derived from 401 KAR 61:165 are already included in the potlines section of Section B of RTA's current Title V permit and will not require any changes due to the proposed project..

5.7.4 401 KAR 63:010 – FUGITIVE EMISSIONS

Vehicle movement on paved and unpaved roads at Sebree Works has the potential to generate fugitive PM emissions that are regulated under 401 KAR 63:010. 401 KAR 63:010 is a generally applicable standard that requires reasonable precautions to prevent airborne PM emissions. Various reasonable precautions are provided in the regulation. In addition, the rule states that no visible fugitive dust emissions will be discharged beyond the property line.

5.7.5 401 KAR 63:020 – POTENTIALLY HAZARDOUS MATTER OR TOXIC SUBSTANCES

Kentucky regulates the emissions of toxic air pollutant emissions through 401 KAR 63:020. KDAQ can require that dispersion modeling or other analyses be completed by facilities constructing or modifying equipment when there is an increase in air toxic pollutant emissions, as defined in 401 KAR 63:020 Section 2 (2), deemed to be significant. This is done so that there is a documented basis for affirming that a facility does not cause an adverse impact. However, pursuant to 401 KAR 63:020, Section 1, the requirements of this rule are applicable only to the extent that such emissions are not elsewhere subject to the provisions of the Kentucky Administrative Regulations. The toxic air pollutant emissions from the proposed project will be subject to the requirements the PMACT. 401 KAR 63:002 Section 3 (1)(ee) incorporates the PMACT by reference. Since the toxic air pollutant emissions are already regulated under this rule, no additional requirements under 401 KAR 63:020 will apply to this permit action.

6.1 SCOPE OF BACT REQUIREMENTS

Pursuant to 401 KAR 51.017 Section 8, a major modification to an existing PSD major source shall apply Best Available Control Technology (BACT). Kentucky's PSD regulations define BACT as:¹⁷

“an emissions limitation, including a visible emission standard, based on the maximum degree of reduction for each regulated NSR pollutant that will be emitted from a proposed major stationary source or major modification that:

- (a) Is determined by the cabinet on a case-by-case basis after taking into account energy, environmental, and economic impacts and other costs, to be achievable by the source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of that pollutant;*
- (b) Does not result in emissions of a pollutant that would exceed the emissions allowed by an applicable standard of 40 C.F.R. Parts 60 and 61; and*
- (c) Is satisfied by a design, equipment, work practice, or operational standard or combination of standards approved by the cabinet, if:*
 - 1. The cabinet determines technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible;*
 - 2. The standard establishes the emissions reduction achievable by implementation of the design, equipment, work practice or operation; and*
 - 3. The standard provides for compliance by means that achieve equivalent results.”*

In accordance with Kentucky's PSD regulations, BACT is determined on a pollutant-by-pollutant basis and covers new or physically modified emission units of a project that have net emission increases of the pollutants for which there is a significant net emission increase. The only new or physically modified emission units for the project covered by this permit application are the three existing potlines, which are identified as Potlines 1, 2, and 3 in the facility's current Title V permit. As noted in Section 5.2, this project triggers PSD permitting requirements for SO₂, PM₁₀, PM_{2.5}, CO, and fluorides. Thus, a “top-down” BACT analysis presented in Sections 6.3, 6.4, and 6.5 of the application, respectively, that addresses SO₂, PM₁₀/PM_{2.5} and fluorides, and CO for the potlines.

¹⁷ 401 KAR 51:017 Section 1 (25).

6.2 BACT DETERMINATION METHODOLOGY

Consistent with KDAQ's implementation of the BACT requirements under 401 KAR 51:017, BACT for the potlines has been evaluated via a "top-down" approach. U.S. EPA also has previously stated its preference for a top-down analysis in a 1987 policy memorandum.¹⁸ Under the top-down approach, the most stringent control available for a similar or identical source or source category is identified. If this level of control is determined to be technically or economically infeasible or poses other adverse environmental or energy concerns, then the next most stringent level of control is evaluated. This process continues until the BACT level under consideration cannot be eliminated. Accordingly, the five basic steps of a top-down BACT review procedure, as identified by U.S. EPA in the March 15, 1990, *Draft BACT Guidelines*, are as follows:¹⁹

BACT STEP 1 - IDENTIFY ALL CONTROL TECHNOLOGIES

Available control technologies are identified for each emission unit in question. The following methods are typically used to identify potential technologies: 1) research of the Reasonably Available Control Technology (RACT)/Best Available Control Technology (BACT)/Lowest Achievable Emission Reduction (LAER) Clearinghouse (RBLC) database, 2) survey of regulatory agencies and drawing precedent from other similar BACT analyses, 3) drawing from previous engineering experience, 4) survey of air pollution control equipment vendors, and/or 5) survey of available literature.

BACT STEP 2 - ELIMINATE TECHNICALLY INFEASIBLE OPTIONS

After the identification of control options, an analysis is conducted to eliminate technically infeasible options. A control option is eliminated from consideration if there are process-specific conditions that prohibit the implementation of the control or if the control efficiency of the option would result in an emission level that is higher than any applicable regulatory limits, such as an NSPS.

BACT STEP 3 - RANK REMAINING CONTROL TECHNOLOGIES BY CONTROL EFFECTIVENESS

Once technically infeasible options are removed from consideration, the remaining options are ranked based on their control effectiveness. If there is only one remaining option, or if all of the remaining technologies could achieve equivalent control efficiencies, ranking based on control efficiency is not required.

¹⁸ U.S. EPA, Office of Air and Radiation, Memorandum from J.C. Potter to the Regional Administrators. Washington, D.C. December 1, 1987.

¹⁹ Office of Air Quality Planning and Standards, *New Source Review Workshop Manual*, October 1990 (Draft), Section B.

BACT STEP 4 - EVALUATE MOST EFFECTIVE CONTROLS AND DOCUMENT RESULTS

In Step 4, an economic, energy, and environmental impact evaluation is performed, if necessary, beginning with the most efficient control option in the ranking and then proceeding, if necessary, to each lower ranking option. Once a control option is reached that is determined to be economically feasible without adverse energy or environmental impacts, it is selected as BACT and it is not necessary to evaluate the remaining options with lower control efficiencies. If the most efficient control option deemed to be technically feasible in Step 3 is directly chosen as BACT, no economic feasibility analysis is required.

The economic evaluation centers on the cost effectiveness of the control option. Costs of installing and operating control technologies are estimated and annualized following the methodologies outlined in the EPA's *OAQPS Control Cost Manual (CCM)*²⁰ and other industry resources. Cost effectiveness is expressed in dollars per ton of pollutant controlled. Objective analyses of energy and environmental impacts associated with each option are also conducted. Both beneficial and adverse impacts are discussed and quantified.

BACT STEP 5 - SELECT BACT

In the final step, one pollutant specific control option is proposed as BACT for each emission unit under review based on evaluations from the previous step.

Although the first four steps of the top-down BACT process involve the technical and economic evaluation of potential controls (i.e., defining the appropriate technology), the selection of BACT in the fifth step involves an evaluation of emission rates achievable. This is because BACT is normally enforced as an emission limit unless technological or economic limitations would make the imposition of an emissions standard infeasible, in which case a work practice or operating standard can be imposed.

6.3 TOP-DOWN BACT FOR SULFUR DIOXIDE (SO₂)

6.3.1 POTLINES SO₂ EMISSIONS CHARACTERISTICS

Most of the SO₂ emissions in an aluminum smelter typically come from the electrolysis process and are related to anode consumption. The use of petroleum coke, which contains sulfur, in the generation of anodes is the primary cause of these emissions. The coke used by aluminum smelters is purchased from the refining industry, for which coke is a waste product. The refining industry tends to optimize the process in order to produce fuels of higher added value (with a low sulfur content), such as gasoline. This tendency increases the sulfur content in the waste product of the refining process, coke, which aluminum smelters use. Indeed, the sulfur content of the coke supplied to the aluminum industry has been on the rise for the past few years.

²⁰ U.S. EPA, Office of Air Quality Planning and Standards. *OAQPS Control Cost Manual*, 6th edition. EPA 452/B-02-001. Research Triangle Park, NC. January 2002.

The exhaust characteristics of potline gases make application of SO₂ control strategies typically used on other types of combustion systems a challenge. First, due to the large volume of exhaust gas generated from the electrolytic process, the relative concentration of SO₂ in the exhaust gas (as compared to other types of industrial and utility combustion processes) is low. The SO₂ concentration in a potline dry scrubber exhaust stream typically ranges from 100 to 135 ppm. At lower concentrations, the mass transfer of SO₂ to a sorbent (in the case of a scrubber/adsorption type of control) is lower, resulting in reduced efficiencies at available residence times. The exhaust temperature downstream of the existing A-398 scrubbers is also relatively low (< 220 °F), which makes application of many dry and semi-dry scrubbing technologies infeasible. In general, the presence of other contaminants and impurities in the exhaust stream (fluorides) requires that any control option for SO₂ work in conjunction with the existing dry alumina scrubbing system.

6.3.2 STEP 1: IDENTIFICATION OF POTENTIAL SO₂ CONTROL OPTIONS

The first of the five steps in a top-down BACT analysis is to identify potentially applicable control technologies for each pollutant. Potentially applicable emission control technologies for the potlines were identified in part by researching U.S. EPA sponsored control technology databases, technical literature, and control equipment vendor information. In addition, a review of existing control technologies in place at other U.S. primary aluminum plants was completed. Options for controlling SO₂ from the potlines consist of both post-process (i.e., “add-on” controls) and pollution prevention methods. The process used in identifying potential control options to evaluate as BACT is discussed in the following subsections.

6.3.2.1 PRIOR SO₂ CONTROL TECHNOLOGY DETERMINATIONS

The Reasonably Available Control Technology (RACT)/BACT/Lowest Achievable Emission Rate (LAER) Clearinghouse (RBLC), a database made available to the public through the U.S. EPA’s Office of Air Quality Planning and Standards (OAQPS) Technology Transfer Network (TTN) website, lists technologies that have been approved in PSD permits as BACT for numerous types of process units.²¹ As part of U.S. EPA’s Clean Air Technology Center, the Research Triangle Institute’s New and Emerging Environmental Technologies (NEET) database also provides information on a larger set of technologies that control air pollution from stationary, mobile, and indoor sources.²² These websites were reviewed to help identify technologies that are commercially available for aluminum reduction potlines and that have been deemed as BACT for other facilities.

The RBLC database was queried for all entries under process code 82.110, which covers primary aluminum operations. The date range was not limited,

²¹ <http://www.epa.gov/ttn/catc/>

²² <http://neet.rti.org/>

and thus covered all data in the RBLC, going back over 30 years. From this query, all records for potlines with SO₂ determinations were extracted. The results are summarized in Table 6-1. A separate query was also performed for the keyword “potline” to capture any entries for potlines that may have been listed under a different process code. However, no additional and relevant entries were identified from this search.

TABLE 6-1. SUMMARY OF SO₂ DETERMINATIONS IN THE RBLC FOR POTLINES

RBLC ID/ Company	Permit Date	Production Rate	BACT Determination	SO₂ Emission Limits
KY-0070 NSA (now Century Aluminum)* Hawesville, KY	1998	66,000 ton aluminum/yr	3% sulfur content in coke and potline control efficiency of 93%	Potline 5 stack: 25.51 lb/hr Potline 5 roof vent: 7.44 lb/hr
SC-0037 Alumax of South Carolina (now Alcoa - Mt. Holley) Goose Creek, SC	1995	234,274 ton aluminum/yr	Limitation on sulfur content in anode coke (2.95%) and anode pitch (1.2%).	4 Potroom Groups: 271 lb/hr each and 1,171 tpy each
KY-0041 Arco Metals Co. (now Rio Tinto Alcan) Sebree Kentucky	1983	72,884 ton aluminum/yr	Low sulfur coke and pitch	388 lb/hr and 1,700 tpy
WA-0003 Alcoa, Inc. Washington	1982	125,560 ton aluminum/yr	Low sulfur content in coke	3% sulfur in coke and 46 lb/ton aluminum
NC-0003 Alcoa – Badin** Badin, NC	1981	54,500 ton aluminum/yr	Undefined	321 lb/hr

* The RBLC lists operation of a wet scrubber system as BACT for SO₂ for the NSA Potline 5; however, the permit issued by KDAQ in 1998 did not list operation of the wet scrubber system as BACT for SO₂. Therefore, a wet scrubber was never required as BACT for Potline 5.

** This facility is either no longer in operation or no longer has primary aluminum operations.

As shown in Table 6-1, the most recent entry in the RBLC database for potlines is from 1998. As evidenced from this list, no post-process control technologies are listed in the RBLC as BACT for potlines.²³ In all cases, BACT for SO₂ from potlines was determined to be the use of raw materials (pitch and/or petroleum coke) with the lowest sulfur content economically available.

Alcoa reached a similar conclusion in conducting a SO₂ and CO control technology analysis for their primary aluminum plant in Massena, New York in

²³ A wet scrubber is listed for SO₂ control for Potline 5 at the NSA facility in Hawesville, Kentucky in the RBLC. However, the requirement to operate the wet scrubber at this facility for SO₂ was later removed and the initial wet scrubber requirement was not a BACT decision, but was based on a need to reduce nearby modeled SO₂ impacts.

2001. (This analysis was conducted pursuant to state SIP rules, and was not associated with a PSD permit action.) In the executive summary of their report, they state that,²⁴

“An extensive search of the BACT/RACT clearinghouse was conducted to review previous determinations for these pollutants from the Primary Aluminum sector. The search revealed that no control technology had been selected as BACT for sulfur dioxide and no determinations had been made for CO or COS from Primary Aluminum. The clearinghouse did, however, identify the use of low sulfur coke (3%) as BACT for Primary Aluminum.”

The RBLC database is the primary public source of information that an applicant can access to inventory control technology determinations across the United States. There are control technology determination databases maintained by select states such as California, Texas, and New Jersey as well. A search of the Texas Commission on Environmental Quality’s BACT resources revealed no determinations of relevance for potlines.²⁵ (There is one primary aluminum facility located in Texas – Alcoa Rockdale). Searches of the other state databases were not performed as there are no primary aluminum facilities in those states.

The absence of any control technology determinations in the RBLC for potlines suggests that there are no commercially available or viable technologies approved/recognized by USEPA for controlling SO₂ from potlines.

6.3.2.2 NEW SOURCE PERFORMANCE STANDARDS

A BACT determination cannot result in emissions of a pollutant that would exceed the emissions allowed by an applicable New Source Performance Standard (NSPS) in 40 CFR Part 60.²⁶ Thus, the applicable NSPS for Primary Aluminum Reduction Plants, Subpart S of 40 CFR Part 60, must be reviewed to define the minimum level of control that would constitute BACT for SO₂. The NSPS is also reviewed to identify potential control technologies that would qualify as BACT.

The NSPS for primary aluminum reduction plants was originally promulgated in 1976 and has been amended twice in 1980 and 1989.²⁷ Subpart S limits

²⁴ Alcoa, Inc., “Part 212 Potroom and Baking Furnace BACT Analysis– SO₂, COS, CO”, Submitted to the New York State Department of Environmental Conservation on July 5, 2001.

²⁵ www.tceq.state.tx.us/permitting/air/nav/bact_index.html

²⁶ 401 KAR 51:001 Section 1 (25).

²⁷ 41 FR 3826, January 26, 1976; 45 FR 44202, June 30, 1980; 54 FR 6669, February 14, 1989

emissions of gaseous and particulate fluorides, measured as total fluorides (TF), from all potroom groups and anode bake furnaces constructed, modified, or reconstructed after October 23, 1974. However, U.S. EPA chose not to establish an emission standard for SO₂ or CO under Subpart S.

By definition, the NSPS represent,

*“the emissions of air pollutants that reflect the degree of emission limitation achievable through the application of the best system of emissions reduction which (taking into account the cost of achieving such reduction and any non-air quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated.”*²⁸

The basis of the NSPS is similar to BACT. The fact that U.S. EPA has not established SO₂ standards under Subpart S suggests that, at least at the time the NSPS was last reviewed, there was no demonstrated system of emissions reduction that was achievable. The Clean Air Act requires that NSPS be reviewed at least every eight years.²⁹ However, the last full review of Subpart S appears to have been completed in 1986.³⁰ According to Dr. Donna Lee Jones of U.S. EPA, as of 2007, the agency had not developed a schedule for reviewing NSPS Subpart S.³¹ The on-going lack of interest by U.S. EPA in evaluating or reconsidering changes to Subpart S may reflect the fact that conclusions of the review would be the same.

6.3.2.3 REVIEW OF SO₂ CONTROL TECHNOLOGIES IN PLACE AT PRIMARY ALUMINUM PLANTS IN THE U.S.

At the time the U.S. EPA was developing the NESHAP for primary aluminum plants in 1996, there were a total of 23 primary aluminum plants located in 14 States.³² Based on data available online, there are now only 20 primary aluminum plants remaining with operation capability in the United States.³³

²⁸ 42 USC 7411, Section 111(a)(1).

²⁹ 42 USC 7411, Section 111(b)(1)(b).

³⁰ U.S. EPA, “Review of New Source Performance Standards for Primary Aluminum Reduction Plants”, Report No. EPA-450/3-86-010, September 1986.

³¹ Email correspondence from Dr. Donna Lee Jones (U.S. EPA) to Ms. Wendy Merz (Trinity Consultants), July 10, 2007.

³² U.S. EPA, Office of Air Quality Planning and Standards, “Basis and Purpose for the Development of Proposed Standards for the Primary Aluminum Industry”, July 19, 1996, pg. 4.

³³ www.altech.is/index.php/id/1827.

These plants can be further classified into two process types—prebake or Söderberg. Approximately 15 of the 20 plants currently with operation capability, including RTA’s Sebree Works, use the prebake process. Pots at prebake plants use anodes that are formed and baked prior to consumption in the pots, while the Söderberg pots use a single, continuous anode that is shaped and baked in place directly in the pot.³⁴

The publicly available permit files for all of the pre-bake facilities inventoried were researched in attempt to survey control technologies in place for SO₂ on potlines, and thereby help define the list of technologies that should be included in this BACT analysis. For a select number of facilities for which it was determined that control technology reviews may have been completed, either as part of PSD permit actions or to comply with state SIP rules, copies of air permit applications and permit files were also obtained and reviewed.

The review of data obtained on the primary aluminum plants in the United States confirmed that the majority of potlines in the U.S. are equipped with dry scrubbers and SO₂ emission control is achieved using raw material management. The dry scrubbers with which many potlines are equipped are designed to control emissions of TF. This is consistent with the information obtained by U.S. EPA in the development of the NESHAP for Primary Aluminum (40 CFR § 63, Subpart LL).³⁵ Six facilities have been identified that are currently or were previously equipped with wet scrubbers, however. These scrubbers were designed for fluoride or PM control, however; not SO₂ control. Two of these facilities (Columbia Aluminum and Northwest Aluminum) are no longer in operation and a third facility (Century Aluminum) does not operate its wet scrubber for SO₂ control. Table 6-2 below reports all U.S. aluminum smelters reviewed for this analysis. (Note that all facilities listed that are equipped with a wet scrubber employ sodium-based scrubbing technology.)

³⁴ U.S. EPA, Office of Air Quality Planning and Standards, “Primary Aluminum Industry: Technical Support Document for Proposed MACT Standards”, July 1996, Section 2.3.

³⁵ Ibid.

TABLE 6-2. SUMMARY OF OTHER FACILITY CONTROL TECHNOLOGIES

Company	Date	Type of Determination	Determination	Potline Type
Alcoa, Inc. Blount County, TN	2007	BART	3% sulfur content in coke	Prebake
Alcoa, Inc. Rockdale, TX	TBD ^a	BACT	3% sulfur content in coke ^b	Prebake
Noranda Aluminum New Madrid, MO	TBD ^c	BACT	Raw material management	Prebake
Century Aluminum Hawesville, KY	TBD ^d	BACT	Management of raw materials	Prebake
Alcoa, Inc.- East Facility Massena, NY	2002	State BACT	Existing wet scrubbers ^e	HSS
Alcoa, Inc. – West Facility Massena, NY	2002	State BACT	2.5% sulfur content in coke	Prebake
Columbia Aluminum (aka Goldendale Aluminum) Goldendale, WA	1985	BACT	Wet scrubbers – Facility is no longer in operation	Prebake and VSS
Northwest Aluminum The Dallas, OR	1977	BACT	Wet scrubbers – Facility is no longer in operation	VSS

- a. The BACT analysis submitted for this facility stated that raw material management constituted BACT for the existing potlines. However, the BACT analysis was never approved for the facility and the PSD permit application was withdrawn by Alcoa because the facility was idled.
- b. The facility operated a wet scrubber on one of its existing potlines. However, the main purpose of this wet scrubber is to achieve control of fluoride and PM, rather than control of SO₂.
- c. PSD application submitted to Missouri DNR in September 2008.
- d. PSD application submitted to KDAQ by Century Aluminum in July 2008 with addendums submitted on October 17, 2008 and November 24, 2008. This project will involve the modification of Potlines 1 – 4.
- e. This facility operates wet scrubbers on its existing potlines. However, the main purpose of these wet scrubbers is to achieve control of fluoride and PM, rather than control of SO₂. In 1995, this facility underwent a modernization project and installed dry alumina scrubbers with baghouses; however, they maintained their existing wet scrubbers.

6.3.2.4 BAT DETERMINATIONS IN EUROPE

The European Commission publishes a series of documents covering the Best Available Techniques (BAT) for various industry sectors.³⁶ These “BREFs”, or Best Available Techniques Reference Documents, provide a basis for permitting certain categories of industrial installations in Europe. The term “best available technique” means,³⁷

“the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit

³⁶ <http://ec.europa.eu/environment/ippc/index.htm>

³⁷ European Commission, Integrated Pollution Prevention and Control, “Reference Document on Best Available Techniques in the Non Ferrous Metals Industries”, December 2001, Preface Section 2.

values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole.”

BAT takes into account the costs and benefits of a measure, similar to the approach for defining BACT in the U.S. The *Reference Document on Best Available Techniques in the Non Ferrous Metals Industries* reviews BAT for processes producing aluminum from primary raw materials. For primary aluminum smelters, the only BAT defined for SO₂ is the use of low sulfur carbon for anodes. It is also recognized that Scandinavian aluminum smelters remove SO₂ with seawater wet scrubbers located after potline dry scrubbers without defining this technique as BAT.

6.3.2.5 INFORMATION FROM PROSPECTIVE SO₂ CONTROL SYSTEMS SUPPLIERS AND OTHER INFORMATION RESOURCES

To further evaluate potential BACT qualifying control technologies, information was sought from several key vendors of engineering services to the primary metals industries and other established vendors of air pollution control systems, such as SO₂ wet scrubbing systems, in the United States. Vendors researched and/or contacted in regard to this analysis included the following:

Key Primary Aluminum Industry Vendors:

- ▲ Fives Solios; www.fivesgroup.com
- ▲ Alstom Environmental Control Systems; www.environment.power.alstom.com
- ▲ Danieli Corus; www.danieli-corus.com
- ▲ Cansolv Technologies, Inc.; www.cansolv.com
- ▲ Worley Parsons.; www.worleyparsons.com

Other Air Pollution Control Equipment Vendors Reviewed:

- ▲ Ducon Technologies, Inc.; www.ducon.com
- ▲ Clean Gas Systems, Inc.; www.cgscgs.com
- ▲ Airpol, Inc.; www.airpol.com

Both Fives Solios (formerly Procedair) and Danieli Corus are two principle vendors to the primary aluminum industry, offering a variety of engineering and pollution control solutions to plants worldwide. Currently, there is no single optimal solution that applies to all plants.

A description of each of the potential SO₂ control technologies identified is found in Appendix D, which contains an extract from a 2008 report prepared by

SNC Lavalin on behalf of Environment Canada.³⁸ The information on the various control technologies was provided by the suppliers of SO₂ scrubbing technology, namely the companies Alstom, Envitech, Marsulex, MECS, Solios, and Cansolv.

6.3.2.6 SUMMARY OF CONTROL OPERATIONS EVALUATED FOR SO₂ BACT

Based on the review of prior BACT determinations, the survey of existing primary aluminum plants, and research of solutions from prospective equipment suppliers and other information sources, the following potential SO₂ control options have been identified for evaluation as part of this BACT.

- ▲ **Management of Raw Materials and Process.** This control option is a pollution prevention method. It involves efforts to procure raw material constituents (e.g., petroleum coke, pitch, and packing coke) with the lowest sulfur content possible, taking into consideration what supplies are consistently available, possess the right quality characteristics, and are economically feasible. Low sulfur content in anodes minimizes SO₂ emissions from potlines during the electrolytic process (anode consumption).
- ▲ **Wet Scrubbing Technologies.** In 2000, the Aluminum Association of Canada issued a technical report evaluating potential SO₂ control technologies for primary aluminum plants and in 2008 SNC Lavalin was mandated the same work but by Environment Canada.³⁹ (See Appendix D for an excerpt from this report.) These reports identified four commercially available wet scrubbing technologies that had potential application to primary aluminum plant processes: sea water, sodium, sodium/calcium dual alkali, and calcium (lime and limestone). In a March 2007 report evaluating potential SO₂ control options as part of a Best Available Retrofit Technology (BART) determination, Alcoa evaluated additional variations of these same technologies.
- ▲ **Dry and Semi-Dry Scrubbing Technologies.** The potlines are currently equipped with a dry scrubber. Use of an additional dry scrubber or semi-dry scrubbing systems (e.g., spray dryer) to provide SO₂ control is also evaluated.

³⁸ Environment Canada, Report 605311, section 3 “Assessment of technologies for the prevention and control of SO₂ emissions”.

³⁹ Aluminum Association of Canada, Section 4 of Final Report issued December 2000, “SO₂ Scrubbing Technologies”.

6.3.3 STEP 2: TECHNICAL FEASIBILITY OF POTENTIAL SO₂ CONTROL OPTIONS

Consistent with U.S. EPA's top-down approach, the control technologies are first evaluated in terms of their technical feasibility. Those options that are deemed to be technically feasible are then ranked in order of decreasing emission reduction potential and are evaluated further in that order.

6.3.3.1 DRY SCRUBBING TECHNOLOGIES

Dry scrubbing is the most common type of pollution control technology applied to potlines for fluorides emissions abatement. Generally, raw pot gases are sent through a dry scrubber where alumina is used as the sorbent to remove the gaseous fluoride and fine particles.⁴⁰ This type of dry scrubbing system does not provide meaningful amounts of SO₂ control.⁴¹ Further, what little SO₂ may be adsorbed on the alumina is only then released at the potlines by the recirculation process, and thus the SO₂ is not truly "controlled".

The traditional type of dry scrubbing technology commonly applied to industrial combustion systems for SO₂ control specifically utilizes limestone as the sorbent. The absorption of SO₂ on the calcium carbonate aerosols requires an elevated temperature. Thus, the injection of limestone is typically done near the discharge of the combustion system (e.g., a boiler). The limestone injected is then captured in an electrostatic precipitator or baghouse system located downstream of the injection point. SO₂ removal efficiencies from pure dry scrubbing systems, approximately 55% for calcium based sorbents, are generally less than can be achieved in wet systems.⁴²

Based on a review of the literature, dry scrubbing systems commonly used on power plants and industrial boilers cannot be applied to control SO₂ for primary aluminum smelters for the following reasons:

- ▲ Compared to large combustion systems used for steam or power generation, the SO₂ concentrations in the exhaust gas from potlines are very low, typically less than 150 ppm, compared to concentrations greater than 2,000 ppm for a boiler exhaust gas. Suitable removal efficiencies cannot be obtained at this low concentration.

⁴⁰ Solios Environnement, Inc., "History of the Development of Dry Scrubbing Technology for Aluminum Smelters", June 25, 2003.

⁴¹ Although SO₂ can react with and attach to alumina particles, alumina has a much higher affinity for fluoride. It is generally accepted in the primary aluminum industry that under its normal design operating conditions, in which the dry alumina feed rate is optimized for fluoride control, a dry alumina scrubber provides little SO₂ control.

⁴² U.S. EPA Clean Air Technology Center, "Flue Gas Desulfurization (FGD) – Wet, Spray, and Dry Scrubbers", EPA-452/F-03-034, July 15, 2003.

- ▲ The exhaust gas temperature from potlines is too low to facilitate use of direct injection of limestone because it is below the absorption reaction temperature. The temperature at the outlet of the A-398 scrubber is less than 250°F, which is below the absorption reaction temperature.

There are no known applications of dry scrubbing technology (for SO₂ control) on any primary aluminum smelters in the United States. Even for larger utility applications, dry scrubbing systems are rarely used and based on a study by U.S. EPA, only 3% of the flue-gas desulfurization systems in the United States are dry systems.⁴³ Given its technical infeasibility and the supporting fact that there are no commercially available dry scrubbing systems (for SO₂) available for the primary aluminum industry, this technology is eliminated from further consideration for BACT.

6.3.3.2 SEMI-DRY SCRUBBING TECHNOLOGIES (SPRAY DRYER/ABSORBER)

Another form of scrubbing technology is a spray dryer, in which a lime based slurry is injected into an exhaust stream in lieu of a dry limestone powder. For example, a slurry of calcium hydroxide [Ca(OH)₂] can be mixed with dilution water and then can be atomized into the exhaust stream to be treated. The SO₂ is absorbed by the atomized slurry droplets, which dry simultaneous to the absorption reaction. The SO₂ reacts with the calcium hydroxide to form calcium sulfite (CaSO₃·½H₂O), some of which can be further oxidized to calcium sulfate (CaSO₄·2H₂O).

For a spray dryer to work as designed, this process requires a relatively high gas temperature and sufficient residence time to ensure the wet spray can be completely dried before the particulate is captured in a downstream ESP or baghouse. SO₂ control efficiencies achievable in spray dryer type scrubbing systems generally range from 80-90%, depending on the inlet conditions.⁴⁴

Application of a spray dryer is not technically feasible since the temperature at the outlet of the A-398 scrubber is less than 250°F. At this temperature, it would not be possible to complete the drying of the limestone slurry.

6.3.3.3 WET SCRUBBING TECHNOLOGIES

Wet scrubbing technologies have been widely applied in the utility and industrial boiler sectors to control SO₂ emissions. In a wet scrubber, the exhaust gas is saturated with water, through direct contact with an open spray, or through contact in a packed bed or tray design. Absorption of SO₂ into the alkaline liquid occurs. A portion of the scrubbing liquid is recirculated with the

⁴³ Ibid.

⁴⁴ Ibid.

balance being purged to a wastewater treatment system. Reagent addition to the scrubbing liquid is generally done to maintain the pH within a desired range of alkalinity.

Common applications of wet scrubbing technologies involve treatment of exhaust streams with relatively high SO₂ concentrations of around 500-3000 ppm. At high inlet SO₂ concentrations, removal efficiencies in a wet scrubbing system can be as high as 95%.⁴⁵ This SO₂ removal efficiency however is a strong function of the difference in SO₂ concentration between the gas phase and liquid phase. In potline exhaust streams, the SO₂ concentration is relatively low (100-135 ppm). Therefore, even if the application of wet scrubbers is considered technically feasible, it is unlikely they could achieve the same level of controls as are seen on utility boiler applications.

RTA already employs a dry scrubber to control fluorides emissions. If a wet scrubber was employed, it would be located downstream of the existing A-398 scrubbers.

Two recent technical reports identified four commercially available wet scrubbing technologies that had potential application in the primary aluminum industry. These were wet scrubbers using the following sorbents: sea water, sodium, sodium/calcium dual alkali, and calcium.⁴⁶⁻⁴⁷ The technical feasibility of these control options is discussed in the following subsections.

6.3.3.3.1 WET SCRUBBER— SEA WATER AS SORBENT

Use of sea water scrubbers at the RTA Sebree Works is inherently not technically feasible given the inland location of the plant.

6.3.3.3.2 WET SCRUBBER— SODIUM AS SORBENT

A few primary aluminum plants in the U.S. have at one time or another tried this sodium-based wet scrubbing technology, on potline exhaust streams (see Table 6-2).

⁴⁵ U.S. EPA Clean Air Technology Center, “Flue Gas Desulfurization (FGD) – Wet, Spray, and Dry Scrubbers”, EPA-452/F-03-034, July 15, 2003.

⁴⁶ Aluminum Association of Canada, Section 4 of Final Report issued December 2000, “SO₂ Scrubbing Technologies”.

⁴⁷ Environment Canada, Report 605311, section 3 “Assessment of technologies for the prevention and control of SO₂ emissions”.

6.3.3.3.3 WET SCRUBBER— DUAL ALKALI SYSTEM

There are no known applications of a dual-alkali scrubbing system to potlines. Dual-alkali systems involve even more costs than the simpler sodium-based systems without any additional SO₂ control.

6.3.3.3.4 WET SCRUBBER— LIME OR LIMESTONE SYSTEM

There are no known applications of lime or limestone-based wet scrubbing systems employed in primary aluminum plants. The technology is ill suited to the low SO₂ concentrations and smaller scale (as compared with utility boiler applications) that exist in a potline application.

6.3.3.4 MANAGEMENT OF RAW MATERIALS AND PROCESS VARIABLES TO MINIMIZE SO₂ EMISSIONS

Petroleum coke and pitch are the two principle raw materials used in the production of green anodes. The petroleum coke from which anodes are formed is a byproduct of the oil refining industry. Pitch is produced by distilling crude tar, which is a byproduct of coking coal. SO₂ emissions from the potlines are a function of the coke and pitch sulfur content used in making the anodes in the anode bake furnace, as well as other furnace design and operational variables. Seeking to minimize the sulfur content of coke and pitch purchased for use in making anodes is an SO₂ pollution prevention method.

The sulfur content of petroleum coke can be as high as 7.5%. Low sulfur petroleum coke has a sulfur content of 3% or less. Since pitch and coke is the source of the sulfur input to the bake furnace, where the baked anodes used in the potlines are produced, and since these are raw materials produced by suppliers, it is not feasible for RTA to produce lower sulfur pitch and coke directly through any on-site processing techniques. It is also not possible to reduce the quantity of sulfur in these materials after they are received. Thus, to some degree, RTA, like other primary aluminum producers, is at the mercy of the market when it comes to sulfur content of the raw materials. Still, through optimal selection and negotiation of contracts with potential suppliers, it would be possible to minimize the raw material sulfur contents. Thus, this pollution prevention method is considered to be technically feasible, to the extent that raw material supplies meeting desired characteristics are available on the market.

6.3.4 STEP 3: RANKING OF POTENTIAL SO₂ CONTROL OPTIONS

Following the next step in the “top-down” BACT approach, the highest ranked control option is evaluated first. If this option is technically and economically feasible, and the option does not have unacceptable energy and adverse environmental impacts, the option is

deemed BACT. Otherwise, the next ranked control option is evaluated. The evaluation process continues until a control option is found that meets all of the BACT requirements. Once BACT is determined, it is unnecessary to evaluate any remaining options that are ranked below the selected BACT.

The potential SO₂ control options determined to be potentially feasible on technical grounds alone are shown in Table 6-3.

TABLE 6-3. REMAINING POTLINE CONTROL TECHNOLOGIES RANKED BY EFFECTIVENESS

Control Technology	Control Efficiency
Wet Scrubber (Sodium- or Calcium-Based Sorbents)	90%
Management of Raw Materials and Process Variables	Not Applicable

Control efficiencies for SO₂ from wet scrubbing systems that could potentially be applied to potlines are known to be less than 90%.⁴⁸ This control efficiency is demonstrated for primary aluminum smelters only for the sodium- and seawater-based scrubbant technologies.

Because management of raw materials and furnace operations is a pollution prevention technique, rather than a pollution control technique, a specific “control” efficiency cannot be defined. However, as compared to unrestricted use of higher sulfur content petroleum coke that may be available on the market, minimizing sulfur content of raw materials would result in lower SO₂ emissions. Still, consistent with the preferred top-down approach for the BACT analysis, the use of wet scrubbing technologies is treated in this analysis as the technology having the most stringent level of control. Thus, in the subsequent evaluation of the economic feasibility and potential adverse environmental and energy impacts, the wet scrubbing option is evaluated first.

6.3.5 STEP 4: EVALUATION OF POTENTIAL SO₂ CONTROL OPTIONS

In this section, the application of wet scrubbing technologies as BACT is evaluated with respect to its economic feasibility and the potential for creating adverse energy and environmental impacts.

6.3.5.1 WET SCRUBBING TECHNOLOGIES

As noted earlier, there are no known instances where BACT for SO₂ on potlines was determined to be the use of wet scrubbing technologies. Economic infeasibility is the primary explanation for this. Given the widespread awareness of this fact among control technology vendors having expertise in the primary aluminum industry, obtaining reliable cost estimates for wet

⁴⁸ Environment Canada, Report 605311, section 3 “Assessment of technologies for the prevention and control of SO₂ emissions”.

scrubbing control systems from prospective vendors is difficult. First, there are no vendors that develop and market SO₂ control systems specifically for potlines in the primary aluminum industry. Second, reflecting what appears to be a well-established fact that such control systems are not economically viable, vendors are reluctant to invest the time necessary to provide refined quotes.

The following economic evaluations are based data presented in the Environment Canada report discussed in the previous sections.⁴⁹ In this analysis, only the sodium, dual alkali, lime, and limestone SO₂ scrubbing technologies were considered (seawater is not reasonably applicable for Sebree Works). For all four types of systems, the Environmental Canada report contains bids that were obtained in 2006. These data were converted from Canadian dollars to U.S. dollars and adjusted for inflation to December 2008 dollars. In many cases, these cost quotes were for facilities with similar annual aluminum production to Sebree Works, but with less A-398 scrubber systems used to control emissions. Sebree Works uses six A-398 scrubber systems to control emissions from the potlines, so up to six wet scrubbers (one for each A-398 scrubber system) may necessary for SO₂ control for the potlines. Therefore, the cost estimates from the Environment Canada report may be less than actual costs that would be incurred by RTA if a wet scrubbing system were installed and operated, leading to a conservative BACT analysis.

Based on the capital cost data obtained, the total annualized costs were then estimated to determine the cost effectiveness in dollars per ton of SO₂ removed. The total annualized cost is a function of the capital cost and annual operating costs. The capital cost estimating technique used is a factored method whereby direct and indirect installation costs are expressed as a function of the total purchased equipment costs. This method is consistent with the latest U.S. EPA guidance manual on estimating control technology costs.⁵⁰

Capital Costs

Total purchased equipment cost represents the delivered cost of the control equipment, auxiliary equipment, and instrumentation. Direct installation costs consist of the direct expenditures for materials and labor for site preparation, foundations, structural steel, erection, piping, electrical, painting, and facilities. Indirect installation costs include engineering and supervision of contractors, construction and field expenses, construction fees, and contingencies. Other indirect costs include equipment startup, performance testing, working capital, and interest during construction. The capital cost calculation presented herein

⁴⁹ Environment Canada, Report 605311, section 3 “Assessment of technologies for the prevention and control of SO₂ emissions”.

⁵⁰ U.S. EPA, *Office of Air Quality Planning and Standards Control Cost Manual*, 6th edition, EPA/452/B-02-001, January 2002. Direct and indirect costs were developed as percentages of the basic equipment cost in accordance with this manual.

does not include any cost assessment for a waste water treatment plant (WWTP). Such a WWTP is mandatory to clean the high “salted” waste water generated in a wet scrubbing system. The capital cost input into the economic feasibility calculations would underestimate the true costs by a significant degree and actual cost per ton of SO₂ removed will be greater than the value calculated without accounting for these costs.

Annualized Costs

Annualized costs are comprised of direct and indirect operating costs. Direct annual operating costs include labor, maintenance, replacement parts, raw materials, utilities, and waste disposal. Indirect operating costs include plant overhead, taxes, insurance, general administration, and capital charges. With the exception of overhead, indirect operating costs are calculated as a percentage of the total capital costs. Capital charges are calculated based on the capital recovery factor (CRF) defined as:

$$CRF = \frac{i(1+i)^n}{(1+i)^n - 1} = \frac{7.0\% (1 + 7.0\%)^{15}}{(1 + 7.0\%)^{15} - 1} = 0.110$$

where i is the annual interest rate and n is the equipment life in years. An interest rate of 7.0% is used for capital recovery in the cost-effectiveness calculations. The economic life for the equipment associated with an SO₂ wet scrubber system is conservatively set to 15 years. Thus, the capital recovery factor used in the cost effectiveness calculations is 0.110.

Using the approach described, the tables in Appendix E provide a breakdown of the capital and annualized operating costs, respectively, estimated for a SO₂ wet scrubber system that would be applied to RTA’s potlines.

Cost Effectiveness

The SO₂ control efficiency that could be achieved by a wet scrubber system, taking into account the low inlet concentration, is assumed to be 90%. As discussed previously in Section 4.2.1, the proposed BACT emission limit reflects an estimated annual SO₂ emission rate from the potline A-398 scrubbers of 5,748 tpy.⁵¹ The calculation of the cost effectiveness is as follows.

$$Cost\ Effectiveness = \frac{\frac{Annualized\ Cost}{year}}{90\% \times \left(\frac{5,748\ ton\ SO_2}{year}\right)} = \$X/ton\ SO_2$$

⁵¹ The potential SO₂ emission rate for the potlines of 5,806 tpy presented elsewhere in this application represents emissions from the A-398 scrubbers and roof vents. The value presented here consists of only emissions from the A-398 scrubbers because the cost effectiveness of control for the A-398 scrubbers is evaluated here.

As illustrated in Table 6-4, the estimated annualized cost of an SO₂ control system consisting of wet scrubbers for RTA's potlines ranges from \$4,909 to \$9,695 per ton of SO₂ removed. Since this calculation does not include the cost to install and operate a WWTP, the actual cost per ton of SO₂ control would be even higher. (See Appendix E for detailed calculations.) Given the volume of waste water to be treated, a very preliminary assessment leads to an estimate of an additional \$2,000 per ton of SO₂ removed to install and operate a WWTP to treat wet scrubber waste water.

TABLE 6-4. COST EFFECTIVENESS OF FOUR SO₂ SCRUBBING TECHNOLOGIES

Technology	Capital Cost (\$Million)	Annualized Cost (\$Million/yr)	Scrubbing Efficiency	Uncontrolled SO ₂ Emissions from Potlines (tpy)	Cost Effectiveness (\$/ton)
Sodium	122	25	90%	5,748	4,909
Dual Alkali	142	28	90%	5,748	5,416
Limestone	259	50	90%	5,748	9,695
Lime	259	50	90%	5,748	9,624

* Note that uncontrolled SO₂ emissions reported here are for the A-398 scrubbers and does not include roof vent emissions, which are included in the emission calculations for the potlines presented in Section 4.

Aside from the numerous potential technical challenges of retrofitting an SO₂ control system after the existing alumina dry scrubbers at Potlines 1, 2, and 3, at the cost-effectiveness value estimated, RTA concludes that this solution is not economically feasible. This conclusion is supported by similar evaluations completed at four other primary aluminum plants:

- ▲ **Alcoa, Inc. (Massena, New York).** In 2001, Alcoa completed a control technology analysis pursuant to 6 NYCRR 212.5(d), a state-level BACT rule, for its plant in Massena, New York (i.e., the Alcoa West plant). An order of magnitude cost estimate was solicited from a prospective vendor for a wet scrubbing system to remove SO₂ from a potline with comparable characteristics (flow and SO₂ emissions) as each of RTA's Sebree Works potlines. The wet scrubbing system would be installed downstream of the existing HF control system. The annualized cost per ton of SO₂ removed was estimated as **\$6,526/ton.**⁵² BACT was affirmed in that case to be the use of low sulfur coke.
- ▲ **Alcoa, Inc., (Alcoa, Tennessee).** In an analysis completed in March 2007 for its primary aluminum facility in Tennessee to evaluate what control options constitute Best Available Retrofit Technology (BART), a process

⁵² Memorandum from Mr. Bob Warland (New York State Department of Environmental Conservation [NYSDEC]) to Mr. Tom Morgan (NYSDEC), "ALCOA West Plant", March 15, 2002. Refer also to Section 5.2 of the report titled "Alcoa – Massena Operations, Part 212 Potroom and Baking Furnace BACT Analysis", submitted by Alcoa to NYSDEC on July 5, 2001.

that is essentially similar to the BACT process, Alcoa sought to obtain cost estimates from prospective vendors for a wet scrubbing system. Based on the emissions profile of the Alcoa potlines, a cost-effectiveness value of **\$7,500/ton** was calculated.⁵³ Alcoa concluded that wet scrubbing technology was not economically feasible for aluminum reduction potlines.

- ▲ **Century Aluminum (Hawesville, Kentucky).** Century Aluminum completed a BACT analysis as part of a PSD permit application to increase facility-wide aluminum production in July 2008. This analysis was updated in application addendums submitted to KDAQ in October 2008 and most recently in November 2008. In the November 2008 addendum, Century presents a BACT economic analysis to determine whether operation of the existing scrubbers, which target fluoride emissions, at the facility would constitute BACT for SO₂. Based on a cost effectiveness of **\$4,000/ton** of SO₂, in combination with arguments relating to adverse energy and environmental impacts, Century determined that operation of their wet scrubbing system does not constitute BACT for SO₂.⁵⁴ KDAQ has not yet issued a draft permit for this project.
- ▲ **Noranda Aluminum (New Madrid, Missouri).** Noranda submitted a PSD application to increase facility-wide aluminum production at their New Madrid, Missouri plant in September 2008. This application includes a BACT analysis for their existing potlines. Noranda determined that the cost to install and operate a wet alkaline scrubber system would be **\$10,285/ton** of SO₂ removed for their Potline 1&2 Stack and **\$24,189/ton** for their Potline 3E and their Potline 3W Stacks. The use of wet scrubbers on the potlines was rejected as BACT.⁵⁵ The Missouri DNR has not yet issued a draft permit for this project.

In addition to being economically infeasible, the application of wet scrubbing technology to the potlines for SO₂ control also creates other adverse energy and environmental impacts. First, wet scrubbing technologies are energy intensive. Energy would be wasted to mine and process the sorbent and transport it to the site, to operate the fans and pumps for the scrubber and treatment plant, and to transport, treat and dispose the waste generated.

⁵³ Although the annualized cost estimates determined by Alcoa were similar to what RTA found, Alcoa assumed a higher SO₂ control efficiency of 95% would be achieved in calculating the cost-effectiveness.

⁵⁴ Century Aluminum GP, Hawesville, Kentucky, "SO₂ Addendum to October 17, 2008 PSD Application", Application submitted to the Kentucky Division for Air Quality, November 14, 2008.

⁵⁵ Noranda Aluminum, New Madrid, Missouri, "Prevention of Significant Deterioration (PSD) Permit Application", Application submitted to the Missouri Department of Natural Resources, September 2008.

The adverse environmental impacts associated with the use of wet scrubbing technologies also partially offset the environmental benefit realized from the emission reductions. First, the wet scrubber would consume fresh water and would create a new wastewater and solid waste stream. Based on the study commissioned by Environment Canada in 2008, it was determined that 0.5 to 2.7 tons of sludge is generated for each ton of SO₂ removed, depending on the technology used.⁵⁶ Second, in the case of lime and limestone-based scrubbing systems, there would be additional sources of particulate matter emissions created associated with the storage and handling of the limestone material. Also of note is a comment from the European Commission in the *Reference Document on Best Available Techniques in the Non Ferrous Metals Industries*, which discusses additional impacts of sea water scrubbers, but applies equally to all wet scrubbing technologies:

“The use of sea water in caustic scrubbers to remove sulphur dioxide may be considered for the reduction of total SO₂ emissions. The cross-media effect on water needs to be considered on a local basis.”⁵⁷

Aside from the direct environmental impacts of the scrubber, there would also be increased emissions from secondary sources that would have to mine, process and transport the reagent materials used by the scrubber. There also would be increased secondary emissions, including greenhouse gas emissions, associated with producing the increased electricity consumed by the scrubber and treatment system.

Considered together, application of wet scrubbing technology at Sebree Works would have an adverse economic and environmental impact that is not justified by the potential reductions in SO₂ emissions. As demonstrated by the analysis completed by RTA for this permit application and other similar analyses completed for other primary aluminum plants, application of wet scrubbing technologies potlines has been and remains economically infeasible. Therefore, this control option is eliminated from further consideration as BACT for SO₂.

6.3.5.2 EVALUATION— MANAGEMENT OF RAW MATERIALS AND PROCESS VARIABLES TO MINIMIZE SO₂ EMISSIONS

Managing raw materials (e.g., to minimize sulfur contents) and process variables (e.g., to optimize production efficiencies) both serve to minimize SO₂ emissions from the potlines. This pollution prevention approach is already in place and is being followed by RTA. While application of this approach is

⁵⁶ Environment Canada, Report 605311, section 3 “Assessment of technologies for the prevention and control of SO₂ emissions”.

⁵⁷ European Commission, Integrated Pollution Prevention and Control, “*Reference Document on Best Available Techniques in the Non Ferrous Metals Industries*”, December 2001, p. 318.

economically feasible, it is not without significant cost. RTA estimates that to meet the proposed BACT emission level (discussed in Section 6.3.6), the incremental cost of procuring petroleum coke supplies with sufficiently low sulfur content will be up to \$3 million per year, as compared to what costs could be incurred if the sulfur content criteria was not present.

6.3.6 STEP 5: PROPOSED SO₂ BACT DETERMINATION

The only control or pollution prevention option remaining for consideration as BACT in the top-down analysis completed is the management of raw materials and the process variables to minimize SO₂ emissions. This option is technically and economically feasible, depending on the form and value of the limitation established. This determination is consistent with findings of the U.S. EPA in the context of their decision not to regulate SO₂ from potlines under NSPS Subpart S. It is also consistent with other determinations published by U.S. EPA in the RBLC database and with current European Commission determinations of BAT. This section presents an analysis and justification for the emission rates being proposed in conjunction with the BACT determination.

To aid in understanding the rationale and basis for the form and value of the SO₂ emission limit proposed, relevant background on the current and projected market for the raw materials used in the anode baking process, principally petroleum coke, is first presented below.

6.3.6.1 BACKGROUND ON MARKET FOR PETROLEUM COKE AND PITCH USED BY THE PRIMARY ALUMINUM INDUSTRY

Petroleum coke that is available in the United States can be classified as either “anode grade” or “fuel grade”. Petroleum coke produced in a delayed coker that has a high carbon content and is low in metals such as vanadium, nickel and iron is suitable for making graphite anodes for the aluminum smelting industry. This “anode-grade” coke is generally processed in calciners and is then marketed to the aluminum industry.⁵⁸ Conversely, coke with higher concentrations of metal is generally not suitable for use in making anodes. The sulfur and metal content of the petroleum coke are the primary parameters for determining grade and differential price. Overall, coke prices fluctuate with the price of crude oil.

Two key conditions in the market for petroleum coke must be recognized in the process of establishing the BACT-qualifying SO₂ emission limit:

⁵⁸ Calciners process high-grade petroleum coke by heating the coke to temperatures between 2,000 and 3,000 °F. The high temperature volatilizes impurities in the coke and removes any water that may also be present. Calciners also blend different sources of coke to produce the desired properties required by individual manufacturers.

1. Petroleum coke demand in the United States and worldwide is expected outpace supply, which will significantly tighten availability of anode-grade coke in the near future.
2. The sulfur content of petroleum coke and pitch available on the market will continue to increase in the coming years.

These market realities have been documented in market studies published by independent third parties, and through analyses completed internally by RTA. The changing market for petroleum coke has also been the subject of papers and presentations by industry analysts and insiders at trade conferences. Highlights from a sample of these studies and presentations are provided below.

Jacobs Consultancy, Trade Conference Presentation. Jacobs Consultancy (Jacobs) is an engineering and management consulting firm with expertise in the oil refinery sector.⁵⁹ Along with professional technical services, Jacobs publishes the *Calcined Petroleum Coke Annual Report*, which offers a detailed analysis of current and projected global market conditions for coke. Jacobs also manages the website www.petcoke.com, which monitors pricing/supply issues for petroleum coke. In the 2007 “World Outlook Annual Report”, Jacobs discussed the experienced large imbalance in the demand versus supply for calcined coke (expected up to 2011), which will create very tight constraints on the quality of available supplies. Jacobs also noted that most new petroleum coke production will be high in sulfur (5%) and vanadium (500 ppm) whereas typical anode grade specifications required sulfur content less than 3.5% and vanadium concentrations less than 350 ppm. Then, in this report Jacobs states that,

“Technically any refiner producing a coke with qualities equal to 5% sulfur or more, and with vanadium levels at 500 ppm or slightly higher could potentially be a non-traditional alternative cokes (NTAC) supplier. Some cokes containing up to 6% sulfur have been used. It all depends on what is available and needed by the calciner for blending. Some customers, in desperation, have actually used off-quality petcoke in calciner feedstock blends to increase their green petroleum coke supply.”

Gulf cost calciners are already producing coke with an average sulfur content of 3.5%. They note that the “overall trend is for more heavy crudes producing higher sulfur/metals pet coke”. Essentially, the increasing drive to reduce SO₂ emissions at the refineries have generally meant that more sulfur is being retained in the coke. The expected trend of increasing sulfur content in anode-grade coke poses a challenge to primary aluminum producers. As there is no technology available for on-site desulfurization of coke, the sulfur content

⁵⁹ www.jacobsconsultancy.com

cannot be directly controlled by primary aluminum plants. It is instead dictated by actions in the oil refining industry.

CRU International, Ltd., Market Study. CRU International, Ltd., is a business analysis and consulting firm with a focus on the metals and associated industries.⁶⁰ In addition to providing consulting services and market analyses, the firm annually publishes a definitive guide on the carbon products industry. The following conclusions can be drawn from the 2008 Edition of “*The Five Year Outlook for Carbon Products*”:

- ▲ The main challenge for the calcined coke industry over the next five years will be the access to ‘calcinable grade’ green petroleum coke. CRU projects that green coke demand will increase by 9.1 million tpy by 2013 just to keep up with the growth in demand for calcined coke. Although coking capacity is projected to increase by 43.7 million tpy by 2013, CRU projects that only 8.4 million tpy of this will be less than 2% sulfur and as a result, the calcinable grade green coke market is going to become even tighter unless marginal cokes are widely accepted by the industry. As low sulfur cokes become increasingly expensive and sought after, aluminum producers will have a stronger impetus to accept marginal cokes.
- ▲ CRU expects that an increasing proportion of the aluminum industry will begin to accept marginal cokes, and this will increase the amount of material effectively available to calciners and anode producers. In many cases, producers could accept a blend of newly obtained 5% and existing 2% sulfur coke to create a 3.5% overall sulfur coke. By being forced to alter their specifications and smelting technologies, aluminum producers will have the options of either returning the market to balance, or instead choosing to pay ever-increasing prices.
- ▲ Price limits on consumer fuels are forcing Chinese refineries to increase profit margins on products such as coke. At the same time, it is possible that Beijing may impose an export tax on green and calcined coke, adding further costs to Western buyers.

Alcoa, Inc., Recent Market Analyses. As noted earlier, Alcoa completed an evaluation of SO₂ control technologies in March 2007 for its primary aluminum plant in Tennessee as part of a BART determination process. As part of this process, Alcoa undertook a study to evaluate the future availability of coke of varying sulfur contents through 2013. The following key conclusions from this analysis were highlighted in Alcoa’s BART report:⁶¹

⁶⁰ www.aluminum.crugroup.com

⁶¹ Alcoa, Inc., *BART Determination Report for Alcoa, Inc. – Tennessee Operations*, Submitted to the Tennessee Department of Environment and Conservation, March 2007, Section 5.1.3.2, pg 5-9.

- ▲ The sulfur content of the world's crude oil supply has been and will continue increasing. Those refiners with coking capacity are minimizing their raw material costs by maximizing the use of high sulfur crude oils to the optimal extent for their overall refinery design. The result will be a continuing increase in the sulfur content of available coke.
- ▲ Coke is a relatively small, low revenue component of the refinery's product profile. As such, the aluminum industry has little influence in controlling the quantity, quality, and price of the coke produced by refineries.
- ▲ Removal or reduction of the sulfur content of the coke once it has been received is not feasible.
- ▲ Growth in the aluminum industry has increased the demand for the limited quantities of coke and has driven prices for coke to unprecedented levels. The increased global growth in aluminum production will continue to outpace the production of coke.
- ▲ The deterioration in coke quality and the tightness of supply is expected to continue for the foreseeable future. The increased demand for coke will force the aluminum industry to accept lower quality coke with higher sulfur contents.

Alcoa concluded that, based on the market and availability of the future coke supply,

"it is infeasible to consider coke at sulfur contents below 3% as a BART pollution prevention option because a supply of coke with sulfur contents below 3% cannot be ensured beyond 2013...".

Alcoa goes on to conclude that,

"These same market pressures are expected to force facilities currently using coke with sulfur contents below 3% to begin using higher sulfur content coke in the future."⁶²

In an unrelated effort, Alcoa also recently assessed the future market for petroleum coke as part of a BACT control technology review completed for its

⁶² Ibid, pg 5-10.

primary aluminum plant in Rockdale, Texas.⁶³ In their BACT analysis, they state that,

“Alternative fuel projects across the United States have drastically affected the supply and demand for low sulfur petcoke. As a result, the cost for utilizing low sulfur petcoke has increased. In addition, based on today’s market and anticipated future markets for petcoke, the availability of low sulfur petcoke is uncertain.”

Rio Tinto Alcan Internal-Confidential Market Analysis. RTA has also completed its own research study to evaluate the future market for the key raw materials that will be utilized by Sebree Works after the Production Increase Project is implemented. The conclusions of this study significantly influenced the process of defining the appropriate BACT emission level that can be met in this context. First, RTA’s own historical data shows an upward trend in the sweet/sour (low/high sulfur) spread of petroleum coke available. Further, RTA also found that because of the supply demand imbalance that already exists in the market, many calciners are being forced to produce lower quality, higher sulfur coke.

Both the RTA and Alcoa market studies as well as those from two prominent industry analysts support the conclusions that anode raw material supplies are constrained and that sulfur contents have and will continue to increase in the future. These facts must be taken into consideration in establishing the SO₂ BACT limit. Essentially, even though some aluminum sites have accepted SO₂ limits historically that are based on the use of 3% sulfur coke or lower, RTA asserts that it is no longer feasible to ensure a consistent supply of raw material at this target, and many of the plants that accepted such limits will be forced to revise their permits. It will also no longer be feasible for primary aluminum plants to function under “per shipment” limits on petroleum coke sulfur content. This is because supplies meeting a given target, even higher than 3%, will not always be available in the right quantities, in the right place, at the right time. Instead of meeting limitations on particular raw materials, there will be an increasing need for flexibility in managing all process variables to meet emission limits. This is what RTA is proposing as part of this BACT analysis.

6.3.6.2 BASIS FOR BACT-LEVEL SO₂ EMISSION RATE AND AVERAGING PERIOD PROPOSED

In Section 4.2 of the application, a detailed explanation of the mass balance approach RTA currently uses to track SO₂ emissions from the potlines and anode bake furnace was presented. This mass balance is encompassed in what

⁶³ Alcoa, Inc., “Permit Amendment and PSD Application for Air Quality Permit 56300, Rockdale Aluminum Smelter”, Submitted to the Texas Commission on Environmental Quality, March 22, 2007. (Note, this PSD permit application is still under review by TCEQ.)

is termed the SO₂ Calculation Engine. For potline portion of the SO₂ Engine, there are two production rate variables and one sulfur content variable that can be used to define a long-term average SO₂ emission rate from the potlines, as previously discussed in Section 4.2.1.

In the context of the pollution prevention method proposed, establishing a BACT limit for SO₂ involves a determination of how these input variables can be managed. Thus, RTA has conducted an exhaustive review of the historical data on these variables both to understand their trends, variability, interrelationships, and importance in minimizing SO₂ emissions. For example, although sulfur content of the underlying raw materials is important in defining SO₂ emissions overall from the potlines and anode bake furnace combined, the production efficiency of the potlines (i.e., the ratio of baked anode consumption per unit of aluminum production), also has an impact on SO₂ emissions from the anode potlines themselves. This is because this production ratio defines how much sulfur is retained in the anode and thus is not released to the A-446 scrubber and stack. Thus, at very high production efficiencies, SO₂ emissions per ton of baked anode consumed can be minimized even if relatively high sulfur content raw materials are utilized.

In addition to examining historical data on the SO₂ Engine input variables, RTA has also assessed how these variables will change in the future based on the forecasts of market conditions made both by RTA itself and by other independent third parties. Specifically, RTA has considered how the tightening of petroleum coke supplies in the United States along with the expectation of increasing sulfur contents would impact its ability to comply with the BACT limit established.

Using this historical data and market forecast data, RTA evaluated SO₂ emissions over the range of possible values for the SO₂ Engine input variables. If a reasonable margin is built into the default assumption for every input variable (to address uncertainties), the predicted SO₂ emissions would be extremely high. Therefore, taking individual limits on any single input variable is not feasible. Instead, with the flexibility to counterbalance the uncertainties between each of the input variables, more aggressive assumptions can be used for each variable that results in a lower predicted SO₂ emission rate that can be achieved on a long-term average basis.

Reflecting this proposed approach, RTA defined a set of default input variables for the potline portion of the SO₂ Engine calculation (refer to Section 4.2.1). Under this base set of SO₂ Engine input variables, the estimated long-term average SO₂ emissions from the potlines is 5,806 tpy. (Refer to calculations presented in Appendix B of the application.) This emission rate is equivalent to the allocation provided for the potlines under the existing SO₂ emissions cap, scaled up to the new potential aluminum production rate. As such, RTA is proposing that a revised facility-wide SO₂ cap be established as BACT for the

purposes of this permit action. That is, RTA is proposing that BACT be defined as an emission limit of **6,326 tpy** for the potlines and anode bake furnace combined, on a 12-month rolling average basis. Under this approach, RTA would have the necessary flexibility to accommodate changes in raw material characteristics and process variables that deviate from the default set of assumptions while still attaining an emissions level that meets BACT and will be achievable moving forward.

There are four aspects to the proposed BACT limit that warrant further discussion. These are (1) the numerical level of the emission limit itself, (2) the form of the emission limit as an overall cap covering both the potlines and anode furnace, (3) the appropriate averaging period, and (4) whether associated operating limits should be established in conjunction with the emission limit. To assist KDAQ in evaluating the proposed BACT limit, additional analysis of these issues is presented in the following paragraphs.

1. **An SO₂ emission rate of 6,326 tpy from the potlines and anode bake furnace represents BACT.** Based on the market projections, RTA's proposal to continue to operate under the revised SO₂ cap of 6,326 tpy is extremely aggressive. First, as discussed in the 2007 Anode Bake Furnace PSD application, the anode bake furnace portion of the SO₂ cap (521 tpy) was set aggressively and the current facility-wide SO₂ cap (5,262.3 tpy) was originally developed under an assumption that petroleum coke with 3% sulfur or less would continue to be available. As discussed in Section 6.3.6, this is unlikely to be the case. Under its revised set of default SO₂ input variables, RTA is accounting for petroleum coke sulfur contents of up to 3.3%. Even reaching this level consistently is not without risk and will involve significant cost. RTA has estimated that to obtain petroleum coke with sufficiently low sulfur content to meet the limit will require annual expenditures of up to \$3 million per year incrementally over baseline case in which coke purchases were dictated solely on quality (i.e., without regard to sulfur content). The only difference between the calculation of the current SO₂ cap and the proposed cap is the potential aluminum production rate in the potlines. Therefore, all of the stringency of the current SO₂ cap is retained in the proposed cap. Certainly, a reduction or tightening of the SO₂ cap, in terms of the numerical limit, would not be feasible.
2. **SO₂ emissions should once again be regulated through a cap covering both the potlines and anode bake furnace.** The existing facility-wide SO₂ emissions cap was only recently established in April 2007, after over 2 years of negotiation and work by both KDAQ and RTA. The separate SO₂ emission limitation for the anode bake furnace was established in the Title V revision issued final in March 2008. The new unit-specific SO₂ limit on the anode bake furnace was imposed because the anode bake furnace had gone through PSD review, but the potlines had not. After the revised

permit is issued for the production increase project, both the anode bake furnace and potlines will have gone through PSD review. Also, having an overall SO₂ emissions cap between the potlines and anode bake furnace reflects the interrelationship of the sulfur balance between them and the fact that the SO₂ Engine can only accurately quantify SO₂ emissions overall. There is no added air quality control benefit in restricting SO₂ emissions individually between the potlines and anode bake furnace because both emission units are “uncontrolled” with respect to SO₂. Thus, even if a lower SO₂ emission rate can be achieved at the anode bake furnace in one month, the SO₂ emissions from the potline would correspondingly be higher, and vice versa. If unit-specific emission limits were established, they would have to be raised considerably to account for the reduced flexibility that would be lost to average out changes in the distribution of emissions between the potlines and anode bake furnace. RTA is instead proposing the more prudent approach of returning to a single emissions cap for the anode bake furnace and potlines combined, as was implemented in the Title V permit issued in April 2007.

3. **The BACT emission limit should be established as a 12-month rolling average limit.** The specific averaging period under which a BACT emission limit must be established is neither explicitly defined within the definitions of BACT under 401 KAR 51:001 nor in the PSD regulations under 401 KAR 51:017. Although it is customary to set emission limits on a short-term basis (e.g., 3-hr average, 24-hr average, 30-day rolling average) for enforceability reasons, RTA proposes that the BACT limit for the potlines be established on a 12-month rolling average basis, consistent with the form of the existing limit in the Title V permit. The mass balance approach utilized for quantifying SO₂ emissions justifies this approach, as is elaborated further below.

RTA has invested significant money and human resources into the infrastructure necessary to use the mass balance approach encompassed by the SO₂ Engine. For example, this approach requires an extensive amount of on-going sampling and testing. All anodes coming into and out of the furnace are weighed and packing coke usage rates must be carefully tracked. To complete the sulfur balance, multiple samples of green and baked anodes are taken each month. Through these efforts, a very accurate estimate of SO₂ emissions on a long-term average basis can be quantified. It is customary in regulating emission units for which the compliance method is via mass balance (e.g., VOC evaporative loss sources) for KDAQ to allow for long-term average emission limits. Accordingly, the mass balance approach used for the SO₂ Engine justifies that the SO₂ emission limit be kept on 12-month rolling average basis.

As demonstrated in Volume 2 of this application report, at the level of the proposed emissions cap, the SO₂ emissions from the Sebree Works do not

cause or contribute to an exceedance of the SO₂ NAAQS or PSD Increments. Specifically, the modeling analyses demonstrated that ambient impacts (i.e., impacts outside the combined RTA-WKE property boundary) at the vast majority of receptors in the region will fall well below the corresponding NAAQS levels. This is true despite the general conservatism built into the regulatory models and the fact that they assume that all sources (e.g., RTA and all regional sources) are emitting SO₂ at their highest levels simultaneously and continuously.

Thus, although the modeling analysis necessarily involved a demonstration of compliance with a 3-hour and 24-hour standard along with an annual standard, RTA contends that short-term limits are none the less unnecessary to be protective of short-term ambient standards. Ambient concentrations of SO₂ in the area around the facility have in fact likely decreased substantially in the past 10 years, due to the installation of FGD systems on WKE's Green Station boilers. (See Volume 2 for additional information.)

4. **Establishing operating limits on specific process variables in conjunction with the emission limit is unwarranted and unworkable.** If limitations on individual variables of the SO₂ Engine were taken (e.g., specific limit on petroleum coke sulfur content), they would each have to be set at levels that would accommodate their expected long-term fluctuation, and as a result the overall emission limit would have to be raised significantly. For example, even though RTA has used a default value of 3.3% sulfur for the petroleum coke in calculating the SO₂ emissions, it is possible that higher sulfur coke would need to be utilized at certain times, depending on the market. Under an overall emission limit for which compliance is demonstrated through use of the SO₂ Engine, RTA could still achieve compliance through managing the other process variables and/or curtailing production. RTA asserts that additional operating limits in conjunction with the emission limit are unnecessary and infeasible for this process.

In accordance with the top-down BACT evaluation conducted, RTA concludes that BACT for the potlines is achieved through application of a pollution prevention method involving the management of raw materials and process variables to minimize SO₂ emissions. The BACT-level emission limit proposed is as follows:

SO₂ emissions shall not exceed 6,326 total tons in any 12-month consecutive period, from the potline and anode bake furnace operations. Compliance shall be determined by computing SO₂ emissions monthly on a mass balance basis using the RTA SO₂ Calculation Engine and calculating a rolling 12-month SO₂ emission total.

6.4 TOP-DOWN BACT FOR PARTICULATE MATTER (PM₁₀/PM_{2.5}) AND FLUORIDES

PM₁₀ and PM_{2.5} emissions from potlines include alumina and carbon (from anode dusting), cryolite, aluminum fluoride, calcium fluoride, and ferric oxide. Fluoride-bearing particulate matter includes fluoride-bearing alumina materials.

There are three size ranges of PM, based on aerodynamic diameter, currently regulated under the PSD program: TSP, which includes PM up to approximately 30 µm, PM₁₀ (up to 10 µm), and PM_{2.5} (up to 2.5 µm). While PM_{2.5} was officially added to the list of regulated NSR pollutants upon the effective date of designation of attainment and nonattainment areas (April 5, 2005), there are currently no official source test methods for PM_{2.5}. Also, the final implementation rule recently promulgated by EPA states that PM₁₀ should continue to be used as a surrogate for PM_{2.5} in dispersion modeling and BACT analyses in states, such as Kentucky, with PSD programs written into their SIP until January 1, 2011 or until an updated SIP is approved by EPA.⁶⁴ Consistent with current and previous EPA guidance, for the purposes of this permitting action, PM₁₀ is used as a surrogate for PM_{2.5}.⁶⁵ Also, for the high efficiency pollution control devices considered for the potlines, very little of the PM emissions are expected to be greater than 10 µm. Therefore, for the proposed project, PM₁₀ emissions are assumed to be equivalent to TSP emissions (hereafter referred to as PM).

Adding to the complexity of establishing PM emission limits for BACT, aside from size, PM emissions can be categorized as either 1) filterable or “front-half” PM, which is what has generally been regulated by the NSPS rules (filterable PM is measured by Method 5 for TSP and Method 201 for PM₁₀), and 2) condensable or “back-half” PM, which is not generally regulated by NSPS rules (condensable PM is measured by Method 202 and makes up a high percentage of PM_{2.5} for combustion sources).⁶⁶ Filterable and condensable particulate are fundamentally different. While filterable emissions are well understood, condensable emissions are more complex and more difficult to measure accurately. For filterable PM, which is captured by traditional PM control devices (e.g., baghouses, ESPs, and venturi scrubbers), emissions can be approximated and managed with control equipment to a much greater degree than can condensable PM, whose emissions are more variable. For most industry sectors, most state agencies still only issue PSD BACT limits in terms of filterable PM/PM₁₀ for enforceability reasons.

Due to the potential biases with currently available condensable particulate test methods, EPA has stated that emission limitations for condensable PM, PM₁₀, and PM_{2.5} shall not be required for PSD permits issued during a transition period described in the recent final fine particulate implementation

⁶⁴ 73 FR 28321, May 16, 2008; *Final Rule for Implementation of the New Source Review (NSR) Program for Particulate Matter Less Than 2.5 Micrometers (PM_{2.5})*.

⁶⁵ Page, Stephen, EPA OAQPS Director, “Implementation of New Source Review Requirements in PM_{2.5} Nonattainment Areas,” April 5, 2005; and Seitz, John, EPA OAQPS Director, “Interim Implementation of new Source Review Requirements for PM_{2.5},” October 23, 1997.

⁶⁶ Method 202 has known biases and several alternative methods are often used in lieu of Method 202.

rule.⁶⁷ This transition period will extend until January 1, 2011, the date on which updated test methods for condensable PM are promulgated, or the date on which the relevant state SIP is updated to specifically require regulation of condensable PM. Based on this recent EPA guidance, the following BACT analysis focuses on control technologies and emission limitations for filterable PM.

The potlines are subject to 40 CFR Part 60, Subpart S (NSPS for Primary Aluminum Production Plants), which regulates total fluorides (gaseous and particulate), and 40 CFR Part 63 Subpart LL, National Emission Standards for Hazardous Air Pollutants for Primary Aluminum Reduction Plants, which also regulates total fluorides (particulate and gaseous). Since particulate fluorides are PM/PM₁₀ constituents, technologies identified in the MACT for fluoride control are also effective at controlling particulates. Alternatively, any PM₁₀ controls would be effective at controlling particulate fluorides. As such, this PM₁₀ top-down BACT also serves as the fluorides top-down BACT.⁶⁸

6.4.1 STEP 1: IDENTIFY ALL POTENTIAL CONTROL TECHNOLOGIES

The first of the five steps in a top-down BACT analysis is to identify control technologies for each pollutant. Similar to the SO₂ control technology identification procedures, potential potline control technologies were identified by researching U.S. EPA sponsored control technology databases for prior control technology determinations, technical literature, and control equipment vendor information. In addition, a review of existing control technologies and emission rates in place at other U.S. primary aluminum plants was completed.

A BACT determination must be at least as stringent as applicable NSPS or NESHAP regulations. As such, the applicable NSPS and NESHAPs were considered in establishing the minimum level of control that would constitute BACT. The Primary Aluminum NSPS (NSPS Subpart S) limits fluoride emissions to 1.9 lb/ton aluminum for potlines and the Primary Aluminum NESHAP (NESHAP Subpart LL) also includes the 1.9 lb/ton aluminum fluorides limit for from existing potlines. Additionally, the NESHAP (or MACT) floor for existing units, or level of control/emissions achieved by the top 12% best-performing sources, is based on a dry alumina scrubber with baghouse. This technology is typically at least 99%⁶⁹ efficient in controlling fluorides and particulate emissions.

6.4.1.1 PRIOR CONTROL TECHNOLOGY DETERMINATIONS

RTA identified prior control technology determinations by searching the RBLC. Additionally, RTA completed a review of U.S. EPA's Clean Air

⁶⁷ 40 CFR §51.166(b)(49)(vi).

⁶⁸ Total fluorides consist of gaseous and particulate fluoride. Since the gaseous fluorides are comprised of hydrogen fluoride, which is not a PSD pollutant, only the particulate portion of total fluorides is addressed in the BACT analysis.

⁶⁹ Based on Primary Aluminum MACT background document, "Primary Aluminum Industry: Technical Support Document for Proposed MACT Standards," dated July 1996.

Technology Center, the NEET database, which provides information on a large set of control technologies. Lastly, RTA conducted a search of state BACT databases, such as managed by the Texas Commission on Environmental Quality's BACT resources.

The RBLC was searched by using a process code of 82.110 for the potlines without limiting the data range period (thus not limiting the number of years searched). All PM/PM₁₀ and fluorides emissions results were extracted, as provided in Tables 6-5 and 6-6.

TABLE 6-5. SUMMARY OF RBLC PM/PM₁₀ CONTROL TECHNOLOGIES FOR POTLINES***

RBLC ID/ Company	Permit Date	Production Rate	BACT Determination	PM/PM₁₀ Emission Limits
KY-0070 NSA (now Century Aluminum)* Hawesville, KY	1998	66,000 ton aluminum/yr	Dry Alumina Scrubber/Baghouse	Potline 5 stack: 13.71 lb/hr Potline 5 roof vent: 15.07 lb/hr
SC-0037 Alumax of South Carolina (now Alcoa - Mt. Holley) Goose Creek, SC	1995	234,274 ton aluminum/yr	Dry Alumina Scrubber	4 Potroom Groups: 5.9 lb/hr 25.8 tpy
KY-0041 Arco Metals Co. (now Rio Tinto Alcan) Sebree Kentucky	1983	72,884 ton aluminum/yr	Baghouse	Potline 4:** 0.02 gr/dscf
NC-0003 Alcoa – Badin * Badin, NC	1981	54,500 ton aluminum/yr	Fabric Filter	Potline 3: 26 lb/hr
MO-0036 Noranda Aluminum New Madrid, MO	1979	70,000 ton aluminum/yr	Coated Filter Dry Scrubber	Potline 1: 56.76 tpy
MO-0036 Noranda Aluminum New Madrid, MO	1979	85,000 ton aluminum/yr	Coated Filter Dry Scrubber	Potline 3: 68.8 tpy

* This facility is either no longer in operation or no longer has primary aluminum operations.

** Potline 4 was never constructed

*** The large variation in PM/PM₁₀ emission limits contained in the RBLC is likely a result of several factors. It is unclear whether many of these values represent limits for a single stack, for both A-398 scrubbers and roof vents or for each emission type individually, and whether these limits are for filterable PM₁₀ only or include both filterable and condensable PM₁₀.

TABLE 6-6. SUMMARY OF RBLC FLUORIDES CONTROL TECHNOLOGIES FOR POTLINES

RBLC ID/ Company	Permit Date	Production Rate	BACT Determination	Fluorides Emission Limits
SC-0037 Alumax of South Carolina (now Alcoa - Mt. Holley) Goose Creek, SC	1995	234,274 ton aluminum/yr	Dry Alumina Scrubber	4 Potroom Groups: 1.02 lb/ton
KY-0041 Arco Metals Co. (now Rio Tinto Alcan) Sebree Kentucky	1983	72,884 ton aluminum/yr	A-398 Dry Scrubbing	Potline 4:** 1.9 lb/ton
NC-0003 Alcoa – Badin* Badin, NC	1981	54,500 ton aluminum/yr	Dry Scrubber	Potline 3: 12 lb/hr
MO-0036 Noranda Aluminum New Madrid, MO	1979	70,000 ton aluminum/yr	Coated Filter Dry Scrubber	Potline 1: 14.3 tpy
MO-0036 Noranda Aluminum New Madrid, MO	1979	85,000 ton aluminum/yr	Coated Filter Dry Scrubber	Potline 3: 6.6 tpy

* This facility is either no longer in operation or no longer has primary aluminum operations.

** Potline 4 was never constructed.

As demonstrated in Tables 6-5 and 6-6, add-on control technologies identified as BACT for potline operations identified in the RBLC include alumina dry scrubbers and baghouses.

The search conducted on the NEET did not identify any add-on control technologies as BACT. The AQMD search and the Texas Commission on Environmental Quality's BACT resources did not identify any determinations for primary aluminum foundry operations.

6.4.1.2 OTHER U.S. PRIMARY ALUMINUM FACILITY CONTROLS

Since RBLC results for PM₁₀ BACT analyses for the primary aluminum industry were minimal, RTA completed a review of existing primary aluminum facility controls in order to expand possible BACT or BACT-like determinations for PM₁₀. Similar to the SO₂ file reviews, RTA reviewed available files for facilities that have recently completed PSD BACT analyses, Best Available Retrofit Technologies (BART) analyses, or state-level control technology reviews. Additional facility operating permits were reviewed to identify control equipment on existing operations.

This review confirmed that the majority of primary aluminum facilities in the U.S. control PM₁₀ and fluoride emissions from potlines using dry alumina scrubbers with baghouses. The reviewed facilities with pertinent BACT, BART, or state-level control technology determinations and their control levels are provided in Table 6-7.

TABLE 6-7. SUMMARY OF OTHER FACILITY CONTROL TECHNOLOGIES

Company	Permit Date	Type of Determination	Determination
Alcoa, Inc. Blount County, Tennessee	2007	BART	Existing dry alumina scrubbers and baghouses
Alcoa, Inc. Rockdale, Texas	TBD ^a	BACT	Existing scrubbers, baghouses, electrostatic precipitators (ESPs), and multicyclones ^b
Noranda Aluminum New Madrid, MO	TBD ^c	BACT	Dry alumina scrubbers
Century Aluminum Hawesville, KY	TBD ^d	BACT	Wet scrubber system
Alcoa, Inc. Wenatchee, Washington	2003	RACT	15 lb PM/ton Al (combined stack and roof monitor emissions) ^e
Alcoa, Inc. – East Facility Massena, NY	2002	State BACT	Dry alumina scrubbers with baghouses

- The BACT analysis was never approved for the facility and the PSD permit application was withdrawn by Alcoa because the facility was shut down.
- The corresponding grain loading emissions rate (used in PM calculations) for these controls was 0.01 gr/dscf.
- PSD application submitted to Missouri DNR in September 2008.
- PSD application submitted to KDAQ by Century Aluminum in July 2008 with addendums submitted on October 17, 2008 and November 24, 2008. This project will involve the modification of Potlines 1 – 4.
- Existing dry scrubbers and baghouses control PM emissions.

6.4.1.3 ADDITIONAL POTENTIAL CONTROL RESOURCES

RTA completed its identification of potential controls by searching the IPCCB BREFS. Specifically, in the “Reference Document on Best Available Techniques in the Non Ferrous Metal Industries” BREF addresses PM₁₀ and fluoride emissions controls that are deemed BACT. The BREF focuses on best management practices such as design of efficient capture hoods, use of computer controls, and minimization of operations without the use of capture hoods as well as possible add-on controls. The BREF supports RTA’s control technology findings via the RBLC and facility file searches by specifying that:

“The vast majority of primary aluminum plants use dry scrubbing with alumina and supplementary dust removal by bag filters to control their emissions.”

For potlines, BAT includes best management practices, as noted above, and the use of an alumina scrubber and fabric filter.⁷⁰

Based on the reviews of the resources listed above, RTA has identified potential controls for PM₁₀ (including fluorides) that are listed in Table 6-8.

TABLE 6-8. POTENTIAL POTLINE CONTROL TECHNOLOGIES

Emission Unit	Control Technology
Potlines	Dry Alumina Scrubber with Baghouse Systems ESPs Wet Scrubbers Multicyclones

These potential control technologies are reviewed in the following sections.

6.4.2 STEP 2: ELIMINATE TECHNICALLY INFEASIBLE OPTIONS

The second of the five steps in a top-down BACT analysis procedure is to eliminate technically infeasible control technologies. For each pollutant, identified control technologies are evaluated for technical feasibility, as presented in the following sections.

6.4.2.1 DRY ALUMINA SCRUBBERS WITH BAGHOUSES

As noted, this control technology is the most common technology applied to primary (i.e., stack) emissions in the primary aluminum industry. This is predominantly due to the high control efficiencies (typically greater than 99%) provided by these controls. RTA's potline operations currently apply this technology for total fluoride and PM₁₀ control. In addition, this control technology is considered BAT in Europe. It also constitutes the technology used in the Primary Aluminum NESHAP to set the MACT floor, which essentially identifies the most effective emissions reduction method for fluoride control (thus relating directly to PM₁₀ control).

Based on the numerous control technology resources reviewed, a dry alumina scrubber/baghouses combination has never been applied, or considered for application, to secondary (i.e., roof vent) emissions. There would be significant technological difficulties in attempting to apply this type of control of roof vents due to the physical attributes of the roof vents. The potrooms are designed for control of primary emissions, including efficient capture hoods to prevent the need for secondary emissions controls. The design of the roof vents does not allow for application of a capture or control system without a complete

⁷⁰ IPCCB BREF, "Reference Document on Best Available Techniques in the Non Ferrous Metal Industries", Chapter 4, Section 4.4.2.1 – Primary aluminum smelting.

redesign of the potrooms themselves. The roof vents run the length of the potrooms; as such, their physical size alone would hamper, if not preclude, attempts to capture these emissions. Additionally, the roof loading and physical area restraints would not be able to accommodate dry alumina scrubbers and baghouses. As a result of the lack of demonstrated applicability on similar sources and the technical implications of the application, dry alumina scrubbers are deemed technically infeasible for the potline roof vents.

6.4.2.2 ELECTROSTATIC PRECIPITATORS

Electrostatic precipitators (ESPs) are collection devices that remove particles from exhaust using the force of an induced electrostatic charge. ESPs are typically used in lieu of baghouses (or fabric filters) and provide similar levels of control. ESPs are technically feasible for potline stacks PM₁₀ and fluoride control.

On the other hand, application of this control device on sources similar to RTA's potline roof vents has not been demonstrated. Additionally, the same technical issues identified for the dry alumina scrubbers and baghouses would prevent the installation of an ESP. As such, ESPs are not technically feasible controls for the potline roof vents.

6.4.2.3 WET SCRUBBER

Wet scrubber systems (described in the SO₂ BACT analysis) are also potential technologies for PM₁₀ control. As specified in the Primary Aluminum NESHAP technical support document⁷¹:

“...wet scrubbers operate at a relatively low pressure drop; consequently, removal efficiencies are much lower than those observed for dry alumina scrubbers.”

Notwithstanding the control efficiency limitations, wet scrubbers are considered technically feasible control technologies for the potline stacks.

The Primary Aluminum NESHAP technical support document also addresses the potential to control secondary (i.e., fugitive) emissions with wet scrubbers. There were four (4) facilities listed in the technical support document as having wet scrubbers controlling secondary emissions. Two (2) of these facilities are prebake type operations that installed the wet scrubbers on their roof vents during original facility installation, and prior to controlling any primary (i.e., stack) emissions. The other two (2) facilities are vertical stud Söderberg-type operations. One of these facilities installed wet scrubbers during original

⁷¹ U.S. EPA's "Primary Aluminum Industry: Technical Support Document for Proposed MACT Standards", July 1996.

installation, while the other facility installed wet scrubbers as a retrofit project. According to the support document, application of the latest (at the time of the support document development in 1996) secondary wet scrubbers would control approximately 90% of coarse particulate and only 10% of fine particulate for an overall control efficiency ranging from 50% to 80%. Despite previous wet scrubber applications, the U.S. EPA opted against selecting wet scrubbers as the secondary “control option” (selected to improve existing controls to lower emissions), likely due to economic feasibility concerns.

RTA believes that there would be significant technical issues with the use of wet scrubbers to control emissions from potline roof vents at Sebree Works, such that this control configuration could be considered technically infeasible. However, based on the existing wet scrubber applications discussed above, for the purposes of presenting a more conservative BACT analysis through Step 4, wet scrubbers are considered technically feasible for potline roof vents for the purpose of this application and are considered further in Steps 3 and 4.

6.4.2.4 MULTI-CYCLONES

A multi-cyclone comprises small cyclones built into a single housing. Each cyclone is a cylindrical vessel, usually with a conical bottom. The flue gas enters the vessel tangentially and sets up a rotary motion whirling in a circular or conical path. The particles are thrown against the vessel walls by the centrifugal force of the flue gas where they impinge and eventually settle into hoppers. Multi-cyclones are designed to control medium-sized to coarse PM and are typically not as efficient as ESPs or baghouses. Multicyclones are technically feasible for potline stacks PM₁₀ and fluoride control.

Similar to dry alumina scrubber and baghouses, and ESPs, there is no demonstrated application of multi-cyclones on potline roof vents, and the previously identified technical issues would apply to the use of multi-cyclones. As such, multi-cyclones are not technically feasible controls for the potline roof vents.

6.4.3 STEP 3: RANK REMAINING CONTROL TECHNOLOGIES BY CONTROL EFFECTIVENESS

The third of the five steps in a top-down BACT analysis procedure is to rank remaining control technologies by control effectiveness as in Table 6-9. The control efficiencies are based on the Primary Aluminum NESHAP support document and available vendor information.

TABLE 6-9. REMAINING CONTROL TECHNOLOGIES RANKED BY EFFECTIVENESS FOR POTLINES.

Emission Unit	Control Technology	Emissions Controlled	Control Efficiency
Potlines	Dry Alumina Scrubber with Baghouse Systems	Stack	99%
	ESPs	Stack	66% - 98% ^a
	Wet Scrubbers	Stack/Roof Vent	50% - 80% ^a
	Multicyclones	Stack	78% ^b

a. U.S. EPA's "Primary Aluminum Industry: Technical Support Document for Proposed MACT Standards", July 1996.

b. Based on AP-42, Chapter 12, Table 12.1-1 (calculated based on PM emissions from multicyclone vs. total captured PM).

6.4.4 STEP 4: EVALUATE MOST EFFECTIVE CONTROLS AND DOCUMENT RESULTS

The fourth of the five steps in a top-down BACT analysis procedure is to evaluate the most effective control and document the results. This has been performed for each remaining control technology on the basis of economic, energy, and environmental considerations, and is described below.

6.4.4.1 PRIMARY EMISSIONS - DRY ALUMINA SCRUBBERS AND BAGHOUSES

RTA is currently operating dry alumina scrubbers and baghouses on its potlines. As this is the most effective control technology identified in Steps 1 through 3, there is no need to conduct an economic feasibility analysis on this or any other control option identified in Table 6-9 for control of primary PM₁₀ and fluoride emissions.

6.4.4.2 SECONDARY EMISSIONS – WET SCRUBBERS

Wet scrubbers are considered the most effective and only control technology for control of secondary emissions of PM₁₀ and fluorides. As such, the economic and environmental feasibility of applying this control to potline roof vents has been considered. This economic and environmental review is based on an evaluation conducted by U.S. EPA as part of the Primary Aluminum NESHAP development. U.S. EPA's evaluation is documented in the *Basis and Purpose Document for the Development of Proposed Standards for the Primary Aluminum Industry*, Appendix C, "Evaluation of Wet Roof Scrubbers as a Control Option for Secondary Emissions – Beyond the Floor".⁷² In this evaluation, the annual cost (capital and operating) to operate retrofitted wet scrubbers for control of a vertical stud Söderberg facility's secondary emissions was calculated to be \$27.60/ton of aluminum processed. This would be equivalent to \$6,997,456/year facility-wide for Sebree Works after implementation of the production increase project (\$27.60 multiplied by

⁷² This document, dated July 19, 1996, is available online at:
<http://www.epa.gov/ttn/atw/alum/alumpg.html#TECH>

253,531 tpy of aluminum production) or \$2,332,485/yr for each potline, assuming equal aluminum production for each of the three potlines.

As shown in Table 6-10, this is equivalent to a cost of \$56,831/ton of PM₁₀ removed for each potline. These costs are based on RTA's proposed PM emissions, U.S. EPA's evaluated wet roof scrubber PM efficiency of 55%, and 1994 dollars. Due to the economic infeasibility based on the 1994 dollars, RTA did not consider it necessary to convert the 1994 dollars to 2009 dollars. Also, while U.S. EPA did not evaluate the cost to retrofit a prebake facility, it did consider the cost to incorporate wet scrubbers for secondary emissions for a new prebake facility installation. The new prebake facility's annualized costs were 7.8% higher than the vertical stud Söderberg annualized costs. While the wet scrubber control efficiency for fluorides was considered by EPA to be 80%, the annualized costs (using the same assumption as stated above) are similar in magnitude to the PM₁₀ removal costs. As shown in Table 6-10, the fluoride removal cost for installation and operation of a wet scrubber to control roof vent emissions is \$41,001/ton.

TABLE 6-10. WET SCRUBBER COST EFFECTIVENESS PER POTLINE FOR ROOF VENT PM₁₀ AND FLUORIDE EMISSIONS

	PM ₁₀	Fluorides
Annualized Cost (\$/yr)	2,332,485	2,332,485
Uncontrolled Emissions Per Potline (tpy)	74.6	71.1
Wet Scrubber Control Efficiency (%)	55.0	80.0
Reduced Emissions Per Potline (tpy)	41.0	56.9
Cost Effectiveness Per Potline (\$/ton)	56,831	41,001

In addition to the economic infeasibility, the use of wet scrubbers would have negative environmental impacts due to the increased demand for electricity and water, and the generation of a waste sludge and wastewater stream.

Based on this economic and environmental evaluation, wet scrubbers are not feasible control options for application on secondary emissions.

6.4.5 STEP 5: SELECT BACT

The fifth and final step in a top-down BACT analysis procedure is the selection of the BACT level of control for each pollutant. Per EPA guidance, BACT is the most effective control technology not eliminated by the previous four steps of the analysis protocol.

For emissions of both PM₁₀ and fluorides, BACT for the potlines has been shown to be the continued operation of the existing A-398 dry alumina scrubber/baghouse systems. Because the existing PM₁₀ and fluorides control technology for the potlines will continue to be used after the production increase project is completed, it is logical that the current production-normalized PM₁₀ and fluorides emissions from the potlines will continue to

constitute BACT. The proposed BACT limitations are summarized in Table 6-11 for the three potlines.

TABLE 6-11. BACT SELECTION AND RESULTING EMISSION RATES – PM₁₀ AND FLUORIDES

Emission Unit	Pollutant	BACT Determination	Proposed BACT Limit
Potlines	PM ₁₀	Stacks: A-398 Dry Alumina Scrubbers	Potlines 1, 2, and 3: 2.27 lb/ton Al (Combined total PM ₁₀ limit for A-398s and roof vents)
		Roof Vents: No Add-on Control	
	Fluorides	Stacks: A-398 Dry Alumina Scrubbers	Potlines 1, 2, and 3: 1.9 lb/ton Al (Combined limit for A-398s and roof vents)
		Roof Vents: No Add-on Control	

As discussed in Section 3.3 of Appendix B, the proposed BACT limit for PM₁₀ is based on the 90th Upper Confidence Level (UCL) of stack test results from PM₁₀ testing conducted on an A-398 reactor and the M-106 Downcomer on Potline 3 at Sebree Works in June and July 2006. The 90th UCL is used when setting the BACT limit to account for potential test-to-test variability in PM₁₀ emissions from the potlines, because the BACT limit must be met at all times. The proposed BACT limit for fluorides is the P-MACT limitation for existing sources, to which Sebree Works will continue to be subject after this project is completed. As discussed above, the existing control technology for fluorides (A-398 scrubbers) will continue to meet BACT; therefore, the numerical emission limitation that corresponds with this control technology will continue to be the P-MACT limitation.

To implement BACT, RTA proposes that a single production-based PM₁₀ limit be set for the three potlines and that compliance with the limit be based on periodic stack testing. Testing for PM₁₀ emissions from the roof vents can only be conducted on Potline 3, because this is the only potline for which the roof vents are equipped with equipment that can be used for PM₁₀ sampling. Because the three potlines at Sebree Works are identical, a single limit for which compliance is determined by testing on one potline is a reasonable method for demonstrating compliance.

The resulting BACT limit for PM₁₀ would read as follows:

PM₁₀ emissions from the potlines (A-398 and roof vent emissions) shall not exceed an average of 2.27 lb/ton of aluminum produced. Compliance shall be determined by testing once per permit term for one Potline 3 A-398 reactor section and the M-106 Downcomer.

To comply with fluoride emission limits imposed through the P-MACT, RTA already conducts a fluorides sampling program to determine the average fluorides emission rate for the potlines as a function of aluminum production. This sampling program consists of

periodic tests of A-398 reactor sections on each potline and periodic sampling using the Alcan Cassette Method for emissions from each potline roof vent. Because the P-MACT limit consists of a single average fluorides emission limit for the three potlines and a thorough sampling program is already in place, RTA suggests that the BACT limit for fluorides consist of a single, production based limit and that compliance with this limit be demonstrated using the procedures required by the P-MACT.

The resulting BACT limit for fluorides would read as follows:

Total fluorides emissions from the potlines (total primary and secondary emissions) shall not exceed an average of 1.9 lb/ton of aluminum produced. Compliance shall be determined by periodic testing as required by the P-MACT (NESHAP, Subpart LL) and Conditions B.3(Testing Requirements) and B.4 (Specific Monitoring Requirements) of this section.

6.5 TOP-DOWN BACT FOR CARBON MONOXIDE (CO)

This BACT analysis has been prepared based on predicted worst-case emissions of CO from the potlines. CO emissions from the potlines are generated primarily through the re-oxidation of aluminum in the presence of CO₂ back to alumina. Since this re-oxidation is detrimental to the potline production efficiency, RTA makes every effort to maximum the potline efficiency by minimizing the occurrence of re-oxidation.

6.5.1 STEP 1: IDENTIFICATION OF POTENTIAL CO CONTROL OPTIONS

Potentially applicable CO emission control technologies for the potlines were identified by researching the U.S. EPA control technology database, technical literature, and by completing a review of existing control technologies in place at other U.S. primary aluminum plants.

As discussed in Section 6.3.2, U.S. EPA has promulgated a NSPS for primary aluminum facilities at 40 CFR Part 60, Subpart S. Through the development of this NSPS and revisions since, U.S. EPA has identified no emissions control technologies for CO that are appropriate (taking into account costs, environmental impacts, and energy requirements) and has issued no emission standards for CO under Subpart S.

As was done for SO₂, the RBLC database managed by U.S. EPA was queried for all entries under process code 82.110, which covers operations at primary aluminum plants. The date range was not limited, and thus covered all data in the RBLC, going back over 30 years. From this query, all records for potlines with CO determinations were extracted. The results are summarized in Table 6-12.

TABLE 6-12. SUMMARY OF CO DETERMINATIONS IN THE RBLC FOR POTLINES

RBLC ID/ Company	Permit Date	Production Rates	BACT Determination	CO Emission Limits
KY-0070 NSA (now Century Aluminum)* Hawesville, KY	1998	66,000 ton aluminum/yr	Good operating practices	Potline 5: 432.56 lb/hr and 1,894.63 tpy ^a
SC-0037 Alumax of South Carolina (now Alcoa - Mt. Holley) Goose Creek, SC	1995	234,274 ton aluminum/yr	Good operating practices	Four Potroom Groups: 1,840 lb/hr and 8,059 tpy
NC-0003 Alcoa, Inc. Badin, North Carolina	1981	54,500 ton aluminum/yr	No control equipment or other BACT parameter limit specified	Potline 3: 1,444 lb/hr

- a. Post-PSD permit issuance stack testing resulted in emissions higher than the listed BACT results. As such the BACT limits were revised to 2,643 lb/hr, 11,576 tpy, and 350.55 lb/ton.

As evidenced from Table 6-12, no post-process control technologies have ever been deemed as BACT for potlines. A search of other prominent BACT databases maintained by individual states also revealed no entries or information regarding CO determinations for potlines. In fact, based on a review of air permits and applications for other primary aluminum plants, there are no CO controls on any potline in the United States. For example, Alcoa completed an evaluation of CO controls for its primary aluminum facility in Warrick, Indiana to comply with a state SIP provision. BACT was determined to be no controls. In its Best Available Technique Reference Document, the European Commission also specifies no control options for CO.⁷³ Clearly, application of CO control to a potline is neither economically feasible nor practical from an energy and environmental control perspective.

Based on a review of technical literature and past control technology determinations, several generally available technologies could be potentially applied to control CO from the potlines. In a BACT analysis completed in 2001 for its primary aluminum plant in Massena, New York under a state SIP provision, Alcoa researched these technologies. At that time, incineration was the only potential technology identified as being available.⁷⁴ There have been no developments in the air pollution control industry that would invalidate this conclusion today. Although a defacto conclusion can quickly be reached that no controls will constitute BACT for CO, to satisfy the top-down requirements of BACT the

⁷³ European Commission, “*Reference Document on Best Available Techniques in the Non Ferrous Metals Industries*”, December 2001, Chapter 12, Table 12.14.

⁷⁴ Alcoa, Inc., “Part 212 Potroom and Baking Furnaces BACT”, July 5, 2001, Section 7.

various types of incineration technologies listed below are evaluated for their potential to meet BACT in this analysis.

- ▲ Catalytic Oxidation (Regenerative and Non-Regenerative)
- ▲ Thermal Oxidation (Regenerative and Non-Regenerative)

Use of good operating practices will increase production efficiency, which would result in a corresponding decrease in CO emissions. Thus, use of good operating practices also evaluated as BACT. Consistent with U.S. EPA's top-down approach, the control technologies are considered in order of decreasing emission reduction potential.

6.5.2 STEP 2: TECHNICAL FEASIBILITY OF POTENTIAL CO CONTROL OPTIONS

6.5.2.1 CATALYTIC OXIDATION

A catalytic oxidation system is designed such that the combustion gas passes over a catalyst bed (usually a noble metal such as palladium or platinum) where CO and VOC are converted to CO₂. Catalytic oxidation allows this oxidation to take place at a faster rate and at a lower temperature than is possible with thermal oxidation. Still, this process requires temperatures of 600 to 1,000 °F to achieve high conversion rates for CO.^{75,76} Below this temperature range, the reaction rate drops sharply and effective oxidation of CO is no longer feasible. Above this temperature, conventional oxidation catalysts break down and are unable to perform their desired functions.

Aside from the need to operate within a specific temperature window, the exhaust gases must be relatively free of sulfur and other catalyst poisons. The catalyst can be chemically washed to restore its effectiveness, but eventually irreversible degradation occurs. For potline operations, the presence of particulate and SO₂ in the exhaust stream would adversely affect the performance of the catalyst.

The temperature of exhaust gas coming from the A-398 scrubbers is less than 250°F. Thus, significant auxiliary fuel input would be required to raise the temperature of the gas stream ahead of the catalytic oxidizer. It is impractical to require reheating of a combustion stream (i.e., requiring use of additional energy and fuel consumption) and generation of additional combustion related emissions, to reduce process related emissions from the potlines.

An alternate variation of the more general catalytic oxidation technology is the use of regenerative systems to improve thermal efficiency. RCOs utilize a

⁷⁵ U.S. EPA, *Air Pollution Control Technology Fact Sheet – Catalytic Incinerator*. EPA-452/F-03-018.

⁷⁶ David A. Lewandowski. *Design of Thermal Oxidation Systems for Volatile Organic Compounds*. Lewis Publishers, Boca Raton, FL. p. 198.

ceramic bed to recapture the heat of the stream exiting the combustion zone. RCOs can be designed to achieve up to 95% recovery of the thermal energy input to the system. As with non-regenerative catalytic oxidizers however, the presence of particulate in the exhaust stream would cause plugging and catalyst poisoning issues and would significantly reduce the CO control efficiency. RCO technology is better designed to control organic emissions from low-particulate loading streams.⁷⁷

Catalytic oxidation for CO control has not been demonstrated in practice for potlines. Catalytic oxidation is not a technically feasible control option and also poses other adverse energy and environmental impacts. Accordingly, both regenerative and non-regenerative catalytic oxidation are deemed technically infeasible and are not considered further.

6.5.2.2 REGENERATIVE AND NON-REGENERATIVE THERMAL OXIDATION

Thermal oxidation can either be regenerative (RTO) or non-regenerative (incinerator or afterburner). Either type of thermal oxidation system can be used to control CO emissions; however, the RTO has the additional benefit of being able to recover much of the heat energy in the gas and thus more self-sustaining than an incinerator or afterburner.

RTOs require a combustion chamber temperature of approximately 1,500°F and a residence time of approximately 0.75 seconds in order to achieve efficient combustion of CO.⁷⁸ Due to this high temperature requirement, RTO systems are typically applied to VOC-containing streams since the heat produced by the oxidation of waste gas VOCs, when combined with the heat recaptured by the RTO, is often enough to sustain operation of the RTO with little or no auxiliary fuel use. The heat content of CO is about ten times less than the heat content of most common VOCs.⁷⁹ Therefore, significantly more clean fuel (such as natural gas or propane) would be required to control a CO-containing exhaust stream than to control a VOC-containing exhaust stream. In addition to the low heat content of CO, the VOC concentration in the potline exhaust is relatively low, thus will only minimally increase the overall exhaust stream heat content. No known primary aluminum facility controls CO emissions via a RTO.

RTO systems use a ceramic bed to recover waste gas energy. The ceramic beds are comprised primarily of alumina and silica. The alumina and silica ceramics are susceptible to corrosion by HF, which is present in the potline exhaust

⁷⁷ U.S. EPA, *Air Pollution Control Technology Fact Sheet – Regenerative Incinerator*. EPA-452/F-03-021, July 2003.

⁷⁸ Ibid.

⁷⁹ Robert H. Perry and Don W. Green, 1997. Perry's Chemical Engineer's Handbook, Seventh Edition.

streams. Several materials have been evaluated, but none have been found to be suitable in the high HF environment that would be found in the potline exhaust. The technical feasibility of an RTO system to control CO from the potline cannot be demonstrated. The combination of the HF in the exhaust stream and the high temperatures required for thermal oxidation of CO would result in the degeneration of the RTO's alumina-silica ceramic bed. Additionally, the temperatures of the units' exhaust streams are too low for the thermal oxidation to occur.

In addition to the technical issues that cannot currently be resolved, as described above, the Air Pollution Control Technology Fact Sheet for Regenerative Oxidation, Document number EPA-452/F-03-021 (see Appendix C), under the heading of Achievable Emission Limits/Reductions, states;

“RTO systems do not reduce the levels of CO.”

Therefore, RTO is not a technically feasible option for CO control on the potlines. However, non-regenerative thermal oxidation, while not an ideal application, is considered technically feasible. Thus, it is retained for further evaluation in the next step of the BACT process.

6.5.2.3 GOOD OPERATING PRACTICES

For potlines, good operating practices implemented to increase production efficiency, thus minimizing CO emissions, are technically feasible.

6.5.3 STEP 3: RANKING OF POTENTIAL CO CONTROL OPTIONS

Following the next step in the “top-down” BACT approach, the highest ranked control option is evaluated first. In this case, a thermal oxidation system is the only identified control option, as shown in Table 6-13. In contrast, proper design and use of an advanced firing system is a pollution prevention system. Thus, thermal oxidation is evaluated first.

TABLE 6-13. REMAINING CONTROL TECHNOLOGIES RANKED BY EFFECTIVENESS FOR POTLINES.

Emission Unit	Control Technology	Control Efficiency
Potlines	Thermal Oxidization	99%
	Good Operating Practices	Undefined

6.5.4 STEP 4: EVALUATION OF POTENTIAL CO CONTROL OPTIONS

6.5.4.1 THERMAL OXIDATION

Although use of a thermal oxidizer would be technically feasible and provide a high level of CO control, this technology is eliminated from consideration as BACT because of the substantial adverse environmental and energy impacts associated with such a solution. The following points support this conclusion:

- ▲ A significant amount of natural gas would be required to raise the temperature of the exhaust gas from the existing A-398 scrubbers to a level sufficient to oxidize the CO (e.g., from less than 250°F to over 1,600°F). This represents a significant waste of a valuable natural resource.
- ▲ The combustion of natural gas in quantities sufficient to control CO from the potline exhaust would generate a significant quantity of NO_x. NO_x is a precursor to ozone formation in the atmosphere and secondary aerosols that can reduce visibility. Regional control of NO_x emissions to affect reductions in ozone concentrations is unquestionably a more significant air quality priority than reducing CO emissions. Ambient concentrations of CO, based on data from existing regional monitors, are significantly below the ambient air quality standards.

Aside from the adverse energy and environmental impacts, application of a thermal oxidizer to aluminum potlines is economically infeasible as well. Alcoa conducted an evaluation of CO control technologies for the potline operations at its primary aluminum plant in Massena, New York. Specifically, in a BACT demonstration submitted pursuant to 6 NYCRR 212.5(d), the cost of the natural gas alone to remove CO was estimated to be **\$114,278 per ton**. The total costs would even be higher.⁸⁰ BACT was affirmed in that case to be “no control”. The New York State Department of Environmental Conservation concluded as part of their BACT review that *“the control of carbon monoxide was found to be infeasible technologically and financially”*.⁸¹

6.5.4.2 GOOD OPERATING PRACTICES

RTA has implemented good operating practices at the potline operations. Good operating practices include the operating of emissions units in a manner such that increased operating efficiencies are realized. For example, RTA operates computer-based controls for the potlines, which improves operation efficiency, thus reducing emissions.

⁸⁰ Memorandum from Mr. Bob Warland (New York State Department of Environmental Conservation [NYSDEC]) to Mr. Tom Morgan (NYSDEC), “ALCOA West Plant”, March 15, 2002.

⁸¹ New York State Department of Environmental Conservation, Permit Review Report for Permit ID 6-4058-00003/00365, September 5, 2002, pg 49.

6.5.5 STEP 5: PROPOSED CO BACT DETERMINATION

As no control technologies (post-process) were determined to be technically and economically feasible, the only remaining control option to propose as BACT is the use of good operating practices. After this production increase project is completed, the benefit in minimizing CO emissions is realized through continued operation of the furnace in a manner that optimizes aluminum production efficiency. Because the existing CO control techniques for the potlines will continue to be used after the production increase project is completed, it is logical that the current production-normalized CO emissions from the potlines will continue to constitute BACT. The proposed BACT limitation for the three potlines is **233.6 lb/ton** of aluminum production, which is a combined limit for A-398 scrubber and roof vent emissions.

As shown in Section 3.2 of Appendix B, the proposed BACT limit is based on the 90th Upper Confidence Level (UCL) of stack test results from CO testing conducted on one of the A-398 reactors at Sebree Works in February 2005. The 90th UCL is used when setting the BACT limit to account for potential test-to-test variability in CO emissions from the potlines, because the BACT limit must be met at all times. Of the total CO emissions from the potlines, 1% is released through the roof vents and 99% is released through the A-398 scrubbers. The February 2005 stack test only sampled CO emissions from the A-398 scrubbers; therefore, an additional 1% of total CO emissions is added to the 90th UCL to account for emissions from the roof vents.

The resulting BACT limit for CO would read as follows:

CO emissions from the potlines (A-398 and roof vent emissions) shall not exceed an average of 233.6 lb/ton of aluminum produced. Compliance shall be determined by testing once per permit term for one Potline 3 A-398 reactor section and the M-106 Downcomer.

6.6 BACT SUMMARY

Proposed BACT for the potlines, in terms of technology and emission limits, is summarized in Table 6-14.

TABLE 6-14. BACT SUMMARY FOR POTLINES

Pollutant	BACT Determination	Proposed BACT Limit	Determination Method
SO ₂	Management of Raw Materials and Process Variables	6,326 tpy in any 12-month consecutive period, from the potline and anode bake furnace operations	RTA SO ₂ Calculation Engine
PM ₁₀ /PM _{2.5}	Stacks: A-398 Dry Alumina Scrubbers Roof Vents: No Add-on Control	Potlines 1, 2, and 3: 2.27 lb/ton Al (Combined total PM ₁₀ limit for A-398s and roof vents)	Test once per permit term
Fluorides	Stacks: A-398 Dry Alumina Scrubbers Roof Vents: No Add-on Control	Potlines 1, 2, and 3: 1.9 lb/ton Al (Combined limit for A-398s and roof vents)	Periodic testing as required by the P-MACT
CO	Good Operating Practices	233.6 lb/ton Al (Combined limit for A-398s and roof vents)	Test once per permit term

DEP7007 SERIES PERMIT APPLICATION FORMS

Commonwealth of Kentucky
Natural Resources & Environmental Protection Cabinet
Department for Environmental Protection

Division for Air Quality
803 Schenkel Lane
Frankfort, Kentucky 40601

DEP7007AI

Administrative
Information

Enter if known

AFS Plant ID#

Agency Use Only

Date Received

Log#

Permit#

PERMIT APPLICATION

The completion of this form is required under Regulations 401 KAR 52:020, 52:030, and 52:040 pursuant to KRS 224. Applications are incomplete unless accompanied by copies of all plans, specifications, and drawings requested herein. Failure to supply information required or deemed necessary by the division to enable it to act upon the application shall result in denial of the permit and ensuing administrative and legal action. Applications shall be submitted in triplicate.

1) APPLICATION INFORMATION

Note: The applicant must be the owner or operator. (The owner/operator may be individual(s) or a corporation.)

Name: Rio Tinto Alcan

Title: _____ Phone: (270) 521-7811
(If applicant is an individual)

Mailing Address: Rio Tinto Alcan
Company

Street or P.O. Box: 9404 State Route 2096

City: Robards State: KY Zip Code: 42452-9735

Is the applicant (check one): ☐ Owner ☐ Operator ☒ Owner & Operator ☐ Corporation/LLC* ☐ LP**

* If the applicant is a Corporation or a Limited Liability Corporation, submit a copy of the current Certificate of Authority from the Kentucky Secretary of State.

** If the applicant is a Limited Partnership, submit a copy of the current Certificate of Limited Partnership from the Kentucky Secretary of State.

Person to contact for technical information relating to application:

Name: Ghassan Dughaish

Title: Environmental Supervisor Phone: (270) 521-7452

2) OPERATOR INFORMATION

Note: The applicant must be the owner or operator. (The owner/operator may be individual(s) or a corporation.)

Name: Same as applicant

Title: _____ Phone: _____

Mailing Address: _____
Company

Street or P.O. Box: _____

City: _____ State: _____ Zip Code: _____

3) TYPE OF PERMIT APPLICATION

For new sources that currently *do not* hold any air quality permits in Kentucky and are required to obtain a permit prior to construction pursuant to 401 KAR 52:020, 52:030, or 52:040.

☐ Initial Operating Permit (the permit will authorize both construction and operation of the new source)

Type of Source (*Check all that apply*): ☐ Major ☐ Conditional Major ☐ Synthetic Minor ☐ Minor

For existing sources that do not have a source-wide Operating Permit required by 401 KAR 52:020, 52:030, or 52:040.

Type of Source (*Check all that apply*): ☐ Major ☐ Conditional Major ☐ Synthetic Minor ☐ Minor

(*Check one only*)

- ☐ Initial Source-wide Operating Permit ☐ Construction of New Facilities at Existing Plant
- ☐ Construction of New Facilities at Existing Plant ☐ Modification of Existing Facilities at Existing Plant
- ☐ Other (explain) _____

For existing sources that currently have a source-wide Operating Permit.

Type of Source (*Check all that apply*): ☒ Major ☐ Conditional Major ☐ Synthetic Minor ☐ Minor

Current Operating Permit # V-05-088 R1

- ☐ **Administrative Revision** (describe type of revision requested, e.g. name change): _____
- ☐ **Permit Renewal** ☒ **Significant Revision** ☐ **Minor Revision**
- ☐ Addition of New Facilities ☒ Modification of Existing Facilities

For all construction and modification requiring a permit pursuant to 401 KAR 52:020, 52:030, or 52:040.

Proposed Date for Start of Construction or Modification: September 2009 Proposed date for Operation Start-up: March 2010

4) SOURCE INFORMATION

Source Name: RTA Sebree Works

Source Street Address: 9404 State Route 2096

City: Robards Zip Code: 42452-9735 County: Henderson

Primary Standard Industrial Classification (SIC) Category: Primary Production of Aluminum Primary SIC #: 3343

Property Area (Acres or Square Feet): 2600 acres Number of Employees: ~650

Description of Area Surrounding Source (*check one*):

☐ Commercial Area ☐ Residential Area ☐ Industrial Area ☐ Industrial Park ☒ Rural Area ☐ Urban Area

Approximate Distance to Nearest

Residence or Commercial Property: ~ 1/2 mile

UTM or Standard Location Coordinates: (*Include topographical map showing property boundaries*)

UTM Coordinates: Zone 16 Horizontal (km) 456.2 Vertical (km) 4,168.9

Standard Coordinates: Latitude _____ Degrees _____ Minutes _____ Seconds

Longitude _____ Degrees _____ Minutes _____ Seconds

4) SOURCE INFORMATION (CONTINUED)Is any part of the source located on federal land? ☐ Yes ☒ No

What other environmental permits or registrations does this source currently hold in Kentucky?

Landfill and Landfarm 051-00008; KPDES KY0004278; KYD058692526

What other environmental permits or registrations does this source need to obtain in Kentucky?

*None***5) OTHER REQUIRED INFORMATION**

Indicate the type(s) and number of forms attached as part of this application.

☐ DEP7007A Indirect Heat Exchanger, Turbine, Internal Combustion Engine☒ DEP7007B Manufacturing or Processing Operations☐ DEP7007C Incinerators & Waste Burners☐ DEP7007F Episode Standby Plan☐ DEP7007J Volatile Liquid Storage☐ DEP7007K Surface Coating or Printing Operations☐ DEP7007L Concrete, Asphalt, Coal, Aggregate, Feed, Corn, Flour, Grain, & Fertilizer☐ DEP7007M Metal Cleaning Degreasers☒ DEP7007N Emissions, Stacks, and Controls Information☐ DEP7007P Perchloroethylene Dry Cleaning Systems☐ DEP7007R Emission Reduction Credit☐ DEP7007S Service Stations☐ DEP7007T Metal Plating & Surface Treatment Operations☒ DEP7007V Applicable Requirements & Compliance Activities☐ DEP7007Y Good Engineering Practice (GEP) Stack Height Determination☐ DEP7007AA Compliance Schedule for Noncomplying Emission Units☐ DEP7007BB Certified Progress Report☐ DEP7007CC Compliance Certification☐ DEP7007DD Insignificant Activities

Check other attachments that are part of this application.

Required Data

- ☒ Map or Drawing Showing Location
(*Figures 2-1 and 2-2 of application*)
- ☒ Process Flow Diagram and Description
(*Appendix C of application*)
- ☐ Site Plan Showing Stack Data and Locations
(*See 2007 ABF Application*)
- ☒ Emission Calculation Sheets
(*Appendix B of application*)
- ☐ Material Safety Data Sheets (MSDS)
(*Not Applicable*)

Supplemental Data

- ☐ Stack Test Report
- ☐ Certificate of Authority from the Secretary of State
(for Corporations and Limited Liability Companies)
- ☐ Certificate of Limited Partnership from the Secretary
of State (for Limited Partnerships)
- ☐ Claim of Confidentiality (See 400 KAR 1:060)
- ☐ Other (Specify) _____

Indicate if you expect to emit, in any amount, hazardous or toxic materials or compounds or such materials into the atmosphere from any operation or process at this location.

☒ Pollutants regulated under 401 KAR 57:002 (NESHAP)☒ Pollutants listed in 401 KAR 63:060 (HAPS)☐ Pollutants listed in 40 CFR 68 Subpart F [112(r) pollutants]☐ Other

Has your company filed an emergency response plan with local and/or state and federal officials outlining the measures that would be implemented to mitigate an emergency release?

☒ Yes☐ No

Check whether your company is seeking coverage under a permit shield. If "Yes" is checked, applicable requirements must be identified on Form DEP7007V. Identify any non-applicable requirements for which you are seeking permit shield coverage on a separate attachment to the application.

☒ Yes☐ No☒ A list of non-applicable requirements is attached

DEP7007AI

(Continued)

6)

OWNER INFORMATION

Note: If the applicant is the owner, write "same as applicant" on the name line.

Name: Same as applicant

Title: _____ Phone: _____

Mailing Address: _____
Company _____

Street or P.O. Box: _____

City: _____ State: _____ Zip Code: _____

List names of owners and officers of your company who have an interest in the company of 5% or more.

NamePosition (owner, partner, president, CEO, treasurer, etc.)

(attach another sheet if necessary)

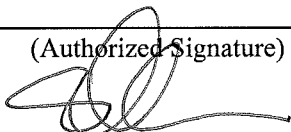
7)

SIGNATURE BLOCK

I, the undersigned, hereby certify under penalty of law, that I am a responsible official, and that I have personally examined, and am familiar with, the information submitted in this document and all its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the information is on knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false or incomplete information, including the possibility of fine or imprisonment.

BY: _____

(Authorized Signature)

Stephane LeBlanc

(Typed or Printed Name of Signatory)

3/6/09
(Date)Sebree Works Manager

(Title of Signatory)

Commonwealth of Kentucky
Natural Resources & Environmental Protection Cabinet
Department for Environmental Protection

DIVISION FOR AIR QUALITY

DEP7007B
MANUFACTURING OR PROCESSING OPERATIONS

(Please read instructions before completing this form)

Emission Point # (1)	Process Description (2)	Continuous or Batch (3)	Maximum Operating Schedule (Hours/Day, Days/Week, Weeks/Year) (4)	Process Equipment (Make, Model, Etc.) (5)	Date Installed (6)
Refer to 7007B Supplement Table 1 at the back of this section.					

Emission Point # (1)	List Raw Material(s) Used (7)	Maximum Quantity Input Of <u>Each</u> Raw Material (Specify Units/Hour) (8) See Item 18	Type of Products (9) See Item 18	Quantity Output* (Specify Units)	
				Maximum Hourly Rated Capacity (Specify Units) (10a)	Maximum Annual (Specify Units) (10b)
Refer to 7007B Supplement Table 2 at the back of this section.					

*(10a) Rated Capacity of Equipment

(10b) Should be entered only if applicant requests operating restrictions through federally enforceable limitations

IMPORTANT: Form DEP7007N, Emission, Stacks, and Controls Information must be completed for each emission unit listed below.

Emission Point # (1)	Fuel Type for Process Heat (11)	Rated Burner Capacity (BTU/Hour) (12)	Fuel Composition		Fuel Usage Rates		Note:
			% Sulfur (13a)	% Ash (13b)	Maximum Hourly (14a)	Maximum Annual* (14b)	If the combustion products are emitted along with the process emissions, indicate so in this column by writing "combined." (15)
Refer to 7007B Supplement Table 3 at the back of this section.							

16) Make a complete list of all wastes generated by each process (e.g. wastewater, scrap, rejects, cleanup waste, etc.). List the hourly (or daily) and annual quantities of each waste and the method of final disposal. (Use a separate sheet of paper, if necessary)

Where possible, anode butts are recycled. Otherwise, waste material is landfilled.

17) **IMPORTANT:** Submit a process flow diagram. Label all materials, equipment and emission point numbers. *Refer to Appendix C of Application Package.*

18) Material Safety Data Sheets with complete chemical compositions are required for each process.

*(14b) Should be entered only if applicant requests operating restrictions through federally enforceable permit conditions.

7007B Form Supplement Table 1 (Items 1-6) - Page 1 of 3

Rio Tinto Alcan

Emission Point # (1)	Process Description (2)	Continuous or Batch (3)	Maximum Operating Schedule (Hours/Day, Days/Week, Weeks/Year) (4)	Process Equipment (Make, Model, Etc.) (5)	Date Installed (6)
<i>E1</i>	<i>Aluminum Production Potline 1</i>	<i>C</i>	<i>24 hr/day; 7 day/wk; 52 wk/yr</i>	<i>Aluminum Production Pots</i>	<i>8/1972</i>
<i>E3</i>	<i>Aluminum Production Potline 2</i>	<i>C</i>	<i>24 hr/day; 7 day/wk; 52 wk/yr</i>	<i>Aluminum Production Pots</i>	<i>8/1972</i>
<i>E5</i>	<i>Aluminum Production Potline 3</i>	<i>C</i>	<i>24 hr/day; 7 day/wk; 52 wk/yr</i>	<i>Aluminum Production Pots</i>	<i>8/1979</i>

7007B Form Supplement Table 2 (Items 7-10) - Page 2 of 3

Rio Tinto Alcan

Emission Point # (1)	Process Description	List Raw Material(s) Used (7)	Maximum Quantity Input Of <u>Each</u> Raw Material (Specify Units/Hour) (8) See Item 18	Type of Products (9) See Item 18	Quantity Output (Specify Units)	
					Maximum Hourly Rated Capacity (Specify Units) (10a)	Maximum Annual (Specify Units) (10b)
<i>E1</i>	<i>Aluminum Production Potline 1</i>	<i>Alumina</i>	<i>18.7 tons/hr</i>	<i>Aluminum</i>	<i>9.65 tons/hr</i>	<i>na</i>
		<i>Anodes</i>	<i>5.2 tons/hr</i>		<i>(annual average)</i>	
		<i>Aluminum Fluoride</i>	<i>0.2 tons/hr</i>			
<i>E3</i>	<i>Aluminum Production Potline 2</i>	<i>Alumina</i>	<i>18.7 tons/hr</i>	<i>Aluminum</i>	<i>9.65 tons/hr</i>	<i>na</i>
		<i>Anodes</i>	<i>5.2 tons/hr</i>		<i>(annual average)</i>	
		<i>Aluminum Fluoride</i>	<i>0.2 tons/hr</i>			
<i>E5</i>	<i>Aluminum Production Potline 3</i>	<i>Alumina</i>	<i>18.7 tons/hr</i>	<i>Aluminum</i>	<i>9.65 tons/hr</i>	<i>na</i>
		<i>Anodes</i>	<i>5.2 tons/hr</i>		<i>(annual average)</i>	
		<i>Aluminum Fluoride</i>	<i>0.2 tons/hr</i>			

Rio Tinto Alcan

E1	Aluminum Production Potline 1	na	na	na	na	na	na	na
E3	Aluminum Production Potline 2	na	na	na	na	na	na	na
E5	Aluminum Production Potline 3	na	na	na	na	na	na	na

DIVISION FOR AIR QUALITY

Emissions, Stacks, and Controls Information

Applicant Rio Tinto Alcan Log #

KyEIS ID #	Emissions Unit and Emission Point Descriptions	Maximum Operating Parameters		Permitted Operating Parameters		
		Hourly Operating Rate (SCC Units/hr)	Annual Operating Hours (hrs/yr)	Hourly Operating Rate (SCC Units/hr)	Annual Operating Rate (SCC Units/yr)	Annual Operating Hours (hrs/yr)
	Emission Unit Name: Date Constructed: HAPs present? ☐ Yes ☐ No					
	Emission Point Name: Source ID: SCC Code: SCC Units: KyEIS Stack #: Fuel Ash Content: Fuel Sulfur Content: Fuel Heat Content Ratio: Applicable Regulations:					
	Emission Point Name: Source ID: SCC Code: SCC Units: KyEIS Stack #: Fuel Ash Content: Fuel Sulfur Content: Fuel Heat Content Ratio: Applicable Regulations:					

SECTION I. Emission Units and Emission Point Information (continued)											
KyEIS ID #	Emission Factors			Control Equipment		Hourly (lb/hr) Emissions			Annual (tons/yr) Emissions		
	Pollutant	Emission Factor (lb/SCC Units)	Emission Factor Basis	Control Equipment Association	Pollutant Overall Efficiency (%)	Uncontrolled Unlimited Potential	Controlled Limited Potential	Allowable	Uncontrolled Unlimited Potential	Controlled Limited Potential	Allowable
				<u>1st control device</u> KyEIS Control ID #: Collection efficiency:							
				Refer to 7007N Form Supplement Table 2 (Section 1 Part 2) At The Back Of This Section.							
				<u>1st control device</u> KyEIS Control ID #: Collection efficiency: <u>2nd control device</u> KyEIS Control ID #: Collection efficiency:							

SECTION II. Stack Information										
KyEIS Stack ID #	Stack Description	Stack Physical Data			Stack Geographic Data			Stack Gas Stream Data		
		Height (ft)	Diameter (ft)	Vent Height (ft)	Vertical Coordinate	Horizontal Coordinate	Coordinate Collection Method Code	Flowrate (acfm)	Temperature (°F)	Exit Velocity (ft/sec)

Refer to 7007N Form Supplement Table 3 (Section II) At The Back Of This Section.

7007N Form Supplement Table 1 (Section I Part 1)

Rio Tinto Alcan

Page 4 N of 6 N

KyEIS ID#	Source ID	Emission Source Description	Date Construct	HAP present?	KyEIS Stack #	SCC Code	SCC Units	Fuel Ash Content	Fuel Sulfur Content	Fuel Heat Content Ratio	Applicable Regulations	Maximum Operating Parameters		Permitted Operating Parameters		
												Hourly Operating Rate (SCC Units/hr)	Annual Operating Hours (hrs/yr)	Hourly Operating Rate (SCC Units/hr)	Annual Operating Rate (SCC Units/yr)	Annual Operating Hours (hrs/yr)
E1	01 02	Aluminum Production Potline 1 (Roof Vents) Aluminum Production Potline 1 (A-398)	8/1972	Y	na	30300101	tons molten aluminum produced	na	na	na	401 KAR 61:165, NESHAP Subpart LL	9.65	8,760	na	na	na
E3	01 02	Aluminum Production Potline 2 (Roof Vents) Aluminum Production Potline 2 (A-398)	8/1972	Y	na	30300101	tons molten aluminum produced	na	na	na	401 KAR 61:165, NESHAP Subpart LL	9.65	8,760	na	na	na
E5	01 02	Aluminum Production Potline 3 (Roof Vents) Aluminum Production Potline 3 (A-398)	8/1979	Y	na	30300101	tons molten aluminum produced	na	na	na	401 KAR 61:165, NESHAP Subpart LL	9.65	8,760	na	na	na

7007N Form Supplement Table 2 (Section I Part 2)

Rio Tinto Alcan

Page 5 N of 6 N

KyEIS Source ID # ID(s)		Emission Factors				Control Equipment			Hourly Operating Rate (SCC Units/hr)	Hourly (lb/hr) Emissions			Annual (tons/yr) Emissions		
		Pollutant	CAS#	Emission Factor (lb/SCC Units)	Emission Factor Basis	Control Equip. #	Control Device	Control Efficiency		Uncontrolled Unlimited Potential	Controlled Limited Potential	Allowable	Uncontrolled Unlimited Potential	Controlled Limited Potential	Allowable
E1	01,02	SO2		45.80 lb/tons molten aluminum produced	Mass Balance	na	na	na	9.65	441.8	441.8	na	1,935.2	1,935.2	na
	01,02	CO		233.61 lb/tons molten aluminum produced	Stack Test	na	na	na	9.65	2,253.7	2,253.7	na	9,871.1	9,871.1	na
	01,02	PM10		2.27 lb/tons molten aluminum produced	Stack Test	C1	A-398	>99.0	9.65	2,188.1	21.9	na	9,583.7	95.8	na
	01,02	PM2.5		1.73 lb/tons molten aluminum produced	Stack Test	C1	A-398	>99.0	9.65	1,666.1	16.7	na	7,297.7	73.0	na
	01,02	Fluorides		1.90 lb/tons molten aluminum produced	Stack Tests	C1	A-398	>99.0	9.65	1,833.0	18.3	na	8,028.5	80.3	na
	01,02	COS		2.46 lb/tons molten aluminum produced	Stack Tests	na	na	na	9.65	23.7	23.7	na	103.9	103.9	na
E2	01,02	SO2		45.80 lb/tons molten aluminum produced	Mass Balance	na	na	na	9.65	441.8	441.8	na	1,935.2	1,935.2	na
	01,02	CO		233.61 lb/tons molten aluminum produced	Stack Test	na	na	na	9.65	2,253.7	2,253.7	na	9,871.1	9,871.1	na
	01,02	PM10		2.27 lb/tons molten aluminum produced	Stack Test	C2	A-398	>99.0	9.65	2,188.1	21.9	na	9,583.7	95.8	na
	01,02	PM2.5		1.73 lb/tons molten aluminum produced	Stack Test	C2	A-398	>99.0	9.65	1,666.1	16.7	na	7,297.7	73.0	na
	01,02	Fluorides		1.90 lb/tons molten aluminum produced	Stack Tests	C2	A-398	>99.0	9.65	1,833.0	18.3	na	8,028.5	80.3	na
	01,02	COS		2.46 lb/tons molten aluminum produced	Stack Tests	na	na	na	9.65	23.7	23.7	na	103.9	103.9	na
E3	01,02	SO2		15.27 lb/tons molten aluminum produced	Mass Balance	na	na	na	9.65	147.3	147.3	na	645.1	645.1	na
	01,02	CO		233.61 lb/tons molten aluminum produced	Stack Test	na	na	na	9.65	2,253.7	2,253.7	na	9,871.1	9,871.1	na
	01,02	PM10		2.27 lb/tons molten aluminum produced	Stack Test	C3	A-398	>99.0	9.65	2,188.1	21.9	na	9,583.7	95.8	na
	01,02	PM2.5		1.73 lb/tons molten aluminum produced	Stack Test	C3	A-398	>99.0	9.65	1,666.1	16.7	na	7,297.7	73.0	na
	01,02	Fluorides		1.90 lb/tons molten aluminum produced	Stack Tests	C3	A-398	>99.0	9.65	1,833.0	18.3	na	8,028.5	80.3	na
	01,02	COS		2.46 lb/tons molten aluminum produced	Stack Tests	na	na	na	9.65	23.7	23.7	na	103.9	103.9	na

7007N Form Supplement Table 3 (Section II)

Rio Tinto Alcan

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KyEIS ID # Source ID Stack Description			Stack Physical Data			Stack Geographic Data			Stack Gas Stream Data	
			Height (ft)	Width (ft)	Vent Height (ft)	Vertical Coordinate	Horizontal Coordinate	Coordinate Collection Method Code	Temperature (F)	Exit Velocity (ft/sec)
<i>E1</i>	<i>01</i>	<i>Potline 1, Potroom 101 Roof Vent</i>	<i>48.5</i>	<i>8 x 1,195</i>	<i>na</i>	<i>455,736</i>	<i>4,167,705</i>	<i>INI</i>	<i>107.5</i>	<i>5.6</i>
<i>E1</i>	<i>01</i>	<i>Potline 1, Potroom 102 Roof Vent</i>	<i>48.5</i>	<i>8 x 1,194</i>	<i>na</i>	<i>455,698</i>	<i>4,167,738</i>	<i>INI</i>	<i>107.5</i>	<i>5.6</i>
<i>E1</i>	<i>02</i>	<i>Potline 1, North A-398 Scrubber</i>	<i>80.6</i>	<i>4.0</i>	<i>na</i>	<i>455,873</i>	<i>4,167,897</i>	<i>INI</i>	<i>241.5</i>	<i>53.3</i>
<i>E1</i>	<i>02</i>	<i>Potline 1, South A-398 Scrubber</i>	<i>80.6</i>	<i>4.0</i>	<i>na</i>	<i>455,816</i>	<i>4,167,833</i>	<i>INI</i>	<i>241.5</i>	<i>53.3</i>
<i>E3</i>	<i>01</i>	<i>Potline 2, Potroom 103 Roof Vent</i>	<i>48.5</i>	<i>8 x 1,195</i>	<i>na</i>	<i>455,668</i>	<i>4,167,765</i>	<i>INI</i>	<i>107.5</i>	<i>5.6</i>
<i>E3</i>	<i>01</i>	<i>Potline 2, Potroom 104 Roof Vent</i>	<i>48.5</i>	<i>8 x 1,194</i>	<i>na</i>	<i>455,631</i>	<i>4,167,798</i>	<i>INI</i>	<i>107.5</i>	<i>5.6</i>
<i>E3</i>	<i>02</i>	<i>Potline 2, North A-398 Scrubber</i>	<i>80.6</i>	<i>4.0</i>	<i>na</i>	<i>455,805</i>	<i>4,167,957</i>	<i>INI</i>	<i>241.5</i>	<i>53.3</i>
<i>E3</i>	<i>02</i>	<i>Potline 2, South A-398 Scrubber</i>	<i>80.6</i>	<i>4.0</i>	<i>na</i>	<i>455,749</i>	<i>4,167,893</i>	<i>INI</i>	<i>241.5</i>	<i>53.3</i>
<i>E5</i>	<i>01</i>	<i>Potline 3, Potroom 105 Roof Vent</i>	<i>48.5</i>	<i>8 x 1,195</i>	<i>na</i>	<i>455,567</i>	<i>4,167,854</i>	<i>INI</i>	<i>107.5</i>	<i>5.6</i>
<i>E5</i>	<i>01</i>	<i>Potline 3, Potroom 106 Roof Vent</i>	<i>48.5</i>	<i>8 x 1,194</i>	<i>na</i>	<i>455,530</i>	<i>4,167,887</i>	<i>INI</i>	<i>107.5</i>	<i>5.6</i>
<i>E5</i>	<i>02</i>	<i>Potline 3, North A-398 Scrubber</i>	<i>104.9</i>	<i>11.3</i>	<i>na</i>	<i>455,704</i>	<i>4,168,047</i>	<i>INI</i>	<i>241.5</i>	<i>44.6</i>
<i>E5</i>	<i>02</i>	<i>Potline 3, South A-398 Scrubber</i>	<i>104.9</i>	<i>11.3</i>	<i>na</i>	<i>455,648</i>	<i>4,167,984</i>	<i>INI</i>	<i>241.5</i>	<i>44.6</i>

Commonwealth of Kentucky
Natural Resources & Environmental Protection Cabinet
Department for Environmental Protection

DIVISION FOR AIR QUALITY

DEP7007V

**Applicable
Requirements
& Compliance**

APPLICANT NAME:

Rio Tinto Alcan

SECTION I. EMISSION AND OPERATING STANDARD(S) AND LIMITATION(S)

KYEIS No. ^{(1)**}	Emission Unit Description ⁽²⁾	Contaminant ⁽³⁾	Origin of Requirement or Standard ⁽⁴⁾	Applicable Requirement, Standard, Restriction, Limitation, or Exemption ⁽⁵⁾	Method of Determining Compliance with the Emission and Operating Requirement(s) ⁽⁶⁾
E1,E3,E5	Potlines (3)	TF	40 CFR 63.848(f), (h), and (j)	Install and operate a device which measures and records the weight of all materials fed/charged and/or aluminum produced; install, operate, calibrate, and maintain a continuous parameter monitoring system for each emission control device; establish control device operating parameter values or ranges; and initiate corrective action in instance of parametric deviations.	Monitoring and recordkeeping of aluminum throughput, monitoring and recordkeeping of control device operating parameter values or ranges, and initiating corrective action as described.
			40 CFR 63.843(a)(1), 401 KAR 61:165, Section 4, and 401 KAR 51:017	Total fluoride (TF) emissions shall not exceed 1.9 lb/ton aluminum produced or 1.6 lb/ton aluminum produced if emission averaging is used.	Monitoring, maintenance of records, and periodic testing.
		Opacity	40 CFR 63.845, 401 KAR 61:165, Section 3	Visible emissions from Potline 1, 2, and/or 3 shall not exceed the following limits: 1) 10% opacity from any potroom roof monitor during normal operations (Potlines 1, 2, and 3), 2) 40% opacity from any potroom roof monitor located directly above sick cells or startup cells (Potlines 1 and 2 only), 3) 10% opacity from any dry scrubbing plant primary control system (Potlines 1, 2, and 3).	Monitoring, maintenance of records, and annual Method 9 readings.
		CO	401 KAR 51:017	Carbon monoxide emissions from the potlines are limited to 233.6 lb/ton of aluminum produced.(Proposed BACT)	Monitoring, maintenance of records, and periodic testing.
		PM10	401 KAR 51:017	PM10 emissions from the potlines are limited to 2.77 lb/ton of aluminum produced. (Proposed BACT)	Monitoring, maintenance of records, and periodic testing.

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KYEIS No. ^{(1)**}	Emission Unit Description ⁽²⁾	Contaminant ⁽³⁾	Origin of Requirement or Standard ⁽⁴⁾	Applicable Requirement, Standard, Restriction, Limitation, or Exemption ⁽⁵⁾	Method of Determining Compliance with the Emission and Operating Requirement(s) ⁽⁶⁾
		SO ₂	401 KAR 51:017	Sulfur dioxide emissions from the potlines and anode bake furnace combined are limited to 6,326 tpy in any consecutive 12-month period. (Proposed BACT)	Monthly emissions tracking and recordkeeping using SO ₂ Calculation Engine.

APPLICANT NAME:

Rio Tinto Alcan

DEP7007V

continued

SECTION II. MONITORING REQUIREMENTS

KYEIS No. ⁽¹⁾	Emission Unit Description ⁽²⁾	Contaminant ⁽³⁾	Origin of Requirement or Standard ⁽⁴⁾	Parameter Monitored ⁽⁷⁾	Description of Monitoring ⁽⁸⁾
E1, E2, E3	Potlines (3)	TF	401 KAR 61:165, Section 6(3)	Ambient TF	Install, operate, and maintain ambient air monitoring equipment for the detection of fluorides.
			40 CFR 63.848(f) and 40 CFR 63.848(g)	Control System	Monitor operating parameters and conduct daily visual inspections of the equipment and control devices.
			40 CFR 63.848(k)	Monitoring Device Accuracy	Calibrate PMACT monitoring devices according to specified accuracy requirements and manufacturer's specifications.
			40 CFR 63.847(e)	Hours of Operation	Monitor monthly total hours of operation.
			40 CFR 63.847(e)	Aluminum Production	Monitoring monthly total aluminum production.
			40 CFR 63.847(e)	Emission Rates	Monitor production-based pollutant emission rates based on monthly total aluminum production.

APPLICANT NAME:

Rio Tinto Alcan

DEP7007V
continued

SECTION III. RECORDKEEPING REQUIREMENTS

KYEIS No. ⁽¹⁾	Emission Unit Description ⁽²⁾	Contaminant ⁽³⁾	Origin of Requirement or Standard ⁽⁴⁾	Parameter Recorded ^{(9)*}	Description of Recordkeeping ⁽¹⁰⁾
E1,E3,E5	Potlines (3)	TF	40 CFR 63.847(e)	Hours of Operation	Record monthly total hours of operation
			40 CFR 63.847(e)	Aluminum Production	Record monthly total aluminum production.
			40 CFR 63.847(e)	Emission Rates	Record production-based pollutant emission rates based on monthly total aluminum production.
			40 CFR 63.850(e)	Stack Test Reports	Maintain records of all PMACT stack test reports.
			40 CFR 63.850(e)(xiii)	Corrective Action	Maintain records of corrective actions taken when operating parameter limits are exceeded.
			401 KAR 61:165, Section 6	Ambient Air Results	Maintain records of ambient air TF monitoring results.
			40 CFR 63.850(e)(xi)	Control System Monitoring	Record results of operating parameter monitoring, daily inspection of equipment, and daily qualitative visual inspections of VE from each control device stack.
			40 CFR 63.850(e)(iii)	SSM Plan	Maintain a copy of SSMP on file.
		Opacity	401 KAR 61:165, Section 3	VE Observations	Record in a log all VE observations including any Method 9 readings, the cause of any abnormal VE readings, and the corrective action taken in abnormal VE readings occur.
			401 KAR 61:165, Section 3	VE Observations	For each stack, vent or control system, maintain records of annual Method 9 readings.
		CO	401 KAR 51:017	CO Emissions	Calculate emissions of CO based on stack test results and aluminum production. (Proposed BACT compliance determination)
		PM10	401 KAR 51:017	PM10 Emissions	Calculate emissions of PM10 based on stack test results and aluminum production. (Proposed BACT compliance determination)
		SO2	401 KAR 51:017	SO2 Emissions	Compute SO2 emissions from total primary aluminum production operations monthly using the SO2 Calculation Engine. (Proposed BACT compliance determination)

APPLICANT NAME: Rio Tinto Alcan

DEP7007V
continued

SECTION IV. REPORTING REQUIREMENTS

KYEIS No. ⁽¹⁾	Emission Unit Description ⁽²⁾	Contaminant ⁽³⁾	Origin of Requirement or Standard ⁽⁴⁾	Parameter Reported ⁽¹¹⁾	Description of Reporting ⁽¹²⁾
E1,E3,E5	Potlines (3)	TF	40 CFR 63.850(a)	PMACT Notifications	Submit notifications of initial performance tests, initial compliance status, and compliance approach.
			40 CFR 63.850(b)	PMACT Testing Summary	Submit an annual summary of all performance tests conducted to maintain compliance with the PMACT.
		TF	40 CFR 63.850(d)	Excess Emissions	Submit quarterly reports of any excess emissions events.
			40 CFR 63.848(i)	Operating Parameter Exceedances	Report exceedances of control device operating parameters subsequent to the sixth exceedance in any semi-annual monitoring period as violations.
		TF	401 KAR 61:165, Section 6	Ambient TF Results	Submit quarterly ambient monitoring data reports.
		NA	401 KAR 50:055	Corrective Action Plan	Submit a corrective action plan if an operating or emission limit is exceeded more than six times in a semi-annual reporting period.
		NA	401 KAR 50:055	General Reporting of Exceedances	Report any exceedance of an operating or emission limit.
		NA	401 KAR 50:045	Test Results	Submit results of stack tests within 45 days of completing field work.

APPLICANT NAME:

Rio Tinto Alcan

DEP7007V

continued

SECTION V. TESTING REQUIREMENTS

KYEIS No. ⁽¹⁾	Emission Unit Description ⁽²⁾	Contaminant ⁽³⁾	Origin of Requirement or Standard ⁽⁴⁾	Parameter Tested ⁽¹³⁾	Description of Testing ⁽¹⁴⁾
E1,E3,E5	Potlines (3)	TF	40 CFR 63.847(b)	Site-Specific Test Plan for Initial Performance Test	Submit a site-specific test plan 30 days prior to the initial performance test.
			40 CFR 63.848(a)	TF	Conduct periodic testing of TF emissions from each potline. For the primary control system, perform at least three emission test runs per year. For each source of secondary emissions, perform at least three emission test runs per month.
			40 CFR 63.847 and 40 CFR 63.849	Performance Test Procedures	Initial and subsequent performance tests shall be conducted in accordance with the relevant provisions of Subparts A and LL using the specified reference methods.
		CO	401 KAR 51:017	CO	In order to demonstrate compliance with proposed BACT limits, RTA presumes that an initial stack test will be required for CO.
		PM10	401 KAR 51:017	PM10	In order to demonstrate compliance with proposed BACT limits, RTA presumes that an initial stack test will be required for PM10.
		SO2	401 KAR 51:017	SO2 Engine Parameters	Conduct testing as required to complete calculations using the SO2 Engine on a monthly and 12-month rolling basis.
		Opacity	401 KAR 61:165, Section 3	Opacity	Perform annual Method 9 readings on each stack, vent, or control device associated with the potlines.

SUPPORTING EMISSIONS DOCUMENTATION

1.0 Emission Unit Index

> The following table provides an index of emission units that are referenced in the emission calculations and air permit application forms.

					2007 KyEIS	2007 KyEIS	
EUID	ID	Process Emission Unit Description	Process Description	Title V Unit #	SI#	ID#	Notes
A1	1	Barge Unloading (T1-T3)		A1 (T1,T2,T3)	A1	EQPT01	Dust Collector
A2	1	Alumina Storage (S1, S2, S3)		A2 (S1, S2, S3)	0A2	EQPT47	Dust Collector
A6	1	Remelt Furnace (89)		A6 (89)	A6	COMB01	Dust Collector
A7	1	Remelt Furnace (90)		A7 (90)	A7	COMB07	Dust Collector
A8	1	Material Transfer (T4)		A8 (T4)	0A8	EQPT04	Dust Collector
B4	1	Reacted Alumina Storage (S7, S8)		B4 (S7,S8)	B4	EQPT05	Dust Collector
B5	1	Reacted Alumina Storage (S9)		B5 (S9)	0B5	EQPT06	Dust Collector
B6	1	Ore Storage (S4, S5)		B6 (S4, S5)	0B6	EQPT07	Dust Collector
B7	1	Ore Storage (S6)		B7 (S6)	0B7	EQPT08	Dust Collector
C1	1	Material Transfer Rail Car (T5)		C1 (T5)	0C1	EQPT09	Dust Collector
C2	1	Aluminum Fluoride (T6, 2S)		C2 (T6, 2S)	0C2	EQPT10	Dust Collector
C4	1	Coke Handling (T7, T8, T9)		C4 (T7, T8, T9)	0C4	EQPT11	Dust Collector
C6	1	Coke Handling (3S, 4S)		C6 (3S, 4S)	0C6	EQPT12	Dust Collector
E1	1	Potline #1 (E1)	Potline #1 Roofs	E1 (P4, P5)	0E1-1	EQPT14	No Add-On Control
E1	2	Potline #1 (E1)	Potline #1 A-398 Scrubbers	E1 (P2, P3)	0E1-2	EQPT14	Dry Scrubber
E3	1	Potline #2 (E3)	Potline #2 Roofs	E3 (P8, P9)	0E3-1	EQPT15	No Add-On Control
E3	2	Potline #2 (E3)	Potline #2 A-398 Scrubbers	E3 (P6, P7)	0E3-2	EQPT15	Dry Scrubber
E5	1	Potline #3 (E5)	Potline #3 Roofs	E5 (3P, 4P)	0E5-1	EQPT16	No Add-On Control
E5	2	Potline #3 (E5)	Potline #3 A-398 Scrubbers	E5 (1P, 2P)	0E5-2	EQPT16	Dry Scrubber
E6	1	Transloading Spent Potliner & Sandblasting		E6 (EL)	0E6	EQPT17	Dust Collector
E8	1	Building (138) Vacuum System		E8 (EM)	0E8	EQPT19	Dust Collector
F1	1	Holding Furnaces (I1-I6)		F1 (I1-I6)	F1	EQPT20	No Add-On Control
F2	1	Holding Furnaces (I7,I8)		F2 (I7,I8)	F2	EQPT21	No Add-On Control
G8	1	Ingot Casting Dross Loading (I9)		G8 (I9)	0G8	EQPT22	Dust Collector
H1	1	Homogenizing Furnace (I1)		H1 (I1)	H1	COMB02	No Add-On Control
H2	1	Homogenizing Furnace (2I)		H2 (2I)	H2	COMB03	No Add-On Control
H3	1	Homogenizing Furnace (3I)		H3 (3I)	H3	COMB04	No Add-On Control
H4	1	Homogenizing Furnace (I31)		H4 (I31)	H4	COMB05	No Add-On Control
J1	1	Butt Surge Tank (E1)		J1 (E1)	0J1	EQPT23	Dust Collector
J2	1	Anode Butt Cleaning (E2)		J2 (E2)	0J2	EQPT24	Dust Collector
J3	1	Butt Stripping/Crushing (E3)		J3 (E3)	0J3	EQPT25	Dust Collector
K1	1	Bath Crush/Crucible Cleaning [P1(23)]		K1 [P1(23)]	K1	EQPT26	Dust Collector

1.0 Emission Unit Index

> The following table provides an index of emission units that are referenced in the emission calculations and air permit application forms.

					2007 KyEIS	2007 KyEIS	
EUID	Process ID	Emission Unit Description	Process Description	Title V Unit #	SI#	ID#	Notes
K3	1	Butt Crushing (E4)		K3 (E4)	0K3	EQPT27	Dust Collector
K5	1	Butt Impactor (E5)		K5 (E5)	0K5	EQPT28	Dust Collector
K7	1	Coke Crushing (E6)		K7 (E6)	0K7	EQPT29	Dust Collector
L1	1	Coke Ball Mill (E7)		L1 (E7)	0L1	EQPT30	Dust Collector
L3	1	Coke Fines Handling (E8)		L3 (E8)	0L3	EQPT31	Dust Collector
M1	1	Anode Mix Hopper (E9)		M1 (E9)	M1	EQPT33	Dust Collector
M2	1	Anode Mix Conveying (1E)		M2 (1E)	M2-M7	EQPT34	Scrubber
M3	1	Anode Mix Conveying (2E)		M3 (2E)	M2-M7	EQPT34	Scrubber
M4	1	Anode Mix Conveying (3E)		M4 (3E)	M2-M7	EQPT34	Scrubber
M5	1	Anode Mixers (6E,7E, 8E)		M5 (6E,7E,8E)	M2-M7	EQPT34	Scrubber
M6	1	Anode Mixers (9E, EA)		M6 (9E,EA)	M2-M7	EQPT34	Scrubber
M7	1	Anode Mixers (5E, 4E)		M7 (5E,4E)	M2-M7	EQPT34	Scrubber
N2	1	Anode Bake Furnace (261 Furnace)	ABF Baked Anodes	N2 (EE)	N2	COMB06	Scrubber
N2	2	Anode Bake Furnace (261 Furnace)	ABF Gas Burners	N2 (EE)	N2	COMB06	Scrubber
Q2	1	Electric Induction Furnaces #1, #2, #3		Q2 (EF)	Q2	EQPT03	Dust Collector
Q4	1	Anode Rod Cleaning (EG)		Q4 (EG)	0Q4	EQPT41	Dust Collector
S5	1	Electrode Boiler (S6) (EI)		S5 (EI)	S5	COMB12	No Add-On Control
S6	1	Indirect Heat Exchanger (S6) (EI)		S6 (EI)	S6	COMB14	No Add-On Control
U1	1	Bath Transfer to Storage Processing (5P)		U1 (5P)	U1	EQPT46	Dust Collector
U2	1	Green Anode Dust Collector (CI7)		U2 (CI7)	0U2	EQPT54	Dust Collector
U3	1	Central Anode Butts Cleaning (EJ)		U3 (EJ)	0U3	EQPT52	Dust Collector
U4	1	Anode Saw Dust Collector (EQ1)		U4 (EQ1)	0U4	EQPT53	Dust Collector
U5	1	Pitch Storage Tanks (EO72, EO73)		U5 (EO 72,73)	0U5	EQPT51	No Add-On Control
Z1	1	Unpaved Haul Roads (EP)		EP (EP)	EP	AREA05	No Add-On Control

2.0 Summary of Facility-Wide Project-Related Emissions Increase

Source of Emissions	PM (tpy)	PM10 (tpy)	PM2.5 (tpy)	NOX (tpy)	CO (tpy)	VOC (tpy)	SO2 (tpy)	Fluorides (tpy)
Potline Emissions Increase	90.2	90.2	63.9	-	8,511.2	-	1,945.6	159.2
Associated Emissions Increase	20.4	20.1	20.1	23.9	105.4	4.5	56.3	0.0
Total Project-Related Emissions Increase	110.7	110.4	84.1	23.9	8,616.6	4.5	2,001.9	159.3
PSD Significant Emission Rate	-	15	10	40	100	40	40	3
PSD Triggered?	NA	Y	Y	N	Y	N	Y	Y

3.0 Potline Emission Increase Calculations

3.1 Potline Production Increase

Baseline Production Rate

Most recent 24-month annual average potline production rate	213,326 ton Al/yr	24-month period ending 07/2008
Current Title V permit represented maximum	219,999 ton Al/yr	

Anticipated Future Production Capacity

Proposed annual aluminum production rate (metric units)	230,000 mt/yr
Proposed annual aluminum production rate	253,531 ton Al/yr
Percent increase from baseline period production	18.85 %

* Per NSR Reform, for determining PSD applicability, the highest 24-month period in the previous 10 years can be used in defining baseline actual emissions. However, pursuant to EPA Region 4 guidance, the most recent 24-month period must be used for dispersion modeling purposes. So that two sets of calculations do not need to be presented, and because regardless of the baseline period chosen, the PSD applicability conclusions will not be affected for any pollutant, the more conservative approach of using the most recent 24-month period is used here.

3.2 CO Emission Increase Calculations

CO Baseline Emission Rate:

- > The baseline CO emission rate for the potlines is calculated using an emission factor that is based on the average CO stack test result from testing conducted at Sebree Works in February 2005, applied to annual average aluminum production data for the period August 2006 to July 2008. The February 2005 stack test consisted of 3 runs on reactor 5 on the Potline 2 North A-398 scrubber.

CO Emission Factor for Potline Roof Vents	1.98	lb/ton Al	1% of total emissions
CO Emission Factor for Potline A-398 Scrubbers	195.9	lb/ton Al	Average from February 15 and 16, 2005 stack test
Combined CO Emission Factor	197.8	lb/ton Al	
Baseline Potline Production	213,326	ton Al/yr	24-month period ending 07/2008
Baseline CO Emissions for Potline Roof Vents	211	tpy	
Baseline CO Emissions for Potline A-398 Scrubbers	20,891	tpy	
Baseline CO Emission Rate	21,102	tpy	

CO Future Potential Emission Rate:

- > The future CO emission rate for the potlines is calculated using an emission factor that is based on the 90th Upper Confidence Level of results from CO stack tests conducted at Sebree Works in February 2005, applied to the future potline aluminum production capacity. This emission rate is representative of BACT.

CO Emission Factor for Potline Roof Vents	2.34	lb/ton Al	1% of total emissions
CO Emission Factor for Potline A-398 Scrubbers	231.3	lb/ton Al	90th UCL from February 15 and 16, 2005 stack test
Combined CO Emission Factor	233.6	lb/ton Al	
Future Potline Production Capacity	253,531	tpy	
Future Potential CO Emissions for Potline Roof Vents	296	tpy	
Future Potential CO Emissions for Potline A-398 Scrubbers	29,317	tpy	
Future Potential CO Emission Rate	29,613	tpy	
Annual Average CO Emission Rate	6,761	lb/hr	

Potline CO Emissions Increase

CO Emission Increase for Potline Roof Vents	85	tpy
CO Emission Increase for Potline A-398 Scrubbers	8,426	tpy
Total Potline CO Emissions Increase	8,511	tpy

3.3 PM/PM10 Emission Increase Calculations

PM/PM10 Baseline Emission Rate:

- > The baseline PM/PM10 emission rate for the potlines is calculated using an emission factor that is based on the average PM/PM10 measured during testing conducted at Sebree Works in June and July 2006, applied to annual average aluminum production data for the period August 2006 to July 2008. The June and July 2006 stack test consisted of 4 runs on one reactor on the Potline 3 South A-398 scrubber and 9 runs on the M-14 downcomer on Potline 3 South. The highest three test runs on each emission unit were used to develop an emission factor representative of a single, 3 run sampling event.

Controlled PM/PM10 Emission Factor for Potline Roof Vents	1.53	lb/ton Al	Average of three runs from June/July 2006 Stack Test Results for Total PM10
Controlled PM/PM10 Emission Factor for Potline A-398 Scrubbers	0.32	lb/ton Al	Average of three runs from June/July 2006 Stack Test Results for Total PM10
Combined PM/PM10 Emission Factor	1.85	lb/ton Al	
Baseline Potline Production	213,326	ton Al/yr	24-month period ending 07/2008
Baseline PM/PM10 Emissions for Potline Roof Vents	163	tpy	
Baseline PM/PM10 Emissions for Potline A-398 Scrubbers	34	tpy	
Baseline PM/PM10 Emission Rate	197	tpy	

PM/PM10 Future Potential Emission Rate:

- > The future PM/PM10 emission rate for the potlines is calculated using an emission factor that is based on the 90th Upper Confidence Level of results from PM/PM10 stack tests conducted at Sebree Works in June and July 2006, applied to the future potline aluminum production capacity. The 90th Upper Confidence Level was calculated based on the highest three test runs on each emission unit to develop an emission factor representative of a single, 3 run sampling event. This emission rate is representative of BACT.

Controlled PM/PM10 Emission Factor for Potline Roof Vents	1.77	lb/ton Al	90th UCL of June/July 2006 Stack Test Results
Controlled PM/PM10 Emission Factor for Potline A-398 Scrubbers	0.50	lb/ton Al	90th UCL of June/July 2006 Stack Test Results
Combined PM/PM10 Emission Factor	2.27	lb/ton Al	
Future Potline Production Capacity	253,531	tpy	
Future Potential PM/PM10 Emissions for Potline Roof Vents	224	tpy	
Future Potential PM/PM10 Emissions for Potline A-398 Scrubbers	64	tpy	
Future Potential PM/PM10 Emission Rate	288	tpy	
Annual Average PM/PM10 Emission Rate	65.6	lb/hr	

Potline PM/PM10 Emissions Increase

PM/PM10 Emission Increase for Potline Roof Vents	61	tpy
PM/PM10 Emission Increase for Potline A-398 Scrubbers	29	tpy
Total Potline PM/PM10 Emissions Increase	90.2	tpy

3.4 PM2.5 Emission Increase Calculations

PM2.5 Baseline Emission Rate:

- > The baseline PM2.5 emission rate for the potlines is calculated using an emission factor that is based on the average PM2.5 measured during testing conducted at Sebree Works in June and July 2006, applied to annual average aluminum production data for the period August 2006 to July 2008. The June and July 2006 stack test consisted of 4 runs on one reactor on the Potline 3 South A-398 scrubber and 9 runs on the M-14 downcomer on Potline 3 South. The highest three test runs on each emission unit were used to develop an emission factor representative of a single, 3 run sampling event.

Controlled PM2.5 Emission Factor for Potline Roof Vents	1.15	lb/ton Al	Average of three runs from June/July 2006 Stack Test Results for PM2.5
Controlled PM2.5 Emission Factor for Potline A-398 Scrubbers	0.31	lb/ton Al	Average of three runs from June/July 2006 Stack Test Results for PM2.5
Combined PM2.5 Emission Factor	1.45	lb/ton Al	
Baseline Potline Production	213,326	ton Al/yr	24-month period ending 07/2008
Baseline PM2.5 Emissions for Potline Roof Vents	122	tpy	
Baseline PM2.5 Emissions for Potline A-398 Scrubbers	33	tpy	
Baseline PM2.5 Emission Rate	155	tpy	

PM2.5 Future Potential Emission Rate:

- > The future PM2.5 emission rate for the potlines is calculated using an emission factor that is based on the 90th Upper Confidence Level of results from PM2.5 stack tests conducted at Sebree Works in June and July 2006, applied to the future potline aluminum production capacity. The 90th Upper Confidence Level was calculated based on the highest three test runs on each emission unit to develop an emission factor representative of a single, 3 run sampling event. This emission rate is representative of BACT.

Controlled PM2.5 Emission Factor for Potline Roof Vents	1.24	lb/ton Al	90th UCL of June/July 2006 Stack Test Results
Controlled PM2.5 Emission Factor for Potline A-398 Scrubbers	0.49	lb/ton Al	90th UCL of June/July 2006 Stack Test Results
Combined PM2.5 Emission Factor	1.73	lb/ton Al	
Future Potline Production Capacity	253,531	tpy	
Future Potential PM2.5 Emissions for Potline Roof Vents	157	tpy	
Future Potential PM2.5 Emissions for Potline A-398 Scrubbers	62	tpy	
Future Potential PM2.5 Emission Rate	219	tpy	
Annual Average PM2.5 Emission Rate	50.0	lb/hr	

Potline PM2.5 Emissions Increase

PM2.5 Emission Increase for Potline Roof Vents	34	tpy
PM2.5 Emission Increase for Potline A-398 Scrubbers	30	tpy
Total Potline PM2.5 Emissions Increase	63.9	tpy

3.5 Fluorides Emission Increase Calculations

Fluorides Baseline Emission Rate:

- > The baseline total fluorides emission rate for the potlines is calculated using an emission factor that is based on the average stack test result from monthly roof vent testing conducted at Sebree Works in the 24-month period ending July 2008 and annual A-398 scrubber testing conducted at Sebree Works in 2007 and 2008, applied to annual average aluminum production data for the period August 2006 to July 2008. Although PSD applies to only non-HF fluorides, no attempt was made to extract out the non-HF fraction of the total fluorides determined using stack test results, for either the baseline or future emission calculations. This is a conservative calculation methodology.

Combined Fluorides Emission Factor	0.77	lb/ton Al	24-month average value for period ending July 2008.
Baseline Potline Production	213,326	ton Al/yr	24-month period ending 07/2008

Baseline Fluorides Emission Rate	82	tpy

Fluorides Future Potential Emission Rate:

- > The future fluorides emission rate for the potlines is calculated using an emission factor based on the PMACT limitation for existing sources, applied to the future potline aluminum production capacity. This emission rate is representative of BACT. Although PSD applies to only non-HF fluorides, no attempt was made to extract out the non-HF fraction of the total fluorides emission limitation.

Combined Fluorides Emission Factor	1.9	lb/ton Al	PMACT limitation for existing sources - Proposed BACT limit.
Future Potline Production Capacity	253,531	tpy	

Future Potential Fluorides Emission Rate	241	tpy
Annual Average Fluorides Emission Rate	55.0	lb/hr

<u>Potline Fluorides Emissions Increase</u>	159.2	tpy

3.6 SO2 Emission Increase Calculations

SO2 Baseline Emission Rate:

- > RTA uses the SO2 Engine to calculate facility-wide SO2 emissions through a mass balance approach to demonstrate ongoing compliance with existing SO2 limitations. The baseline SO2 emission rate for the potlines is determined through a review of the SO2 Engine data set for the period from 2003 through 2008. Taking into account baked anode sulfur contents and anode consumption rates, the selected baseline SO2 emission rate occurred in the period between February 2005 and January 2007. (This period was selected pursuant to NSR Reform requirements, where any 24-month baseline period can be assigned in the previous 10 year period for the purposes of the PSD applicability analysis. The modeling significance analysis results in concentrations over the Significant Impact Levels (SILs), so the modeling analysis will not be affected by whether the most recent 24-month period or another 24-month period is used in the modeling significance analysis.) Five percent of the baked anode sulfur is emitted as COS and of the remaining baked anode sulfur not emitted as COS, 2% is emitted as condensible particulate matter.

Aluminum Production	213,326	ton Al/yr	24-month period ending 07/2008
Anode Consumption Rate	0.428	t/t Al	24-month period ending 07/2008
Baked Anode Sulfur Content	2.27	%S	24-month period ending 07/2008
Uncorrected SO2 emissions from potlines (not accounting for COS or CPM)	4,146	tpy	= (213326 ton Al/yr) x (0.428 t/t Al) x (2.27% S) x (2 ton SO2/ton S)
% of BA Sulfur Emitted as COS	5	%	
COS baseline emissions:	207	tpy	
Remaining SO2 emissions after accounting for COS:	3,939	tpy	
% of remaining SO2 emissions emitted as CPM:	2	%	
Baseline SO2 Emissions from Potline	3,860	tpy	
% of Potline Emissions from A-398 Scrubbers	99	%	
Baseline SO2 Emissions for Potline Roof Vents	39	tpy	
Baseline SO2 Emissions for Potline A-398 Scrubbers	3,821	tpy	

SO2 Future Potential Emission Rate:

- > The future potential emission rate for the potlines (5,806 tpy) is a portion of the proposed BACT-level emission rate (6,326 tpy), which covers the potlines and anode bake furnace combined. The SO2 Engine input parameters that are the basis of this BACT emission rate take into account historical data for the key process variables and forecasts of future raw material characteristics (e.g., sulfur contents). The future potential SO2 emission rate for the potlines, based on application of the SO2 Engine to these variables, is calculated below. As with the baseline emission calculations, it is assumed that five percent of the baked anode sulfur is emitted as COS and of the remaining baked anode sulfur not emitted as COS, 2% is emitted as condensible particulate matter.

Future Potline SO2 Emissions (Based on Aluminum Production)

Future Potline Production	253,531	ton Al/yr	
Expected Future Anode Consumption Rate	0.426	t/t Al	SO2 Engine Estimate - Same as rate used in 2007 ABF PSD Application.
Baked Anode Sulfur Content	2.89	%S	SO2 Engine Estimate - Same as rate used in 2007 ABF PSD Application.
Total uncorrected SO2 emissions from potlines	6,236	tpy	= (253531 ton Al/yr) x (0.426 t/t Al) x (2.89% S) x (2 ton SO2/ton S)
% of BA Sulfur Emitted as COS	5	%	
COS baseline emissions:	312	tpy	
Remaining SO2 emissions after accounting for COS:	5,924	tpy	
% of remaining SO2 emissions emitted as CPM:	2	%	
Future SO2 Emissions from Potline	5,806	tpy	
% of Potline Emissions from A-398 Scrubbers	99	%	
Future SO2 Emissions for Potline Roof Vents	58	tpy	
Future SO2 Emissions for Potline A-398 Scrubbers	5,748	tpy	
Future SO2 Emissions from A-446 scrubber	521	tpy	Current BACT limit in Title V permit for ABF
Combined Potline and ABF SO2 Emission Rate	6,326	tpy	Proposed new BACT limit for Potlines/ABF
Current Title V Permit SO2 Cap	5,262	tpy	

SO2 Emissions Increase for Potlines

SO2 Emission Increase for Potline Roof Vents	19	tpy	
SO2 Emission Increase for Potline A-398 Scrubbers	1,926	tpy	
Total SO2 Emissions Increase for Potlines	1,946	tpy	= 5806 tpy - 3860 tpy

4.0 Production Increase Project Associated Emissions Increase Calculations

- Emission units upstream and downstream of the potlines will see an increase in annual utilization as a result of the potline capacity increase, and thus will have an associated increase in emissions due to the project. Baseline emissions are estimated based on the most recent emission factors available for each emission unit and process throughput data submitted by RTA to KDAQ in the 2007 KyEIS report scaled by the ratio of annual average aluminum production in the 24-month baseline period (August 2006 through July 2008) to the 2007 KyEIS reported aluminum production. Projected emissions are calculated by scaling the process throughput by the facility-wide aluminum production increase, based on the fact that process throughput for all units at Sebree Works is roughly proportional to aluminum production in the potlines. The emissions increases attributable to the project are then calculated as the difference between the projected emissions and the baseline emissions for each emission unit. For additional information, see Section 4 of the application report in Volume 1 of

Aluminum Production Increase

18.85 % (Refer to Section 3.1 of this appendix)

4.1 Associated Emissions Increase - PM10

EUID	Emission Unit Description	Controlled Emission Factor (lb/SCC Units)	Baseline Emissions		Projected Emissions		Attributable Emissions Increase (tpy)
			Process Throughput (tpy)	Controlled Emissions (tpy)	Process Throughput (tpy)	Controlled Emissions (tpy)	
A1	Barge Unloading (T1-T3)	0.001 lb/tons material Processed	416,893	0.22	495,464	0.27	0.04
A2	Alumina Storage (S1, S2, S3)	0.002 lb/ton alumina processed	277,928	0.32	330,309	0.38	0.06
A6	Remelt Furnace (89)	0.579 lb/ton aluminum produced	-	-	-	-	-
A7	Remelt Furnace (90)	1.900 lb/mmcsf	-	-	-	-	-
A8	Material Transfer (T4)	0.004 lb/tons material Processed	416,893	0.79	495,464	0.94	0.15
B4	Reacted Alumina Storage (S7, S8)	0.021 lb/ton alumina processed	277,928	2.96	330,309	3.52	0.56
B5	Reacted Alumina Storage (S9)	0.043 lb/ton alumina processed	138,965	2.96	165,155	3.52	0.56
B6	Ore Storage (S4, S5)	0.003 lb/ton alumina processed	277,928	0.48	330,309	0.58	0.09
B7	Ore Storage (S6)	0.002 lb/ton alumina processed	138,965	0.17	165,155	0.20	0.03
C1	Material Transfer Rail Car (T5)	0.009 lb/tons material processed	103,374	0.45	122,857	0.54	0.09
C2	Aluminum Fluoride (T6, 2S)	0.003 lb/ton aluminum fluoride processed	3,336	<0.01	3,965	<0.01	<0.01
C4	Coke Handling (T7, T8, T9)	0.001 lb/ton coke processed	103,374	0.03	122,857	0.03	<0.01
C6	Coke Handling (3S, 4S)	0.001 lb/ton coke processed	103,374	0.04	122,857	0.05	<0.01
E6	Transloading Spent Potliner & Sandblasting	0.122 lb/ton material processed	5,139	0.31	6,108	0.37	0.06
E8	Building (138) Vacuum System	0.286 lb/ton material processed	150	0.02	178	0.03	<0.01
F1	Holding Furnaces (I1-I6)	0.400 lb/tons aluminum processed	155,081	31.02	184,308	36.86	5.85
F2	Holding Furnaces (I7,I8)	0.400 lb/tons aluminum processed	68,886	13.78	81,869	16.37	2.60
G8	Ingot Casting Dross Loading (I9)	0.002 lb/ton aluminum processed	3,380	<0.01	4,017	<0.01	<0.01
H1	Homogenizing Furnace (1I)	1.900 lb/mmcsf	64	0.06	76	0.07	0.01
H2	Homogenizing Furnace (2I)	1.900 lb/mmcsf	22	0.02	26	0.02	<0.01
H3	Homogenizing Furnace (3I)	1.900 lb/mmcsf	38	0.04	46	0.04	<0.01
H4	Homogenizing Furnace (I31)	1.900 lb/mmcsf	65	0.06	77	0.07	0.01

EUID	Emission Unit Description	Controlled Emission Factor (lb/SCC Units)	Baseline Emissions		Projected Emissions		Attributable Emissions Increase (tpy)
			Process Throughput (tpy)	Controlled Emissions (tpy)	Process Throughput (tpy)	Controlled Emissions (tpy)	
J1	Butt Surge Tank (E1)	0.036 lb/ton anode processed	22,897	0.42	27,212	0.50	0.08
J2	Anode Butt Cleaning (E2)	0.390 lb/ton abrasive consumed	53	0.01	63	0.01	<0.01
J3	Butt Stripping/Crushing (E3)	0.100 lb/ton anode processed	22,897	1.15	27,212	1.36	0.22
K1	Bath Crush/Crucible Cleaning [P1(23)]	0.317 lb/ton material processed	6,556	1.04	7,792	1.23	0.20
K3	Butt Crushing (E4)	0.102 lb/ton anode processed	22,897	1.16	27,212	1.38	0.22
K5	Butt Impactor (E5)	0.058 lb/ton anode processed	22,897	0.66	27,212	0.79	0.12
K7	Coke Crushing (E6)	0.025 lb/ton coke processed	103,374	1.28	122,857	1.53	0.24
L1	Coke Ball Mill (E7)	0.020 lb/ton coke processed	103,374	1.04	122,857	1.23	0.20
L3	Coke Fines Handling (E8)	0.037 lb/ton coke processed	103,374	1.93	122,857	2.29	0.36
M1	Anode Mix Hopper (E9)	0.018 lb/ton anode processed	123,926	1.11	147,282	1.32	0.21
M2	Anode Mix Conveying (1E)	0.046 lb/ton anode processed	41,309	0.95	49,094	1.12	0.18
M3	Anode Mix Conveying (2E)	0.046 lb/ton anode processed	41,309	0.95	49,094	1.12	0.18
M4	Anode Mix Conveying (3E)	0.046 lb/ton anode processed	41,309	0.95	49,094	1.12	0.18
M5	Anode Mixers (6E, 7E, 8E)	0.046 lb/ton anode processed	41,309	0.95	49,094	1.12	0.18
M6	Anode Mixers (9E, EA)	0.046 lb/ton anode processed	41,309	0.95	49,094	1.12	0.18
M7	Anode Mixers (5E, 4E)	0.046 lb/ton anode processed	41,309	0.95	49,094	1.12	0.18
N2	Anode Bake Furnace (261 Furnace)	0.131 lb/Tons Material Processed	116,928	7.66	138,966	9.10	1.44
N2	Anode Bake Furnace (261 Furnace)	1.900 lb/mmescf	317	0.30	377	0.36	0.06
Q2	Electric Induction Furnaces #1, #2, #3	0.056 lb/ton aluminum charged	1,497	0.04	1,779	0.05	<0.01
Q4	Anode Rod Cleaning (EG)	0.001 lb/ton abrasive consumed	45	<0.01	53	<0.01	<0.01
S5	Electrode Boiler (S6) (EI)	1.900 lb/mmescf	46	0.04	55	0.05	<0.01
S6	Indirect Heat Exchanger (S6) (EI)	1.900 lb/mmescf	15	0.01	18	0.02	<0.01
U1	Bath Transfer to Storage Processing (5P)	0.667 lb/ton material processed	54,023	18.03	64,204	21.42	3.40
U2	Green Anode Dust Collector (CI7)	0.094 lb/each anode Processed	142,896	6.69	169,828	7.95	1.26
U3	Central Anode Butts Cleaning (EJ)	0.231 lb/ton anode processed	22,897	2.64	27,212	3.14	0.50
U4	Anode Saw Dust Collector (EQ1)	0.036 lb/ton anode processed	116,927	2.13	138,964	2.53	0.40
U5	Pitch Storage Tanks (EO72, EO73)	0.004 lb/ton pitch processed	17,932	0.04	21,312	0.05	<0.01
Total PM10 Associated Emissions Increase							20.13

4.2 Associated Emissions Increase - PM2.5

EUID	Emission Unit Description	Controlled Emission Factor (lb/SCC Units)	Baseline Emissions		Projected Emissions		Attributable Emissions Increase (tpy)
			Process Throughput (tpy)	Controlled Emissions (tpy)	Process Throughput (tpy)	Controlled Emissions (tpy)	
A1	Barge Unloading (T1-T3)	0.001 lb/tons material Processed	416,893	0.22	495,464	0.27	0.04
A2	Alumina Storage (S1, S2, S3)	0.002 lb/ton alumina processed	277,928	0.32	330,309	0.38	0.06
A6	Remelt Furnace (89)	0.579 lb/ton aluminum produced	-	-	-	-	-
A7	Remelt Furnace (90)	1.900 lb/mmcsf	-	-	-	-	-
A8	Material Transfer (T4)	0.004 lb/tons material Processed	416,893	0.79	495,464	0.94	0.15
B4	Reacted Alumina Storage (S7, S8)	0.021 lb/ton alumina processed	277,928	2.96	330,309	3.52	0.56
B5	Reacted Alumina Storage (S9)	0.043 lb/ton alumina processed	138,965	2.96	165,155	3.52	0.56
B6	Ore Storage (S4, S5)	0.003 lb/ton alumina processed	277,928	0.48	330,309	0.58	0.09
B7	Ore Storage (S6)	0.002 lb/ton alumina processed	138,965	0.17	165,155	0.20	0.03
C1	Material Transfer Rail Car (T5)	0.009 lb/tons material processed	103,374	0.45	122,857	0.54	0.09
C2	Aluminum Fluoride (T6, 2S)	0.003 lb/ton aluminum fluoride processed	3,336	<0.01	3,965	<0.01	<0.01
C4	Coke Handling (T7, T8, T9)	0.001 lb/ton coke processed	103,374	0.03	122,857	0.03	<0.01
C6	Coke Handling (3S, 4S)	0.001 lb/ton coke processed	103,374	0.04	122,857	0.05	<0.01
E6	Transloading Spent Potliner & Sandblasting	0.122 lb/ton material processed	5,139	0.31	6,108	0.37	0.06
E8	Building (138) Vacuum System	0.286 lb/ton material processed	150	0.02	178	0.03	<0.01
F1	Holding Furnaces (I1-I6)	0.400 lb/tons aluminum processed	155,081	31.02	184,308	36.86	5.85
F2	Holding Furnaces (I7,I8)	0.400 lb/tons aluminum processed	68,886	13.78	81,869	16.37	2.60
G8	Ingot Casting Dross Loading (I9)	0.002 lb/ton aluminum processed	3,380	<0.01	4,017	<0.01	<0.01
H1	Homogenizing Furnace (1I)	1.900 lb/mmcsf	64	0.06	76	0.07	0.01
H2	Homogenizing Furnace (2I)	1.900 lb/mmcsf	22	0.02	26	0.02	<0.01
H3	Homogenizing Furnace (3I)	1.900 lb/mmcsf	38	0.04	46	0.04	<0.01
H4	Homogenizing Furnace (I31)	1.900 lb/mmcsf	65	0.06	77	0.07	0.01
J1	Butt Surge Tank (E1)	0.036 lb/ton anode processed	22,897	0.42	27,212	0.50	0.08
J2	Anode Butt Cleaning (E2)	0.390 lb/ton abrasive consumed	53	0.01	63	0.01	<0.01
J3	Butt Stripping/Crushing (E3)	0.100 lb/ton anode processed	22,897	1.15	27,212	1.36	0.22
K1	Bath Crush/Crucible Cleaning [P1(23)]	0.317 lb/ton material processed	6,556	1.04	7,792	1.23	0.20
K3	Butt Crushing (E4)	0.102 lb/ton anode processed	22,897	1.16	27,212	1.38	0.22
K5	Butt Impactor (E5)	0.058 lb/ton anode processed	22,897	0.66	27,212	0.79	0.12
K7	Coke Crushing (E6)	0.025 lb/ton coke processed	103,374	1.28	122,857	1.53	0.24
L1	Coke Ball Mill (E7)	0.020 lb/ton coke processed	103,374	1.04	122,857	1.23	0.20
L3	Coke Fines Handling (E8)	0.037 lb/ton coke processed	103,374	1.93	122,857	2.29	0.36
M1	Anode Mix Hopper (E9)	0.018 lb/ton anode processed	123,926	1.11	147,282	1.32	0.21

EUID	Emission Unit Description	Controlled Emission Factor (lb/SCC Units)	Baseline Emissions		Projected Emissions		Attributable Emissions Increase (tpy)
			Process Throughput (tpy)	Controlled Emissions (tpy)	Process Throughput (tpy)	Controlled Emissions (tpy)	
M2	Anode Mix Conveying (1E)	0.046 lb/ton anode processed	41,309	0.95	49,094	1.12	0.18
M3	Anode Mix Conveying (2E)	0.046 lb/ton anode processed	41,309	0.95	49,094	1.12	0.18
M4	Anode Mix Conveying (3E)	0.046 lb/ton anode processed	41,309	0.95	49,094	1.12	0.18
M5	Anode Mixers (6E, 7E, 8E)	0.046 lb/ton anode processed	41,309	0.95	49,094	1.12	0.18
M6	Anode Mixers (9E, EA)	0.046 lb/ton anode processed	41,309	0.95	49,094	1.12	0.18
M7	Anode Mixers (5E, 4E)	0.046 lb/ton anode processed	41,309	0.95	49,094	1.12	0.18
N2	Anode Bake Furnace (261 Furnace)	0.131 lb/Tons Material Processed	116,928	7.66	138,966	9.10	1.44
N2	Anode Bake Furnace (261 Furnace)	1.900 lb/mmcsf	317	0.30	377	0.36	0.06
Q2	Electric Induction Furnaces #1, #2, #3	0.056 lb/ton aluminum charged	1,497	0.04	1,779	0.05	<0.01
Q4	Anode Rod Cleaning (EG)	0.001 lb/ton abrasive consumed	45	<0.01	53	<0.01	<0.01
S5	Electrode Boiler (S6) (EI)	1.900 lb/mmcsf	46	0.04	55	0.05	<0.01
S6	Indirect Heat Exchanger (S6) (EI)	1.900 lb/mmcsf	15	0.01	18	0.02	<0.01
U1	Bath Transfer to Storage Processing (5P)	0.667 lb/ton material processed	54,023	18.03	64,204	21.42	3.40
U2	Green Anode Dust Collector (CI7)	0.094 lb/each anode Processed	142,896	6.69	169,828	7.95	1.26
U3	Central Anode Butts Cleaning (EJ)	0.231 lb/ton anode processed	22,897	2.64	27,212	3.14	0.50
U4	Anode Saw Dust Collector (EQ1)	0.036 lb/ton anode processed	116,927	2.13	138,964	2.53	0.40
U5	Pitch Storage Tanks (EO72, EO73)	0.004 lb/ton pitch processed	17,932	0.04	21,312	0.05	<0.01
Total PM2.5 Associated Emissions Increase							20.13

4.3 Associated Emissions Increase - NOX

EUID	Emission Unit Description	Controlled Emission Factor (lb/SCC Units)	Baseline Emissions		Projected Emissions		Attributable Emissions Increase (tpy)
			Process Throughput (tpy)	Controlled Emissions (tpy)	Process Throughput (tpy)	Controlled Emissions (tpy)	
F1	Holding Furnaces (I1-I6)	1.196 lb/tons aluminum processed	155,081	92.72	184,308	110.20	17.48
F2	Holding Furnaces (I7,I8)	0.399 lb/tons aluminum processed	68,886	13.73	81,869	16.32	2.59
H1	Homogenizing Furnace (1I)	100 lb/mmescf	64	3.20	76	3.80	0.60
H2	Homogenizing Furnace (2I)	100 lb/mmescf	22	1.10	26	1.30	0.21
H3	Homogenizing Furnace (3I)	100 lb/mmescf	38	1.92	46	2.28	0.36
H4	Homogenizing Furnace (I31)	100 lb/mmescf	65	3.23	77	3.84	0.61
N2	Anode Bake Furnace (261 Furnace)	50 lb/mmescf	317	7.93	377	9.43	1.50
S5	Electrode Boiler (S6) (EI)	100 lb/mmescf	46	2.30	55	2.73	0.43
S6	Indirect Heat Exchanger (S6) (EI)	100 lb/mmescf	15	0.74	18	0.88	0.14
Total NOX Associated Emissions Increase							23.91

4.4 Associated Emissions Increase - CO

EUID	Emission Unit Description	Controlled Emission Factor (lb/SCC Units)	Baseline Emissions		Projected Emissions		Attributable Emissions Increase (tpy)
			Process Throughput (tpy)	Controlled Emissions (tpy)	Process Throughput (tpy)	Controlled Emissions (tpy)	
F1	Holding Furnaces (I1-I6)	0.169 lb/tons aluminum processed	155,081	13.12	184,308	15.60	2.47
F2	Holding Furnaces (I7,I8)	0.056 lb/tons aluminum processed	68,886	1.94	81,869	2.31	0.37
H1	Homogenizing Furnace (1I)	84 lb/mmescf	64	2.68	76	3.19	0.51
H2	Homogenizing Furnace (2I)	84 lb/mmescf	22	0.92	26	1.10	0.17
H3	Homogenizing Furnace (3I)	84 lb/mmescf	38	1.61	46	1.91	0.30
H4	Homogenizing Furnace (I31)	84 lb/mmescf	65	2.72	77	3.23	0.51
N2	Anode Bake Furnace (261 Furnace)	8.900 lb/Tons Material Processed	116,928	520.33	138,966	618.40	98.07
N2	Anode Bake Furnace (261 Furnace)	84 lb/mmescf	317	13.33	377	15.84	2.51
S5	Electrode Boiler (S6) (EI)	84 lb/mmescf	46	1.93	55	2.30	0.36
S6	Indirect Heat Exchanger (S6) (EI)	84 lb/mmescf	15	0.62	18	0.74	0.12
Total CO Associated Emissions Increase							105.39

4.5 Associated Emissions Increase - VOC

EUID	Emission Unit Description	Controlled Emission Factor (lb/SCC Units)	Baseline Emissions		Projected Emissions		Attributable Emissions Increase (tpy)
			Process Throughput (tpy)	Controlled Emissions (tpy)	Process Throughput (tpy)	Controlled Emissions (tpy)	
A7	Remelt Furnace (90)	5.5 lb/mmcsf	-	-	-	-	-
F1	Holding Furnaces (I1-I6)	0.199 lb/tons aluminum processed	155,081	15.43	184,308	18.34	2.91
F2	Holding Furnaces (I7,I8)	0.199 lb/tons aluminum processed	68,886	6.85	81,869	8.15	1.29
H1	Homogenizing Furnace (1I)	5.5 lb/mmcsf	64	0.18	76	0.21	0.03
H2	Homogenizing Furnace (2I)	5.5 lb/mmcsf	22	0.06	26	0.07	0.01
H3	Homogenizing Furnace (3I)	5.5 lb/mmcsf	38	0.11	46	0.13	0.02
H4	Homogenizing Furnace (I31)	5.5 lb/mmcsf	65	0.18	77	0.21	0.03
N2	Anode Bake Furnace (261 Furnace)	5.5 lb/mmcsf	317	0.87	377	1.04	0.16
S5	Electrode Boiler (S6) (EI)	5.5 lb/mmcsf	46	0.13	55	0.15	0.02
S6	Indirect Heat Exchanger (S6) (EI)	5.5 lb/mmcsf	15	0.04	18	0.05	<0.01
Total VOC Associated Emissions Increase							4.49

4.6 Associated Emissions Increase - SO2

EUID	Emission Unit Description	Controlled Emission Factor (lb/SCC Units)	Baseline Emissions		Projected Emissions		Attributable Emissions Increase (tpy)
			Process Throughput (tpy)	Controlled Emissions (tpy)	Process Throughput (tpy)	Controlled Emissions (tpy)	
F1	Holding Furnaces (I1-I6)	0.005 lb/tons aluminum processed	155,081	0.36	184,308	0.43	0.07
F2	Holding Furnaces (I7,I8)	0.002 lb/tons aluminum processed	68,886	0.05	81,869	0.06	0.01
H1	Homogenizing Furnace (1I)	0.6 lb/mmcsf	64	0.02	76	0.02	<0.01
H2	Homogenizing Furnace (2I)	0.6 lb/mmcsf	22	<0.01	26	<0.01	<0.01
H3	Homogenizing Furnace (3I)	0.6 lb/mmcsf	38	0.01	46	0.01	<0.01
H4	Homogenizing Furnace (I31)	0.6 lb/mmcsf	65	0.02	77	0.02	<0.01
N2	Anode Bake Furnace (261 Furnace)	5.110 lb/Tons Material Processed	116,695	298.14	138,688	354.32	56.19
N2	Anode Bake Furnace (261 Furnace)	0.6 lb/mmcsf	317	0.10	377	0.11	0.02
S5	Electrode Boiler (S6) (EI)	0.6 lb/mmcsf	46	0.01	55	0.02	<0.01
S6	Indirect Heat Exchanger (S6) (EI)	0.6 lb/mmcsf	15	<0.01	18	<0.01	<0.01
Total SO2 Associated Emissions Increase							56.30

4.7 Associated Emissions Increase - Fluoride

EUID	Emission Unit Description	Controlled Emission Factor (lb/SCC Units)	Baseline Emissions		Projected Emissions		Attributable Emissions Increase (tpy)
			Process Throughput (tpy)	Controlled Emissions (tpy)	Process Throughput (tpy)	Controlled Emissions (tpy)	
G8	Ingot Casting Dross Loading (I9)	0.061 lb/ton aluminum processed	3,380	0.10	4,017	0.12	0.02
N2	Anode Bake Furnace (261 Furnace)	0.00018 lb/Tons Material Processed	116,928	0.01	138,966	0.01	<0.01
Total Fluoride Associated Emissions Increase							0.02

5.0 Potline Potential Emissions Summary

- > This section contains a summary of the potential emissions for the potlines for all pollutants for which PSD is triggered, taking into account future production capacity and proposed BACT emission limits.

EUID	Process ID	EU Description	Process Description	SO2 Emissions ¹ (tpy)	CO Emissions ¹ (tpy)	PM10 Emissions (tpy)	PM2.5 Emissions (tpy)	Fluorides Emissions (tpy)
E1	1	Potline #1 (E1)	Potline #1 Roofs	19.4	98.7	74.6	52.2	71.1
E1	2	Potline #1 (E1)	Potline #1 A-398 Scrubbers	1,915.8	9,772.4	21.2	20.8	9.2
E3	1	Potline #2 (E3)	Potline #2 Roofs	19.4	98.7	74.6	52.2	71.1
E3	2	Potline #2 (E3)	Potline #2 A-398 Scrubbers	1,915.8	9,772.4	21.2	20.8	9.2
E5	1	Potline #3 (E5)	Potline #3 Roofs	19.4	98.7	74.6	52.2	71.1
E5	2	Potline #3 (E5)	Potline #3 A-398 Scrubbers	1,915.8	9,772.4	21.2	20.8	9.2

1. 99% of SO2 and CO emissions are released through the A-398 scrubbers and the remainder is released through the potline room roof vents.

5.1 Potential Emissions Summary for Non-Potline Emission Units

- > This section contains a summary of the potential emissions for all units except the potlines for all pollutants for which PSD is triggered, and for which a NAAQS modeling analysis is required.

EUID	Process ID	EU Description	SO2 Emissions (tpy)	CO Emissions (tpy)	Notes
A7	1	Remelt Furnace (90)	0.17	23.55	1
F1	1	Holding Furnaces (I1-I6)	0.53	19.09	1
F2	1	Holding Furnaces (I7,I8)	0.06	2.12	1
H1	1	Homogenizing Furnace (1I)	0.04	4.97	1
H2	1	Homogenizing Furnace (2I)	0.04	4.97	1
H3	1	Homogenizing Furnace (3I)	0.04	4.97	1
H4	1	Homogenizing Furnace (I31)	0.04	5.15	1
N2	1	Anode Bake Furnace (261 Furnace)-Process	520.87	650.60	2, 3
S5	1	Electrode Boiler (S6) (EI)	0.03	4.60	1
S6	1	Indirect Heat Exchanger (S6) (EI)	0.03	4.60	1

1. SO2 and CO emissions from 2007 KyEIS for Seabree Works.
2. SO2 emission limit for Anode Bake Furnace from Condition B.2.c of Seabree Works' Title V permit (V-05-088 R1).
3. Potential CO emissions for the Anode Bake Furnace as reported in the PSD permit application for the recent Anode Bake Furnace project, submitted in August 2007.

6.0 PSD Increment Baseline SO2 Emissions Calculations for Potlines

> This section contains a summary of the SO2 increment baseline emissions for the potlines.

Potlines 1 and 2

Based on the construction dates on record for Potlines 1 and 2 (August 1972), the units were in existence on the major source baseline date (January 6, 1975). Increment baseline emissions are the estimated actual emissions on the baseline date. The baseline emission rate for Potlines 1 and 2 is calculated based on the aluminum production rate and estimated physical properties of the baked anodes on the baseline date. The sulfur content of the baked anode varies over time; therefore, separate short-term and annual SO2 emission rates are calculated based on the historical short-term sulfur content and the annual average sulfur content of the pet coke, respectively. The calculation of increment baseline emissions follows the methodology presented below.

<i>Short-Term Baseline SO2</i>	Value	Units	Basis
Plant-Wide Avg Annual Aluminum Production on Baseline Date	127,479	ton Al/yr	Historical production records
Plant-Wide Hourly Aluminum Production on Baseline Date	14.55	ton Al/hr	Assumes 8,760 hours of operation
Estimated Historical Short-Term Sulfur Content in Pet Coke	2.64%		Historical pet coke inventory data
Net Carbon Consumption	0.434	ton anode /ton Al	Historical production records
Net Carbon Consumption (metric units)	434	kg/mt	
Pitch Sulfur Content	0.80%		Historical production records
Pitch Consumed	81.70	kg/mt	Historical production records
Anode Baking Loss	6.30%		Historical production records
Maximum Sulfur Content in BA	2.47%		$= (81.7 \text{ kg/mt} \times 0.8\% + (((434 \text{ kg/mt} / (1 - 6.3\%)) - 81.7 \text{ kg/mt}) \times 2.64\%)) / 434 \text{ kg/mt}$
Uncorrected Hourly SO2 Emissions from Potlines	624.28	lb/hr	$= 2.47\% \times 0.434 \text{ ton anode/ton Al} \times 14.55 \text{ ton Al/hr} \times 2 \text{ lb SO2/lb S} \times 2,000 \text{ lb/ton}$
% of BA Sulfur Emitted as COS	5	%	
COS baseline emissions:	31.21	lb/hr	$= 624.28 \text{ lb/hr} \times 5\%$
Remaining SO2 emissions after accounting for COS:	593.07	lb/hr	$= 624.28 \text{ lb/hr} - 31.21 \text{ lb/hr}$
% of remaining SO2 emissions emitted as CPM:	2	%	
Short-Term Baseline SO2 Emissions from Potlines	581.20	lb/hr	$= (1 - 2\%) \times 593.07 \text{ lb/hr}$
Short-Term Baseline SO2 Emission Factor	39.94	lb/ton Al	Short-term emission factor $(= 581.20 \text{ lb/hr} / 14.55 \text{ ton Al/hr})$
Aluminum Production per Potline on Baseline Date	7.28	ton Al/hr	Based on actual annual average aluminum production on baseline date divided evenly between two existing potlines. $(= 14.55 \text{ ton Al/hr} / 2)$
Short-Term Emissions per Potline on Baseline Date	290.6	lb/hr	$= (7.28 \text{ ton Al/hr}) \times (39.94 \text{ lb/ton Al})$
Short-Term Stack Emissions per Potline on Baseline Date	287.7	lb/hr	
Short-Term Roof Vent Emissions per Potline on Baseline Date	2.9	lb/hr	

<i>Annual Average Baseline SO2</i>	Value	Units	Basis
Plant-Wide Avg Annual Aluminum Production on Baseline Date	127,479	ton Al/yr	Historical production records
Plant-Wide Hourly Aluminum Production on Baseline Date	14.55	ton Al/hr	Assumes 8,760 hours of operation
Estimated Historical Annual Average Sulfur Content in Pet Coke	1.60%		Historical pet coke inventory data
Net Carbon Consumption	0.434	ton anode /ton Al	Historical production records
Net Carbon Consumption (metric units)	434	kg/mt	
Pitch Sulfur Content	0.80%		
Pitch Consumed	81.70	kg/mt	
Anode Baking Loss	6.30%		
Annual Average Sulfur Content in BA	1.56%		$= (81.7 \text{ kg/mt} \times 0.8\% + (((434 \text{ kg/mt} / (1 - 6.3\%)) - 81.7 \text{ kg/mt}) \times 1.6\%)) / 434 \text{ kg/mt}$
Uncorrected Annual SO2 Emissions from Potlines	1,722.82	tpy	$= 1.56\% \times 0.434 \text{ ton anode/ton Al} \times 14.55 \text{ ton Al/hr} \times 2 \text{ lb SO}_2/\text{lb S} \times 2,000 \text{ lb/ton}$
% of BA Sulfur Emitted as COS	5	%	
COS baseline emissions:	86.14	tpy	$= 1722.82 \text{ tpy} \times 5\%$
Remaining SO2 emissions after accounting for COS:	1,636.68	tpy	$= 1722.82 \text{ tpy} - 86.14 \text{ tpy}$
% of remaining SO2 emissions emitted as CPM:	2	%	
Annual Baseline SO2 Emissions from Potlines	1,603.95	tpy	$= (1 - 2\%) \times 1636.68 \text{ tpy}$
Annual Average SO2 Emission Factor	25.16	lb/ton Al	Annual average emission factor $(= 1603.95 \text{ tpy} \times 2000 \text{ lb/ton} / 127479 \text{ ton Al/yr})$
Aluminum Production per Potline on Baseline Date	7.28	ton Al/hr	Based on actual annual average aluminum production on baseline date divided evenly between two existing potlines. $(= 14.55 \text{ ton Al/hr}$
Annual Average Emissions per Potline on Baseline Date	183.1	lb/hr	$= (7.28 \text{ ton Al/hr}) \times (25.16 \text{ lb/ton Al})$
Annual Average Stack Emissions per Potline on Baseline Date	181.3	lb/hr	
Annual Average Roof Vent Emissions per Potline on Baseline	1.8	lb/hr	

Potline 3

Based on the construction date on record for Potline 3 (August 1979) in comparison to the major source baseline date (January 6, 1975), Potline 3 was not in existence on the major source baseline date. Because Potline 3 was constructed after the major source baseline date, all of the emissions from this unit are increment consuming. Therefore, the projected potential emission rate was used to determine the level of increment consumption.

6.1 PSD Increment Baseline SO2 Emissions Calculations for All Units Except Potlines

- > This section documents the actual emissions for SO2 on the baseline date for units other than the potlines. The baseline emissions on the major source baseline date are calculated assuming that emissions are proportional to facility-wide aluminum production. Therefore, SO2 emissions calculated for the PSD netting baseline period (Section 4.6 of this appendix) are scaled by the ratio of annual facility-wide aluminum production just prior to the major source baseline date to annual average facility-wide aluminum production for August 2006 to July 2008, which is the PSD netting baseline period. See the sample calculation below and Section 4 of the application report for additional information.

	Value	Units	
Annual Aluminum Production on PSD Increment Baseline Date	127,479	tpy	Historical production records for 1974
Current Annual Aluminum Production	213,326	tpy	Average for 24-month period ending 07/2008

EUID	Process ID	EU Description	SO2 Emissions	
			Current Emissions (tpy)	Increment Baseline Date (tpy)
F1	1	Holding Furnaces (I1-I6)	0.36	0.22
F2	1	Holding Furnaces (I7,I8)	0.05	0.03
H1	1	Homogenizing Furnace (1I)	0.02	0.01
H2	1	Homogenizing Furnace (2I)	0.01	0.00
H3	1	Homogenizing Furnace (3I)	0.01	0.01
H4	1	Homogenizing Furnace (I31)	0.02	0.01
N2	1	Anode Bake Furnace (261 Furnace)	298.14	178.16
N2	2	Anode Bake Furnace (261 Furnace)	0.10	0.06
S5	1	Electrode Boiler (S6) (EI)	0.01	0.01
S6	1	Indirect Heat Exchanger (S6) (EI)	0.00	0.00

Sample Calculation for F1: SO2 Emissions on Baseline Date (tpy) = (0.36 tpy) x (127479 tpy) / (213326 tpy) = 0.22 tpy

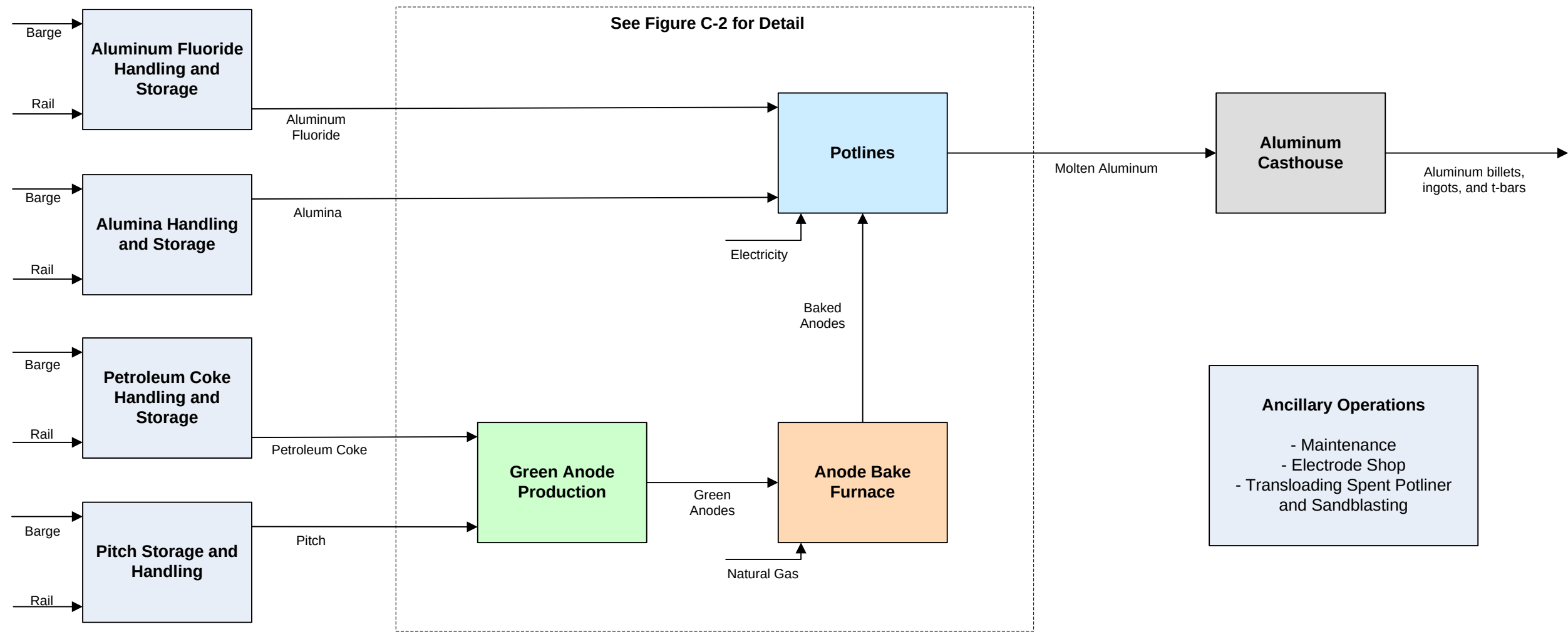
6.2 PSD Increment Affecting SO2 Emissions Calculations for All Units Except Potlines

- > This section contains a summary of the increment affecting emissions for SO2. Increment consuming SO2 emissions from units other than the potlines are calculated by subtracting emissions on the baseline date (Appendix B, Section 6.1) from future projected SO2 emissions after the production increase project is complete (Appendix B, Section 4.6). See the sample calculation below and Section 6 of the air quality modeling analysis contained in Volume 2 of the application.

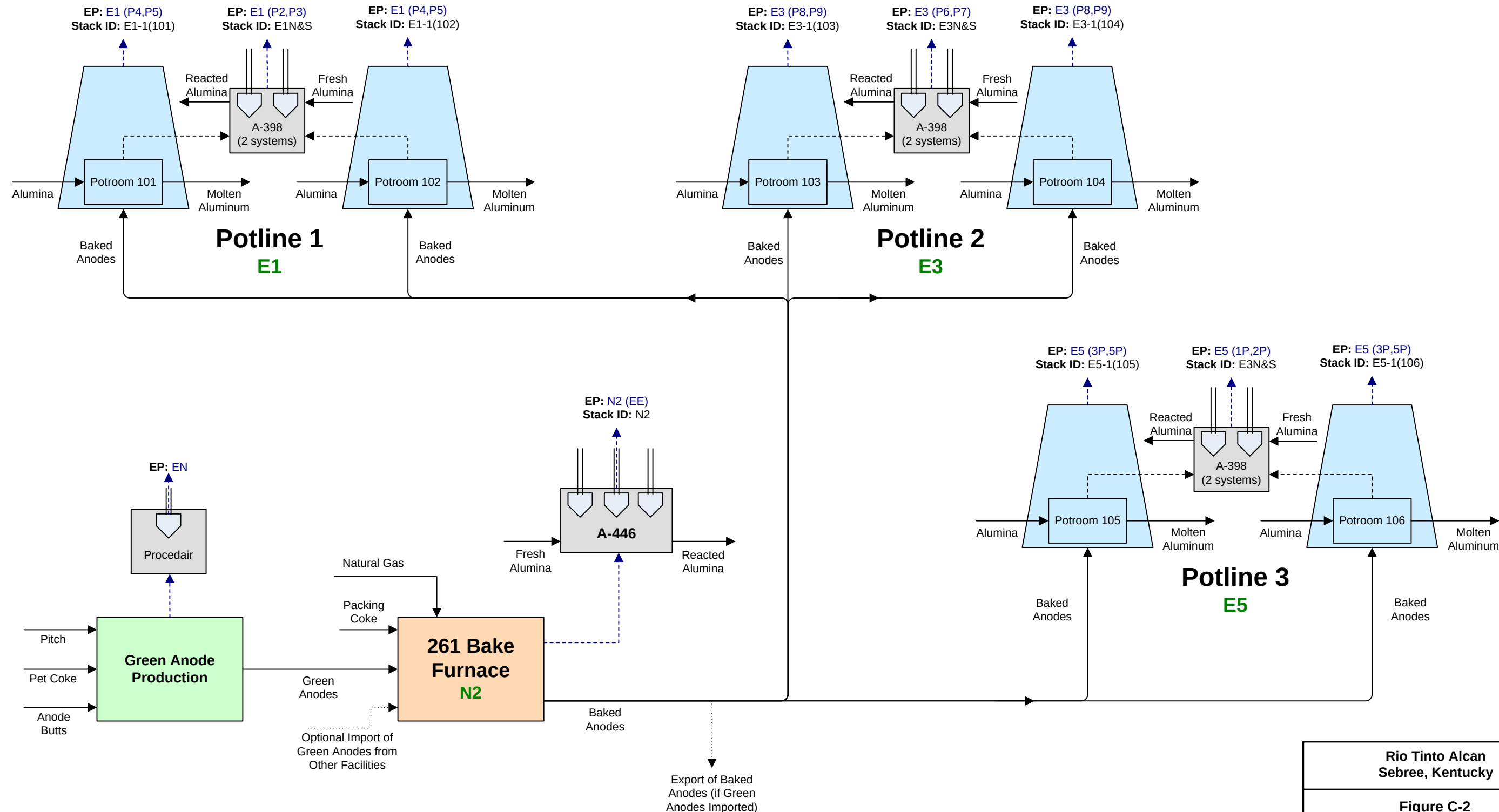
EUID	Process ID	EU Description	Increment Consuming Emissions (tpy)
F1	1	Holding Furnaces (I1-I6)	0.21
F2	1	Holding Furnaces (I7,I8)	0.03
H1	1	Homogenizing Furnace (1I)	0.01
H2	1	Homogenizing Furnace (2I)	0.00
H3	1	Homogenizing Furnace (3I)	0.01
H4	1	Homogenizing Furnace (I31)	0.01
N2	1	Anode Bake Furnace (261 Furnace)	176.17
N2	2	Anode Bake Furnace (261 Furnace)	0.06
S5	1	Electrode Boiler (S6) (EI)	0.01
S6	1	Indirect Heat Exchanger (S6) (EI)	0.00

SEBREE WORKS PROCESS FLOW DIAGRAMS

Sebree Works Simplified Facility Operations Overview



Potlines and Anode Bake Furnace Operations



Flow Legend

→ Process Flow

---→ Exhaust Gas Flow

Rio Tinto Alcan
Sebree, Kentucky

Figure C-2
Detailed Potlines and
Anode Bake Furnace
Process Flow Diagram

Tripty Consultants

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EXCERPT FROM ENVIRONMENT CANADA SO₂ CONTROL REPORT

Section 3 from the 2008 Environment Canada report is presented here to provide additional information regarding wet scrubbing control technologies that have been evaluated for control of emissions from potlines at primary aluminum plants. The reference for this report is Environment Canada, Report 605311, section 3 “Assessment of technologies for the prevention and control of SO₂ emissions”, 2008.

3 ASSESSMENT OF TECHNOLOGIES FOR THE PREVENTION AND CONTROL OF SO₂ EMISSIONS

Most of the SO₂ emissions in an aluminum smelter typically come from the electrolysis process and are related to anode consumption. The use of coke with a high sulphur content in the generation of anodes is the primary cause of these emissions. The coke used by aluminum smelters is purchased from the refining industry, for which coke is a waste product. The refining industry tends to optimize the process in order to produce fuels of higher added value (with a low sulphur content), such as gasolines. This tendency increases the sulphur content in the waste product of the refining process—coke, which aluminum smelters use. Indeed, the sulphur content of the coke supplied to the aluminum industry has been on the rise for the past few years.

To our knowledge, eleven aluminum smelters treat their atmospheric emissions of SO₂, in whole or in part, and two aluminum smelters being built plan to install an SO₂ treatment system. These aluminum smelters are located primarily in Norway and the United States. Six of the seven aluminum smelters in Norway treat their SO₂ emissions with sea water. In the aluminum smelters being built (Qatalum and EMAL), the treatment system to be installed will also use sea water. The remaining aluminum smelters (one in Norway and the other four in the United States) use sodium scrubbers (sodium carbonate or sodium hydroxide), with variations in the purge mechanism.

The 2008 update was an opportunity to check whether new technologies were available and whether the technologies of the previous study, which were identified back in 2000, had been or would soon be applied throughout the aluminum industry.

3.1 Methodology

The primary purpose of this section of the study is to update the study performed by SLEI in 2000. Each phase of the previous study was reviewed to determine whether new developments had occurred since 2000.

The review of technologies involved synthesizing the available information on the following aspects:

- description of the process
- efficiency and performance
- operation
- ranges of application
- benefits and drawbacks of the technology
- impacts on emissions of other pollutants
- the order of magnitude of investment expenses and operating expenses

3.1.1 Assessment of the technologies

In all, four technologies were reviewed in 2000, namely:

- sea water
- sodium
- sodium/calcium double alkali
- calcium

The first two were the only ones that aluminum smelters had used as of 2000, after dry scrubbers. To our knowledge, no new installation has been performed since 2000. At two of the aluminum smelters being built, sea-water scrubbers are in the plans. Experience with double-alkali scrubbers was limited: only one Söderberg-type plant (HSS), a small-capacity plant in India, has used them. This technology merits examination, as it would allow for the recycling of sodium hydroxide, an expensive reagent.

In the United States, as in the rest of the world, calcium is the most widely used technology for treating the gases from coal-fired power plants. Historically, this technology has always been rejected by aluminum smelters because of its high cost of investment and the large amount of space that it takes up—the size of a dry gas-treatment centre for an aluminum smelter using prebaked anodes. In addition, operational factors also limit the attractiveness of this technology. In general, it requires a plant for grinding and preparing the calcium carbonate, and the waste generated is abundant and often cannot be recycled, as the calcium sulphate produced is not of commercial quality suitable for gypsum-board factories.

During the study in the year 2000, potential emerging technologies were identified; that is, either recent technologies that were applied to sectors other than the aluminum industry or promising technologies that were already in the pilot phase. The three potential technologies identified were the following:

- Cansolv technology, in which SO_2 is absorbed by amines and then desorbed in the form of a commercial product (acid or SO_2)
- Biostar technology, by Danieli Corus (Hoogovens), in which the wash liquor of the sodium scrubber is treated in a batch reactor to extract elemental sulphur and recover the caustic soda continuously recycled in the scrubber
- A dry scrubber with two-stage alumina injection, being developed by Alstom, in which the desorbed SO_2 could potentially be upgraded.

As far as we know, only the Cansolv technology had been implemented as of the year 2000, though not in the aluminum industry. Of these three technologies, only the Cansolv technology has been retained in this update (Section 3.6).

Since 2000, new technologies for treating SO_2 emissions have been developed or improved. Of these new technologies, we have identified three that could prove interesting, although they have not been used in the aluminum industry. The technologies identified are the following:

MEL (Magnesium Enhanced Lime) technology, which involves improving the calcium scrubber through the use of lime improved with magnesium oxide.

- The SNOX process, developed by TOPSØE Technologies. This technology uses a catalytic process to convert SO_2 to sulphuric acid suitable for sale.
- Absorption of SO_2 using ammonia, from the firm Marsulex. This process allows for the SO_2 to be converted into ammonium sulphate gas, which can be used as a fertilizer.

In addition, two technologies that could potentially reduce SO₂ at the source were reviewed. By eliminating sulphur before the electrolysis process, these two technologies would lead to a reduction in the amount of SO₂ emitted by aluminum smelters. These two technologies are:

- Hydrotreating of the waste products used in the production of petroleum coke.
- The use of inert anode technology, which has been under development for several years. This technology, however, will not be feasible in the short term.

A description of these various processes and technologies can be found in Section 3.6 of this report.

In general, SO₂ emissions treatment technologies follow the basic chemical principle of the conservation of matter, according to which “nothing is created, nothing is destroyed, and everything can be transformed.” The treatment of atmospheric emissions of SO₂ necessarily requires the transformation of the gases to be treated into a liquid or a solid. In the case of technologies currently used by aluminum smelters, SO₂ is converted into sulphate dissolved in sea water or in a sodium liquor. Continuous purging helps to equalize the levels of sulphates in the liquor. This purged liquor, rich in sulphates or in salt, is then emptied into a waterway.

Power plants use lime or calcium carbonate to capture SO₂, and some of them manage to produce commercial-grade gypsum (CaSO₄ · 2H₂O) or sulphuric acid.

Absorption technologies, such as Cansolv technology, have the benefit of minimizing waste products while upgrading the SO₂ in the form of sulphur, SO₂ or acid that may potentially have a commercial value. The objective, however, is not to make a profit on the products but to avoid the costs of disposal and to recover certain expenses (*e.g.*, shipping) through the sale of the product to a user.

Several factors interact in a complex manner and may affect the choice of a technology for removing SO₂ at a specific site. At least four aspects must be considered:

1. Considerations related to the smelter's site. For example, only the two aluminum smelters on the Côte-Nord could consider using treatment by means of sea water, if the alkalinity of the sea water allowed.
2. Availability of costs and reagents. For example, caustic soda could be selected at Jonqui re, because it is already in use there in the Bayer process for extracting alumina.
3. Available alternatives for the disposal of effluent liquors or solid wastes. At some sites, liquid discharges are prohibited because of the sensitivity of the environment.
4. Performance requirements (efficiency of scrubbing).

Currently there is no single optimal solution that applies to all plants.

For each of the technologies identified, a description several pages long was written. The information came primarily from the suppliers of SO₂ scrubbing technology, namely the companies Alstom, Envitech, Marsulex, MECS, Solios and Cansolv. Multiple exchanges were held with these suppliers in order to collect the information presented.

A table in Section 3.7 presents a comparison of the identified technologies according to the performance, experience, inputs, wastes and upgradable products of the various technologies. A few observations concerning the applicability of these technologies to aluminum smelters are also made.

Assessment of costs of implementation

For each technology, an order of magnitude for investment expenses, obtained from the information compiled, is presented.

The costs of operation and maintenance, however, are related more to the costs of the reagents used, and therefore to the amount of SO_2 to be captured. Conversely, the costs of energy depend on the amount of gas to be processed. The costs of the main reagents were calculated according to the amounts identified in the processes' inputs and the costs obtained from suppliers in Québec in May 2008. The table of the unit costs used in the study is given in Appendix A. Note that the unit costs of the chemicals can fluctuate according to market conditions and shipping distances. The prices given in Appendix A exclude shipping fees and other applicable expenses (FOB). In general, we assumed that the Canadian dollar was at par with the US dollar. For the purposes of converting between \$CAN/t Al and \$CAN/t SO_2 when comparing technologies, we have used the typical characteristics shown in Table 17, namely the removal of 5 000 t SO_2 , for annual production of 250 000 t of aluminum. This rate of removal represents approximately 90% efficiency in the removal of SO_2 , typical of the minimum performance expected of a prebaked-anode aluminum smelter using anodes made from coke with a sulphur content of approximately 3% and pitch with a sulphur content of approximately 0.8%.

3.1.3 Changes in budgetary costs in recent years

The budgetary costs presented in this study come from assessments based on recent projects or on budgetary assessments performed in recent years. Note that investment expenses have greatly increased in the past few years because of the non-linear rise in the costs of labour and materials. For obtaining more precise assessments, a detailed assessment is recommended.

3.1.4 Typical characteristics of the gases to be treated

In this study, typical characteristics of the gases to be treated are used. The data for a scrubber for a cell room at a recently built aluminum smelter using prebaked anodes with production of approximately 200 000 t Al/year and for the two scrubbers of a cell room at a less recently built aluminum smelter with production of approximately 250 000 t Al/year are shown in the following tables.

Table 16: Typical characteristics of the gases to be treated (1 scrubber)

Typical characteristics	Units	Cell room 200 000 t Al/y
Number of dry scrubbers		1
Temperature of gases	Celsius	90 – 100
Normal rate of gas flow through the scrubber ⁽¹⁾	Million Nm ³ /h	1.8 – 2
Concentration of SO ₂ in the scrubber's chimney (range of instantaneous variability)	mg/Nm ³ ppm	260 – 350 100 – 135
Annual SO ₂ emissions ⁽²⁾	tonnes/ye	4 800 – 5 200
Other emissions typical at the outlets of dry scrubbers		
HF	mg/Nm ³	< 0.5
Particles	mg/Nm ³	3
H ₂ O	%	2

(1) Flow rate at a reference temperature of 0 °C.

(2) Corresponding to anode consumption of 400–415 kg/t Al and sulphur content in the anode of 3% to 3.2% (emissions of 24–26 kg SO₂/t Al at the scrubber).

Table 17: Typical characteristics of the gases (two scrubbers)

Typical characteristics	Units	Cell room 250 000 t Al/y
Number of dry scrubbers		2
Temperature of gases	Celsius	80 – 90
Actual rate of flow through scrubber ⁽¹⁾	Million m ³ /h	1.43
Normal rate of flow through scrubber ⁽²⁾	Million Nm ³ /h	1.09
Total gas flow for the plant	Million Nm ³ /h	2.18
Concentration of SO ₂ in the scrubber's chimney	mg/Nm ³ ppm	260 – 300 100 – 115
Annual SO ₂ emissions	t/y	5 000 – 5 750
Other emissions typical at the outlets of dry scrubbers		
HF	mg/Nm ³	< 1
Particles	mg/Nm ³	5
H ₂ O	%	2

(1) Flow rate under the exit temperature conditions of the gases

(2) Flow rate at a reference temperature of 0 °C.

3.2 Scrubber using sea water

Six of the seven aluminum smelters in Norway treat their gaseous effluents with sea water; an eighth, currently being built, will also use this process. The following table lists the aluminum smelters at which a scrubbing system using sea water is already installed

or is being built.

Table 18: Aluminum smelters that use a scrubbing system based on sea water

Aluminum smelter	Prebaked cells ⁽²⁾		VSS cells ⁽³⁾	
	Production ⁽⁵⁾ t Al/y	Gas flow rate x 1 000 Nm ³ /h	Production ⁽⁵⁾ t Al/y	Gas flow rate x 1 000 Nm ³ /h
Elkem, Lista	-	-	94 000	170
Hydro, Karmoy	167 000	1 525	122 000	220
Sor-Norge, Husnes	176 000	1 600	-	-
Hydro, Hoyanger	58 000	460		
Hydro, Sunndal	367 000	4 000		
Elkem, Mosjoen	138 000	1 375	50 000	90
Qatalum ⁽⁴⁾	585 000	6 400		
EMAL ⁽⁴⁾	700 000	7 600		

(2) Flow rate of the gases estimated at 80 000 Nm³/t Al and at 95 000 Nm³/t Al for recently built smelters

(3) Flow rate of gases estimated at approximately 16 000 Nm³/t Al

(4) Plants being built – Design flow rate

(5) Production or capacity of the plant according to the information available for 2007

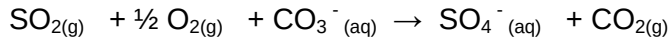
During the design of Alcoa's plant in Fjarðaál, Iceland, in 2005, a study of the ecological risks of a system based on sea water was performed even though the plant satisfied the prevailing standards without using a SO₂ treatment system. In the end, the system was not installed. The conclusions of the study³ showed that there was a low probability of harmful effects on marine organisms resulting from emissions of PAHs, fluorides and sulphur dioxide from the sea-water-based treatment system, and these effects would be limited to a small area of approximately 9 200 m² that lay directly at the outlet for the effluent, mainly benzo(a)pyrène.

3.2.1 Description

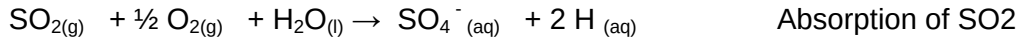
Sea water is alkaline (with a pH between 8.0 and 8.3) and contains a surplus of calcium and sodium carbonate in solution. These components give sea water the property of absorbing and neutralizing acidic gases such as SO₂. Treatment by means of sea water is done in an open-circuit wet scrubber without the addition of reagents. The gases run through a gas distributor at the bottom of the scrubber, against the flow of the sea water, which is fed in by nozzles at the top of the scrubber. The cleaned gaseous effluent then passes through a mist eliminator before leaving the scrubber. A plume of steam may be visible, depending on atmospheric conditions. The liquid effluent is emptied into the sea,

³ Ecological Risk Assessment for Use of Wet Scrubbers at Alcoa Fjarðaál Aluminium Plant in Reyðarfjörður, Fjarðabyggð, Iceland, prepared for Alcoa, September 2005.

where oxidation of the SO₂ to sulphate occurs relatively slowly after the effluent is mixed into the sea. The water emptied into the sea is generally at a temperature higher than that of the ambient sea water. The overall reaction occurs as follows:

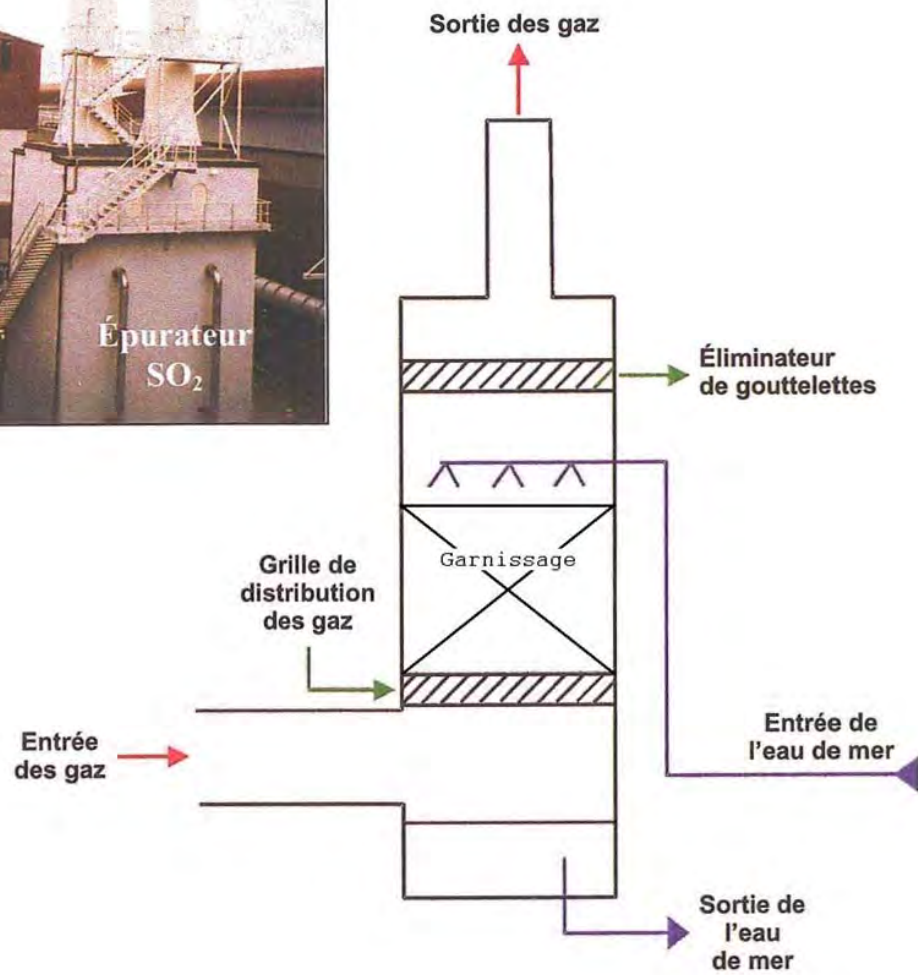
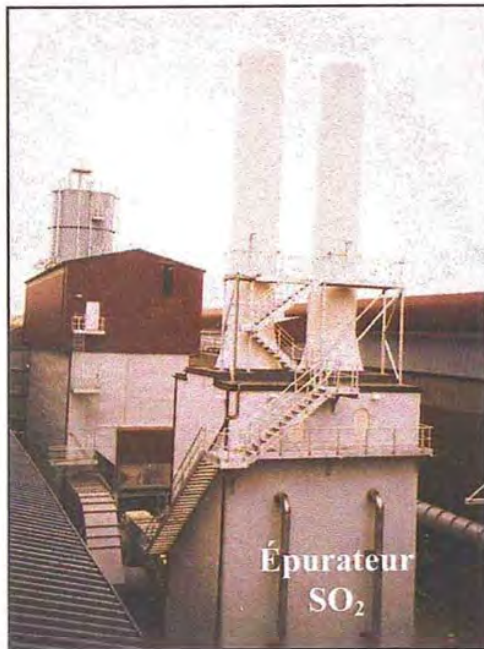


using the following reactions:



The scrubber is made of concrete, with an inner lining of epoxy to prevent the deterioration of the concrete. The ducts are made of stainless steel to prevent corrosion. The sea-water intake is typically located approximately 10 metres below sea level in order to ensure uniform water quality.

Aluminerie Karmøy, Norvège



3.2.2 Efficiency and performance

Performance is related above all to the amount of sea water used and to the alkalinity of the water. During the study in the year 2000, experience showed that removal in excess of 90% could be obtained with a ratio of 3 l to 3.5 l of sea water per Nm³ of gas to be treated, through the use of conventional washing towers.

Experience shows that removal of 95% to 99% of the SO₂ is currently possible. To achieve this efficiency while minimizing the amount of water used, a static washing tower is installed, with a wooden or polypropylene mesh structure as its lining. On the other hand, this type of system requires more maintenance, and the energy requirement is higher than that of a system with no lining, given the higher energy loss caused by the lining.

At the 3 aluminum smelters in Norway, the technology has shown efficiency of 97.7% to 99.9%, with average output concentrations of SO₂ ranging from 0.5 to 4.1 mg/Nm³. The company that is installing the scrubbers guarantees output concentrations between 5 and 10 mg/Nm³.

3.2.3 Operation

Inputs (washing tower with no lining)

- Sea water used to scrub the gases: 3 to 3.5 l per m³ of gas to be treated.
- Electricity consumption estimated at approximately 2 000 to 4 000 kWh/tonne of SO₂.
- Cost of electricity:
- Gas exhaust fan: 100 to 200 kWh/million Nm³ of gas.
- Sea-water pumping rate: 500 to 600 kWh/million Nm³ of gas for a pumping height of 50 metres.

Wastes (washing tower with no lining)

- No solid waste.
- Liquid waste of approximately 3 to 3.5 l per m³ of gas to be treated. This waste is the disposal of the treatment water back into the sea. Outflow of that type requires the installation of a dedicated waste duct.

The amount of water that evaporates is less than 1% of the water used.

- The liquid waste contains a small amount of SO₂ (approximately 60–90 mg/l), which, once oxidized, will result in an increase of at most 140 mg/l in sulphate content, which is minor relative to the sulphate concentrations commonly found in sea water (approximately 2 700 to 3 000 mg/l).
- The reaction entails the release into the atmosphere of 0.69 tonnes of CO₂ per tonne of SO₂ removed. In fact, the calcium-carbonate equilibrium in sea water will keep a large amount of the CO₂ in dissolved form. This emission represents less than 1% of the emissions of CO₂ equivalent by an aluminum smelter and contributes to the increase in the plants' intensity of emissions.

3.2.4 Benefits and drawbacks

Benefits

- No solid waste.
- No expenditures on reagents; low maintenance costs.
- Bio-assays and studies to monitor the marine environment have shown that the environmental impact for various specific cases is negligible. Whether this type of treatment would have an impact on the marine environment in Canada remains to be determined.
- The technique removes particles and some of the fluorides not removed by the dry scrubber.

Drawbacks

- An impact study is required in order to ensure the acceptability of the approach and obtain the environmental permits required for its installation.
- Some local authorities may reject this type of treatment, since it empties its waste directly into the environment.
- The discharge of an effluent at a temperature higher than that of the ambient environment could have a negative impact on that area.
- A plume of steam coming out of the scrubber's chimney is visible in winter.
- The plume of steam might be drawn back down into the scrubber, and acidic mist could be produced in the summer, depending on the efficiency of the mist eliminator.
- The temperature of the gases leaving the chimney is reduced by 50 to 60 °C.
- The water intake could be obstructed by marine organisms.
- Despite the use of stainless steel, the risk of corrosion remains.
- The chance of clogging the tower increases when the liquid/gas ratio is low (e.g., 3 l/Nm³ of gas versus 6 l/Nm³).
- Depending on operating conditions, the lining could become clogged and could require additional maintenance.
- Brackish water could require adjustment of alkalinity (with CaO, for example) or a higher water flow rate. The quality of the sea water should therefore be checked for the aluminum smelters on the Côte-Nord.
- If the waste water should require treatment, very large basins would be required, owing to the large volume of water used. In this case, another approach to treatment could be more beneficial.

3.2.5 Impact on emissions of other pollutants

The process removes particles and some of the fluorides not removed by the dry scrubber. In performance tests on a scrubber using sea water that is installed in Norway, the firm Alstom obtained removal rates higher than 99.9% for particles and fluorides following the installation of a scrubber using sea water downstream from a dry scrubber. These results are much higher than the manufacturer's guaranteed removal rates.

3.2.6 Costs

Investment

Treatment using sea water is the least expensive of the systems for treating SO₂ that are currently used by aluminum smelters. The investment expenses for treatment by means of sea water are estimated at \$50 to \$200 CAN per tonne of aluminum produced on an annual basis. The variation in the cost of the system depends on several factors, including, among others, the supplier, the site of installation, the cost of labour, and the

elevation and distance from the salt-water intake. The cost of the system for delivering and eliminating water could by itself represent \$20 to \$50 CAN per tonne of aluminum produced on an annual basis. For prebaked-anode aluminum smelters in Québec, the upper part of this range should be considered.

Operation and maintenance

The chief operating expense is related to the pumping of sea water. Energy consumption is the key factor, and it depends on the height and distance from the sea, and also on the pumping rate, the presence or absence of a lining, the energy source (thermal or hydroelectric), and the efficiency of the motor and the pump. Operating costs are estimated at \$2 to \$5 CAN/t of aluminum produced for the aluminum smelters of the Côte-Nord (between \$120 and \$270 CAN/t SO₂).

3.3 Sodium scrubber

The following table lists the aluminum smelters at which a scrubbing system using sodium is installed.

Table 19: Aluminum smelters using a sodium scrubbing system

Aluminum smelter	Means of managing the purge from the scrubber	Prebaked cells ⁽²⁾		VSS cells ⁽³⁾	
		Production t Al/year	Gas flow rate x 1 000 Nm ³ /h	Production t Al/year	Gas flow rate x 1 000 Nm ³ /h
Hydro, Ardal	Direct disposal	154 000	1 400	HSS 123 000	3 190
Massena, NY	Treatment Treatment				
Hawesville, KY	Evaporation	52 285 ⁽¹⁾	636	48 000	90
Goldendale, WA	Evaporation	120 000	1 100		
The Dalles, OR				82 000	150

(1) Line 5, Hawesville, Kentucky: the scrubber was run from April 1999 to June 2000. It is no longer being used, owing to a change to the operating permit.

(2) Volume of gas estimated at 80 000 Nm³/t Al for the prebaked cells of the Ardal and Goldendale plants. (3) Volume of gas estimated at 16 000 Nm³/t Al for the VSS cells of the Goldendale and The Dalles plants.

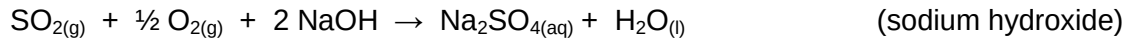
3.3.1 Description

The wet sodium scrubbing system is made up of washing towers in which a sodium liquor (carbonate [Na₂CO₃] or hydroxide [NaOH]) is injected from nozzles against the flow of the gases. The towers are made of stainless steel, FRP or concrete with an inner lining of FRP (fibreglass-reinforced plastic).

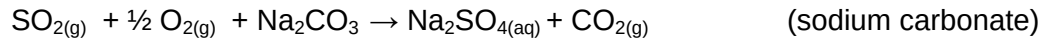
After coming into contact with the liquor, the gas is run through a mist eliminator to remove the liquor mist that is present in the gas flow. The liquor is recycled in a closed circuit, with part of the liquor constantly being purged.

The purge is sent to a water-treatment system that adjusts its pH and precipitates the fluorides out before releasing it into the environment. The solid precipitates are collected in a filter press and are sent to a landfill for industrial waste. In arid regions, the purged liquor is sent to an evaporation basin. This approach produces a salt (Na₂SO₄), which must then be disposed of.

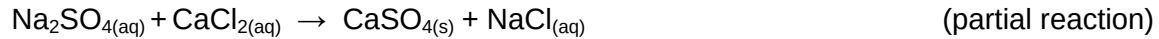
The following overall reaction occurs:



or

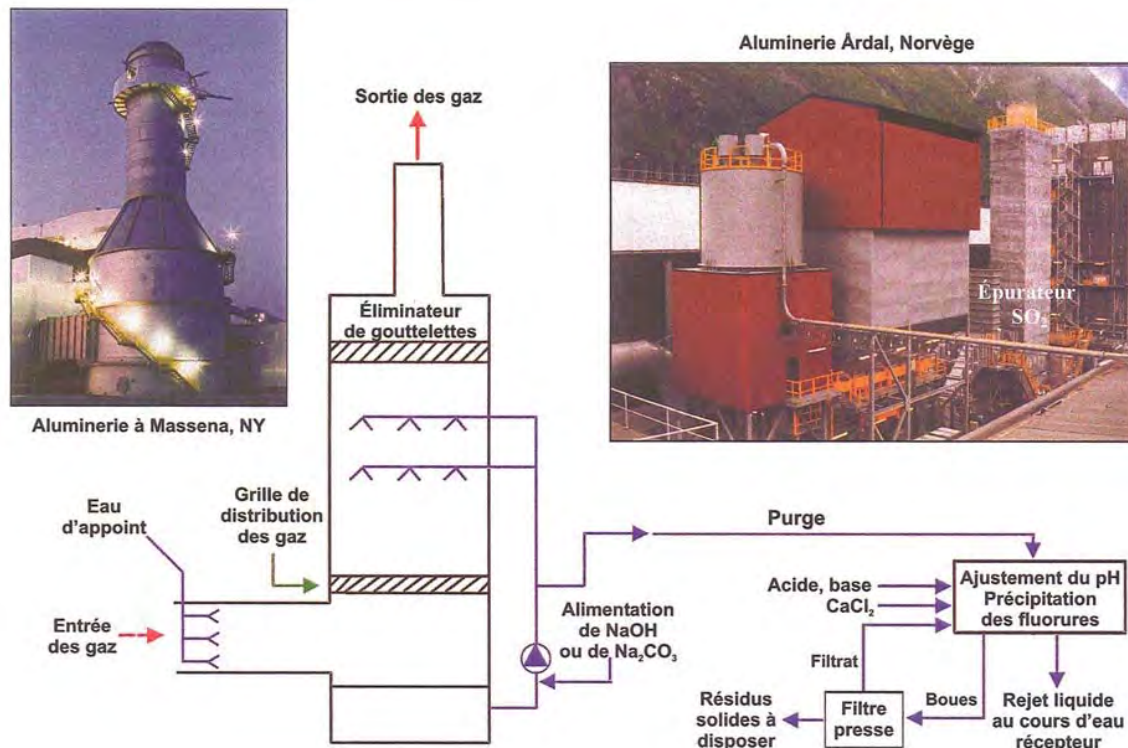


Treatment of fluorides and salts in the purged liquid:



In reality, the SO_2 is absorbed in the liquor as sodium bisulphite (NaHSO_3 or Na_2SO_3 , as the case may be). The continuous and repeated exposure of the recycled liquor to gases rich in oxygen facilitates the absorption of oxygen and oxidation into sulphates.

Figure 4: Sodium scrubber



3.3.2 Efficiency and performance

Experience shows that a scrubber with two rows of nozzles and a liquid/gas ratio of 3.5 to 4 l/Nm³ of gas yields removal in excess of 90%. The addition of a third row of nozzles yields removal in excess of 93%.

3.3.3 Operation

Inputs ⁽¹⁾

Wet scrubber	
Make-up water (to offset losses from evaporation)	25–30 m ³ per million Nm ³ of gas
Salt (water softener)	0.2 kg/m ³ of water used
Sodium carbonate Na ₂ CO ₃ or Sodium hydroxide NaOH	1.7 tonnes/tonne SO ₂ removed 1.3 tonnes/tonne SO ₂ removed
Water treatment	
Calcium chloride	25 kg/t SO ₂ to 500 kg/t SO ₂ ⁽²⁾
Hydrochloric acid 20% HCl Sodium hypochlorite	20 l/m ³ of liquor to be treated
Caustic soda 25%	8 l/m ³ of liquor to be treated 2 l/m ³ of liquor to be treated
Other	
Electricity consumption	1 200 to 2 000 kWh/tonne of SO ₂ removed
• Exhaust fan	100 to 200 kWh/million Nm ³ gas
• Pumping	300 to 500 kWh/million Nm ³ gas

1. Values drawn from experience at the Massena plant
2. Values obtained from the Massena and Hawesville plants. CaCl₂ is used to remove fluorides. The amount required depends on the results of the removal of fluorides. In both cases, salts (e.g., NaCl, Na₂SO₄) are left in the waste liquid at a concentration of 10% to 12% in solution.

Wastes

- Solid waste from 1–2 kg/t Al (salts of calcium and fluoride) to 10 kg/t Al.
- Approximately 1 l/1 000 l of the recycled liquor is purged. There is liquid waste following treatment: approximately 20 l/kg SO₂ removed (2 to 5 m³/h) with 10% salts (NaCl, Na₂SO₄) and 0.25 to 2 mg/l fluorides on average.
- When Na₂CO₃ is used: atmospheric emissions of 0.69 t CO₂/t SO₂ removed. This emission represents less than 1% of the emissions of CO₂ by an aluminum smelter and contributes to the increase in the plants' intensity of emissions.

3.3.4 Benefits and drawbacks

Benefits

- The technique removes particles and some of the fluorides not removed by the dry scrubber.
- Removal of approximately 30% of carbonyl sulphide.
- Efficient removal of SO₂.
- Many suppliers exist. There are also pre-built systems for low gas flow rates.

Drawbacks

- Additional controls relative to treatment using sea water.
- The temperature of the gases leaving the chimney is reduced by 50 to 60 °C.
- The plume of steam might be drawn back down into the scrubber, and acidic mist

could be produced in the summer, depending on the efficiency of the mist eliminator.

- A plume of steam coming out of the scrubber's chimney is visible in winter.
- The tanks and ducts that carry the liquor must be heated. Too low a temperature could cause salts to precipitate out (scaling). In addition, the ducts could freeze in the winter, as with any wet process.
- Solid waste.

3.3.5 Costs

Initial investment: In 2000, according to Alstom, the expected investment was US\$50–80 per tonne of aluminum produced per year (Ref.: Strommen, Bjornstad, Wedde, 2000).

The available expenses, converted to equivalent expenses, totalled approximately US\$70–80/t Al for plants using prebaked anodes (with 1.5–3 million Nm³/h of gas to process). Alstom has not installed a sodium scrubber in its aluminum smelters since 2000, and no recent expenses are available.

Table 20: Cost of installation at various plants before 2000

Aluminum smelter	Millions (US) ²	US/t Al ²	US/t Al ² (prebaked)
Ardal	12	59	73
Massena (HSS) Hawesville	14 ⁽¹⁾	114	65 to 70
	4.8	92	92

(1) Water treatment was designed to treat a variety of effluents at the plant. The cost of treating the purge alone would have yielded a factor of approximately US\$100/t Al.

(2) No conversion of US\$ to CAN\$ can be performed, as the exchange rates varied considerably and the exact year of the project is unknown.

A scaling factor must be taken into account. It costs less per tonne of aluminum to treat a high flow (e.g., 2 million Nm³/h) than to treat a low flow (600 000 Nm³/h). In addition, the analysis of investment expenses must take into account the expected availability of the scrubbing system. If the system must be operational 100% of the time, at least two wet scrubbers are required; each of them must be capable of receiving the plant's entire gas flow, but ordinarily each will be operated at half of its capacity.

If availability of 97% is deemed acceptable, a single wet scrubber will suffice, and it is possible to modify the rows of nozzles slightly to aim for a removal efficiency rate of 93% when the scrubber is being used.

Finally, it would be possible to reheat the treated gases before they go out through the chimney, by heating them to avoid the return of mist, as some power stations do. To that end, an investment of CAN\$2–4 million per million Nm³/h of gas would be required, not including the cost of electricity and the atmospheric emissions that would result. This option becomes attractive if it is possible to reheat the gases by energy recovery, which is not necessarily possible.

According to recent data (2006), investment expenses of almost CAN\$47 million can be expected for an aluminum smelter producing 250 000 t Al per year using coke with 3% sulphur, which corresponds to an investment of almost CAN\$200/t Al. There are also several manufacturers that offer factory-built scrubbers. On the other hand, this type of scrubber cannot treat a heavy flow of gas. The scrubber's dimensions are limited by the

need to transport the main components. It is possible to install several systems in parallel, but the costs and the space required are greater than for the installation of 1 or 2 large systems. In the present case, using a system of this type at an aluminum smelter that yields 250 000 t Al/year would require the installation of 40 to 50 scrubbers in parallel, which is not realistic.

Annual cost of operation and maintenance

Table 21: Typical costs of operation and maintenance for an aluminum smelter using prebaked anodes (250 000 t Al/an)

Item	\$CAN/t SO ₂ removed
Sodium hydroxide Calcium chloride	780
Chemicals	20–450
Electricity	25–50
Operator	2 000 kWh/t SO ₂ (at CAN\$0.03/kWh)
Maintenance	10 to 40
	160
TOTAL:	1 075–1 540

This cost represents an equivalent of CAN\$21–30/t Al. To this amount must be added the costs of disposing of the residue, which are on the order of CAN\$100 per tonne of residue (approximately CAN\$1/t Al).

3.4 Double-alkali scrubber

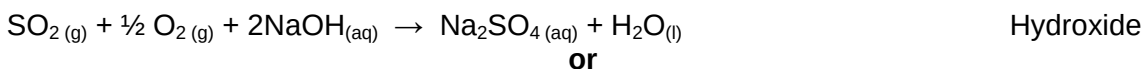
Currently no aluminum smelter using dry treatment of gases and a SO₂ removal system recovers sodium hydroxide. A low-capacity HSS-cell aluminum smelter in India used a double-alkali system without prior treatment of the gases with a dry scrubber.

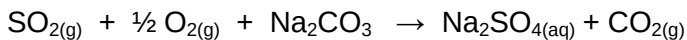
This type of system is similar to the one used as a gas treatment system for the oldest prebaked cells at Arvida. On the other hand, the objective of the system is to remove not SO₂ but fluorides. This system replaces dry scrubbers.

3.4.1 Description

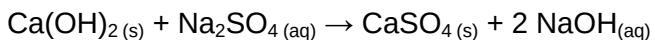
A sodium alkali (hydroxide or carbonate) is used in the wet scrubber to absorb the SO₂. The principle of the removal of SO₂ is identical to that of the sodium scrubber, with the exception of the sodium hydroxide recovered. Part of the sodium liquor is continually purged and mixed with hydrated lime in a regeneration tank. The soluble salts of SO₂ are precipitated out in a mixture of gypsum and calcium sulphite hemihydrate. It is possible that the precipitation of gypsum will be much more difficult in the absence of CaF₂. The active alkali is regenerated and reintroduced to the scrubber to absorb more SO₂.

The following overall reactions occur:





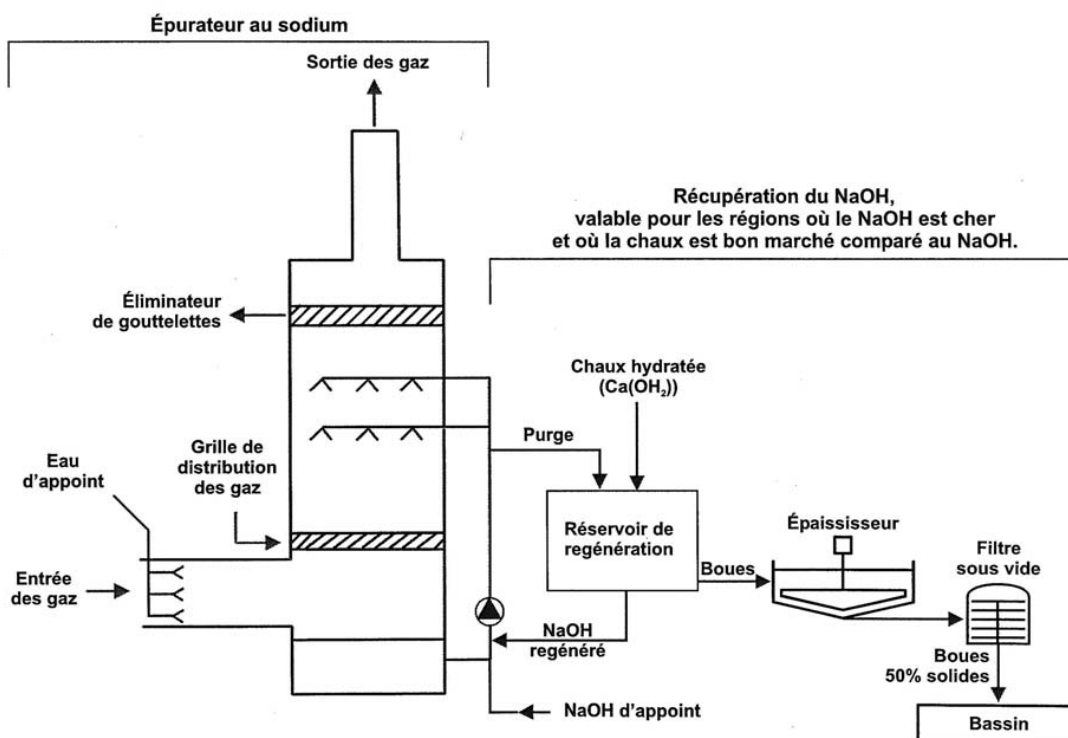
Carbonate



Regeneration of NaOH

The precipitated calcium salts settle in a thickener and are then dehydrated in a filter under vacuum. The slurry, containing 50% solids, is emptied as it is into a waterproof basin, or it may undergo a final step of dehydration before disposal.

Figure 5: Double-alkali scrubber



3.4.2 Efficiency and performance

Identical to those of the sodium scrubber.

3.4.3 Operation

Inputs

- Hydrated lime: 1.2 t/t SO₂ removed.
- NaOH: 25 kg/t SO₂ removed; or Na₂CO₃: 35 kg/t SO₂ removed.
- Water: 25–30 m³ per million Nm³ of gas, to replace evaporation losses.
- Electricity: 100 kWh/M Nm³ (fan)
500 kWh/M Nm³ (pumps)

Wastes

- Slurries: 2.1 t of slurries (50% solids)/t of SO₂ removed. CaSO₄ could be of interest to a cement plant.
- Liquid wastes: depends on the local rate of application.
- Atmospheric emissions: 0,69 t CO₂ /t SO₂, if Na₂CO₃ is used. These emissions are negligible and make up less than 1% of the CO₂ emissions of an aluminum smelter and contribute to the rise in the plants' intensity of emissions.

3.4.4 Benefits and drawbacks

Benefits

- The primary reagent is recycled.
- Efficient removal of SO₂.
- The technique removes particles and some of the fluorides not removed by the dry scrubber, as well as part of the carbonyl sulphide.
- Lime, used in regeneration, is economical.
- Has lower liquid wastes than a sodium scrubber.

Drawbacks

- There is a slurry basin to manage. The amount of slurries produced is not large.
- The equipment and its operation are more complex than those of the sodium scrubber.
- The drawbacks of sodium scrubbers also apply to the double-alkali scrubber.

3.4.5 Costs

Investment

This system requires more equipment than the sodium scrubber. Thus it entails higher expenses for investment, operation (chemicals) and maintenance. This system is unlikely to be more economical overall than the other types of scrubbing process. Further analysis could be required in some special cases. According to recent data (2006), investment expenses of almost CAN\$55 million can be expected at an aluminum smelter yielding 250 000 t Al per year using coke with 3% sulphur, which corresponds to an investment of almost CAN\$220 /t Al.

Operation and maintenance

Item	\$CAN/t SO ₂ removed
Hydrated lime	250
Make-up NaOH or Na ₂ CO ₃	15
Electricity	3 000 kWh/t SO ₂ (at CAN\$0.03/kWh)
Operator	10 to 40
Maintenance	250
TOTAL:	615 to 645

A cost of approximately CAN\$645/t SO₂ removed represents a cost of approximately CAN\$15/t Al. To this amount must be added the costs of disposing of the residue, which are on the order of CAN\$100 per tonne of residue.

3.5 Calcium injection scrubber (dry, semi-dry or wet)

Most technologies for controlling emissions of SO₂ in coal-fired power plants involve adding a calcium-based reagent. Under favourable conditions, the reagent reacts with the SO₂ to form calcium sulphite, which is then oxidized into calcium sulphate. Because of their low cost, calcium carbonate (CaCO₃) and slaked lime (Ca(OH)₂) are the most widely used reagents.

In the dry process, calcium carbonate is injected as a fine powder. This solution requires the installation of a dry scrubber (bag filter). The reaction produces a dry residue, which is recovered. The gypsum (calcium sulphate) produced would probably not be of commercial grade.

In the semi-dry process, the lime is usually dissolved in water and injected into the scrubber. The milk of lime dries as soon as it comes into contact with the hot gases. The semi-dry process is the most commonly used in gas desulphurization systems for power plants. This solution requires the installation of a dry scrubber (bag filter) the size of the current scrubbers after the milk-of-lime reactor, which makes this solution prohibitively expensive and difficult to implement, given the limitations of space.

In the wet process, the lime or calcium carbonate is dissolved in water and then injected into the absorber. Ordinarily the gases come into contact with the liquor in counter-current flow. Other configurations can be used, such as the configuration using co-current flow. In this process, unlike the semi-dry process, the milk of lime does not dry when it comes into contact with the gases.

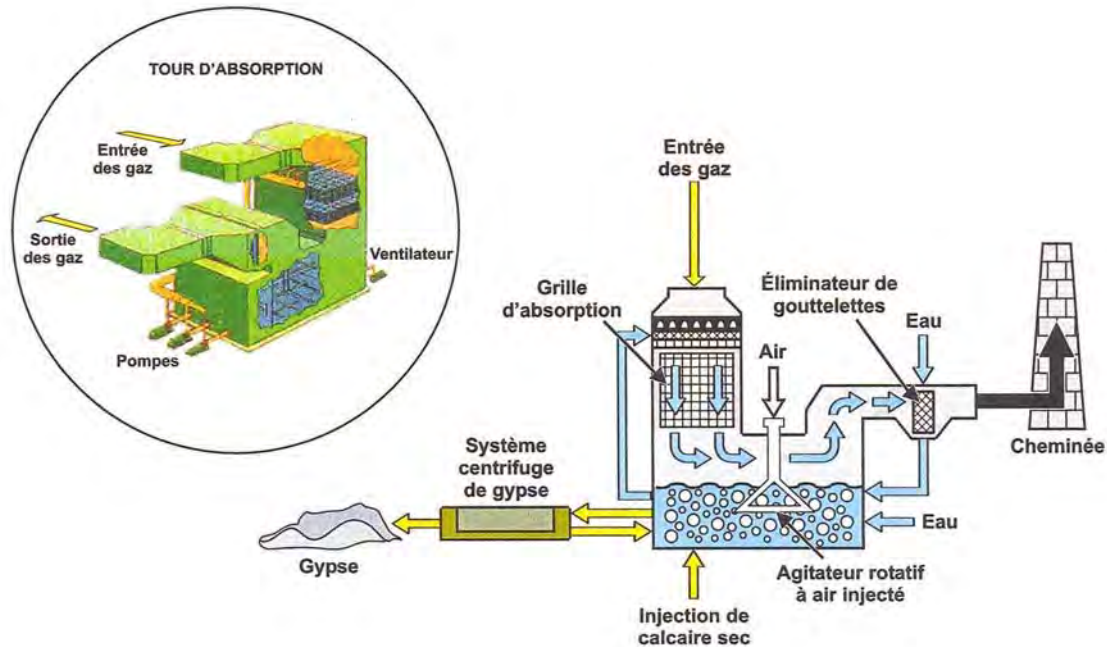
3.5.1 Description

The gas oxidation process removes SO₂ in an absorption tower in which the following three actions take place (Figure 6):

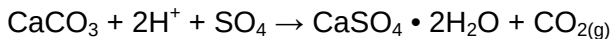
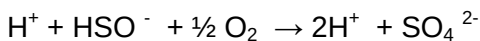
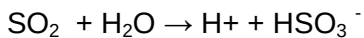
- cooling of the gases
- absorption of SO₂
- oxidation of the resulting calcium sulphite into commercial-grade gypsum (calcium sulphate).

In the absorption tower, rows of nozzles spray the reagent in liquor form (lime or calcium carbonate in aqueous solution) as a fine mist that affords a large surface area of liquid/gas contact. Then the gases are fed into a vast zone for gas/liquid dissociation above a tank of liquor (at the bottom of the absorption tower) and exit through a mist eliminator.

Figure 6: Example of a counter-current calcium scrubber for a power plant



After coming into contact with the gases, the liquor falls back into the liquor tank. The main product of the reaction, calcium sulphite, is oxidized into gypsum through the action of rotating air-sparging agitators that simultaneously mix the liquor in the tank and inject air into it. Air is also injected through fixed jets to complete the oxidation process. The supernatant portion of the liquor is recycled and reinjected. The reactions are the following:



The resulting slurries are extracted from the tank and dried in a system that may include different types of equipment such as a centrifuge, a furnace, a belt filter, etc. The extracted water is reused in the process, and the recovered gypsum is either buried or sold.

3.5.2 Efficiency and performance

Because of the typical temperature of the gases exiting the dry scrubbers at aluminum smelters (approximately 100 °C), the semi-dry process cannot be used at aluminum smelters.

In the industry of power generation, it is generally guaranteed that the efficiency of removal will 90% and that availability of the scrubbing equipment will exceed 95%.

The liquid/gas ratio is approximately 6.7 l/Nm³, and the calcium/sulphur ratio is almost stoichiometric (1.01).

The first commercial unit was installed in 1964. More than 86 facilities throughout Europe, North America and the Far East use this technology, on a wide range of gas sources and SO₂ concentrations.

Compared to aluminum smelters, power plants have gas flow rates on the same order of magnitude as those found in the aluminum industry. The SO₂ concentration of the gases from power plants, however, is much higher than that of aluminum smelters (> 2 000 mg/Nm³ vs 260 to 370 mg/Nm³).

3.5.3 Operation

Inputs

- Calcium carbonate: 1.6 t CaCO₃/t of SO₂ removed. Lime may also be used (1.2 t Ca(OH)₂/t of SO₂ removed).
- Electricity: approximately 2 000 kWh/million Nm³ of gas.
- Water: approximately 45 m³ per million Nm³ of gas.

Wastes

Liquid waste is slight; the water is returned to the liquor tank in the absorption tower. A purge may be necessary in order to eliminate other acids contained in the gases (fluorine and chlorine). The resulting gypsum (2.7 t/t SO₂) may be sold to a company that produces gypsum board. Atmospheric emissions of 0.69 t CO₂/t SO₂ removed should be expected if CaCO₃ is used. These emissions represent less than 1% of the CO₂ emissions of an aluminum smelter. Nonetheless, the benefits and drawbacks of these emissions of greenhouse gases (GHGs) must be taken into consideration from the perspective of overall reduction of the plant's emissions.

3.5.4 Benefits and drawbacks

Benefits

- The technology is well established in the field of power plants.
- Removal rates of 95% are commonly achieved, and it is possible to achieve removal rates approaching 98%.
- The reagents are readily available.
- The gypsum produced is stable for burial, and the procedure can be customized during the design phase to yield commercial-grade gypsum that can subsequently be resold.
- Most installations have been available and operational more than 99% of the time, with no need for substitute scrubbing modules. The guarantees made to the client specify that the equipment will be operational 98% of the time.

Drawbacks

- The investment expenses are higher than those for the technologies already in use at aluminum smelters. In addition, the space requirement is greater, comparable to that of a dry alumina-injection scrubbing system.
- The system has not yet been used to treat gases at an aluminum smelter.
- The sale of the gypsum requires a local market, without which the gypsum must be disposed of as a waste product.

3.5.5 Impact on emissions of other pollutants

Although we lack precise data, the wet process, like most other processes, will have an impact on particulate emissions. On the other hand, the dry and semi-dry processes require the installation of an additional system to reduce particulate emissions.

3.5.6 Costs

Investment expense

According to recent data (2006) provided by SNC-Lavalin Clean Air, the investment expense for the construction of a lime-based treatment unit for the sulphur dioxide from a coal-fired power plant with gas flow on the same order as that of an aluminum smelter (2.4 million Nm³/h) is €75M. If we make the assumption that the investment is proportional to the flow of gas to be treated, the resulting high investment expense for an aluminum smelter producing 250 000 t Al/year would be on the order of CAN\$100 million, which corresponds to approximately CAN\$400/t Al.

Annual cost of operation and maintenance

- Calcium carbonate: CAN\$42/t of SO₂ removed
- Or lime: CAN\$246/t of SO₂ removed
- Electricity: 6 000 to 8 000 kWh/t SO₂ at CAN\$0.03/kWh
- Operator: CAN\$40/t of SO₂ removed
- Maintenance: CAN\$200/t of SO₂ removed
- Total: CAN\$450–700/t SO₂ removed

A cost of CAN\$450–700/t SO₂ removed represents the equivalent of a cost of approximately CAN\$10–15/t Al. To this must be added the costs of disposing of the gypsum, if it cannot be sold.

The costs of disposing of the residue are on the order of CAN\$100 per tonne of residue. This corresponds to a cost of approximately CAN\$270/t SO₂, which represents a cost of approximately CAN\$6/t Al.

3.6 Other technologies

3.6.1 The Cansolv[®] process

The Cansolv system is a unique process for regenerating sulphur dioxide. This technology uses a patented amine solution to achieve selective absorption of sulphur dioxide from a wide variety of gaseous effluents. To date, eight Cansolv gas-treatment units are in operation, two will be started up in 2008 and several others are in the design or construction phase. The process is successfully applied in diverse industries with gaseous effluents containing a high concentration of SO₂, such as sulphur recovery

units, catalytic cracking and coking in refineries, cogeneration units, sulphuric acid plants and plants that recover used sulphuric acid, and non-ferrous metal foundries (zinc, lead and copper). The process recovers sulphur in a marketable form without producing residues in the form of waste. It has not yet been implemented in the primary aluminum industry, however.

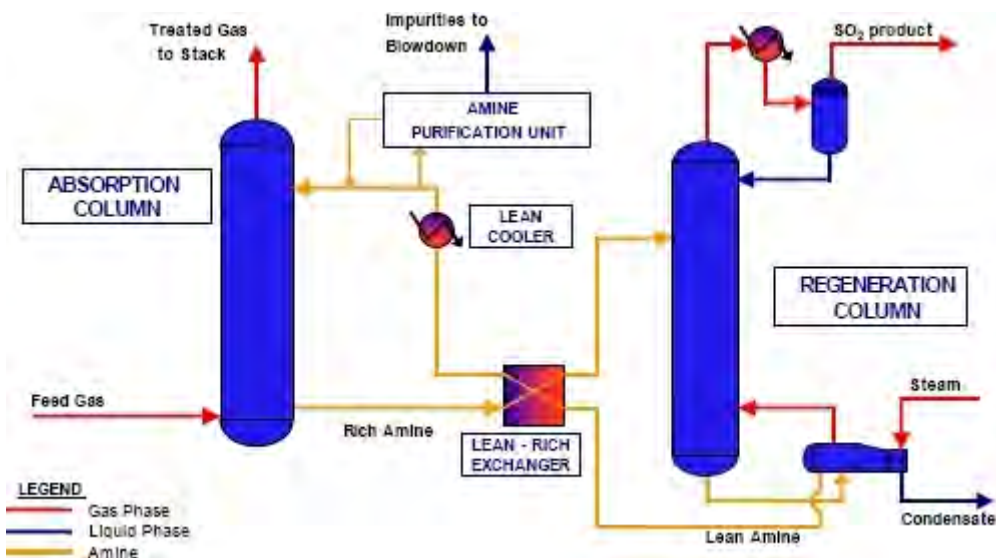
Description

The Cansolv system includes the following chief components: a SO₂ absorption column, a regeneration column and an amine purification unit.

The major steps in the process are described in the following paragraphs:

- **Gas conditioning:** Before going into the absorber, the gases must be cooled to their saturation temperature. During this step, particles and strong acids must be removed from the gas. Since the typical gas from an aluminum smelter contains few particles and few strong acids, a simple cooling tower would suffice.
- **Absorption:** Gases are put into contact with the amine (Cansolv Absorbent DS™) to absorb SO₂. A counter-current tower is used to achieve maximum absorption of the acidic gas in the absorbent. A structured packing tower is used to minimize height and diameter; this has a direct effect on the costs of the system. Rich in SO₂, the amine is then transferred to a storage tank.
- **Regeneration of amines:** The regeneration process includes three main components: the regeneration column, a reboiler and a condenser. The rich amine is pumped into the regeneration column at a constant flow rate. A counter-current flow of steam is then used to desorb the SO₂. The gaseous SO₂ is recovered and then routed to a conversion system, where the SO₂ may be sold in the form of sulphuric acid or sulphur. The lean amine is returned to the absorption tower.
- **Purification:** Amines accumulate salts that cannot be regenerated in the system. These salts must be removed in order to avoid an excessive accumulation. To this end, part of the amine flow is diverted to run through a purification unit that removes salts that cannot be regenerated (sulphates, thiosulphates, nitrates, chlorides and fluorides).

Figure 7: Simplified diagram of the Cansolv® process



Efficiency and performance

At an aluminum smelter, the gases requiring treatment contain a low concentration of SO_2 (concentrations below 140 ppmv). The Cansolv process is generally less economical when the concentrations of SO_2 are lower than 700 ppmv. The amount of steam required during the regeneration of the amine becomes very high relative to the amount of SO_2 recovered. A large amount of steam must be used in order to achieve a low concentration of SO_2 in the gaseous effluent. The amount of steam used varies exponentially. For a plant yielding 250 000 t Al/ year and a removal rate of approximately 55% of SO_2 , approximately 78 t of steam per hour would be required. The costs associated with generating steam would thus be very high, given that a boiler to produce the steam would have to be installed in addition to the treatment system.

Range of application

To date, eight commercial units are in operation, two will be started up in 2008 and several others are currently being designed. The process offered by CANSOLV®, however, cannot be used in the aluminum industry.

3.6.2 SNOX™ technology

The SNOX™ process, of TOPSØE Technologies, is a process that regenerates gaseous effluents through catalytic treatment. The process can eliminate up to 98% of SO_2 and SO_3 . The process can also eliminate up to 96% of NO_x and a large portion of particles. SO_2 and SO_3 are recovered in the form of commercial-grade sulphuric acid (H_2SO_4).

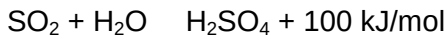
The process is also known as WSA (Wet-Gas Sulphuric Acid) and is often employed without the system that removes NO_x . More than 50 plants are currently using this system. The process is generally used to treat effluents containing a high level of SO_2 and SO_3 , as in the combustion of coke or sludge asphalt with a sulphur level above 3%.

The same process, using the same catalysts, is used in the traditional commercial production of sulphuric acid.

During the process, the gases are passed through a catalytic oxidation reactor in which approximately 98 % of SO₂ is oxidized according to the following reaction:



The gases are then cooled to form 95% concentrated sulphuric acid according to the following reaction:



This process is not currently used to treat the gaseous effluents from the aluminum industry. Whether the process can be used with the concentrations of SO₂ (approximately 100 ppm) generally found in the aluminum industry will have to be determined. In addition, the gases must be heated to 400 °C (the activation temperature of the catalyst) before entering the oxidation reactor. As with the commercial procedure for producing sulphuric acid, however, the presence of fluorides and particles in the gaseous effluent could reduce the efficiency of the process. Specifically, a fluoride concentration greater than 0.3 ppm will attack the catalyst's support, and the presence of particles could clog the catalyst within the reactor. Pre-treatment could be required in this case.

3.6.3 The MEL (Magnesium-Enhanced Lime) process

The MEL process is an adaptation of the traditional lime process. It is already used like the traditional lime process to treat the gaseous effluents from coal-fired power plants. The process has been used in the United States since the 1970s. It can reduce SO₂ from 95% to 98%. Generally, a lime mixture containing 3% to 6% magnesium oxide (MgO) by mass is used. During the reaction, the magnesium oxide reacts with the SO₂ to yield magnesium sulphite (MgSO₃), which acts as a catalyst and increases the efficiency of the treatment of the gas.

The primary advantage of this process relative to the traditional calcium process is the greater ability to absorb SO₂. Consequently, a lower liquid–gas ratio is implied. The lower liquid–gas ratio and the reagents used will have a major impact on capital costs and operating expenses.

The main residue produced by the process is gypsum, just as with the traditional process. The magnesium sulphite, however, can be converted to magnesium hydroxide through the addition of calcium hydroxide. The Mg(OH)₂ can be used to reduce SO₃ emissions.

3.6.4 The process of desulphurization by ammonia

The ammonia process, marketed by Marsulex, desulphurizes gases through contact with ammonia in an absorption column. The primary advantage of this process stems from the fact that the residue that it yields (ammonium sulphate) is of commercial grade and can be sold as a fertilizer.

The reagent (ammonia) required in this process, unlike the calcium process, calls for special storage conditions and additional precautions during handling.

According to Marsulex, the technology has proven to have a major economic advantage over traditional technologies from the perspective of both capital investment and operating expenses, when gas flows exceed 1 000 000 m³/h and the concentration of SO₂ is greater than 4000 mg/m³. Typical gas flow rates are greater than 1 000 000 m³/h, but typical concentrations of SO₂ are approximately 300 to 350 mg/m³. Consequently, the process is not attractive for the aluminum industry. It is used primarily in the energy-generation industry and in industries that generate their own energy or steam.

3.6.5 Desulphurization of petroleum coke

Through the installation of a hydrotreatment system, the residues from the refining process that are used in the production of coke can be treated to yield coke with a low sulphur content.

The hydrotreatment process primarily involves bringing the residues used in coke production into contact with a hydrogen stream. The sulphur contained in these residues is transferred to the hydrogen stream. The hydrogen, rich in H₂S, must then be treated to remove the H₂S before being returned to the reactor. The H₂S is then treated so as to eliminate it. Treatment can be performed in a sulphur recovery unit similar to the one that is typically found in refineries.

This process has the advantage of yielding coke with a low sulphur content. On the other hand, it would appear that the coke must have a sulphur concentration between 2% and 3% in order to yield high-quality anodes. Beyond having an impact on atmospheric emissions, the sulphur content of the coke affects the quality and performance of the anode, as well as the quality of the metal. Furthermore, the addition of a treatment would increase the cost of the coke, which generally sells for less than crude oil.

3.6.6 Development of the inert anode

The development of non-carbon inert anodes with stable dimensions that will be consumed slowly during the electrolysis process offers great potential for progress in the aluminum production process. Researchers predict an improvement in energy efficiency ranging from 10% to 25%, although major challenges remain to be overcome in the development of the process.

The costs of producing aluminum would also be noticeably reduced, as the manufacture of carbon anodes, baking equipment and anode rodding equipment would no longer be necessary and inert anodes would no longer have to be replaced every 26–28 days. Moreover, non-carbon anodes would also have the advantage of removing the source

of carbon for the generation of PFCs, thereby eliminating greenhouse gas emissions connected to the anode effect and eliminating the source of sulphur that yields SO₂ emissions.

Research in the field of inert anodes has been in progress for several years in both government and industry. Shop tests with inert anodes are being conducted at a number of plants. One major problem with inert anodes is their inability to resist the usual environment in the cells—for example, the high temperatures and corrosive nature of the baths. A commercially viable design for a cell using inert anodes has not yet been developed. According to the results, it is quite likely that the technology will not be suitable for all existing types of cells.

In its work on sustainable development, Alcoa states that it would expect to reduce its greenhouse gas emissions by 50% from the levels of 1990 if inert-anode technology succeeded.

3.7 Comparison of the technologies

The various treatment technologies are shown in Table 22.

Table 22: Summary comparison of technologies for the treatment of SO₂

Parameters	Sea water	Sodium	Double alkali	Calcium	Cansolv
Performance (% SO ₂ removal)	3 to 3.5 l/Nm ³ : 90% 6 to 7 l/Nm ³ : > 95%	3.5 to 4 l/Nm ³ : 90% 5 l/Nm ³ : 93	3.5 to 4 l/Nm ³ : 90% 5 l/Nm ³ : 93 %	> 90% (98%)	(< 55%) 95% possible, but a large amount of steam is required
Experience	6 smelters Norway (prebaked + VSS)	4 smelters USA 1 smelter Norway		Power plants	
Inputs per M Nm³/h of gas					
Electricity	600 to 800 kWh (pumping height 50 m)	400 – 700 kWh	600 kWh	2000 kWh	295 – 330 kWh
Make-up water		25 – 30 m ³	25 – 30 m ³	45 m ³	1565 m ³ (cooling)
Inputs per tonne of SO₂					
Reagents	N/A	1.7 t Na ₂ CO ₃ or 1.3 t NaOH	1.2 t Ca(OH) ₂ 25 kg NaOH (or Na ₂ CO ₃)	1.6 CaCO ₃ or 1.2 t Ca(OH) ₂	0.6 kg amine
Purge treatment	N/A	25 – 500 kg CaCl ₂ and other products	N/A	N/A	60 kg NaOH
Steam	N/A	N/A	N/A	N/A	56 to 140 tonnes
Waste per tonne of SO₂					
Liquids	3 – 3.5 l/Nm ³ gas	20 m ³ with 10% salts (NaCl, Na ₂ SO ₄)	Depends on pluviometry	N/A	2.7 m ³ (2% Na ₂ SO ₄)
Solids	N/A	100 – 1 000 kg (salts)	2.1 tonnes of sludge	N/A	0.6 kg used amine
Atmospheric waste	< 0.69 t CO ₂	0.69 t CO ₂ (for Na CO)	0.69 t CO ₂ (for Na CO)	0.69 t CO ₂ (for Ca CO)	N/A
Other characteristics					
Saleable product	N/A	N/A	Sludge (cement plant?)	Gypsu	SO ₂
Applicability to aluminum smelters	Proven technology. Check alkalinity of sea water. Absence of alkalinity could be offset by higher flow and/or the addition of lime.	Proven technology.	Proven technology. Equipment more complex than a sodium scrubber.	Technology not used at aluminum smelters. High costs. Takes up lots of space.	Technology not used at aluminum smelters. High cost for steam required to achieve SO ₂ removal rates equivalent to those of other technologies.

For the sake of comparing the costs of the technologies, the cost analyses (DOE, 1999. Environment Canada, Oct. 1997) are expressed in annualized expenses; that is, the sum of the annual operating and maintenance expenses with total capital expenses amortized over the lifetime of the asset. These expenses are expressed per tonne of finished product (e.g., aluminum) or per tonne of SO₂ removed. The costs exclude the potential revenues anticipated from the sale of the subproducts or the disposal of the waste products.

Table 23: Annualized budgetary costs of the technologies for the treatment of SO₂⁽¹⁾

Technology	Investment initial CAN\$/t Al	Depreciation CAN\$/t Al	Operation and maint. CAN\$/t Al	Total cost ^{(2), (4)} CAN\$/t Al	Total cost ^{(2), (4)} annualized CAN\$/t SO ₂
Sea water ⁽³⁾	50 – 200	6.6 – 26.3	2 – 5	8.6 – 31.3	429 – 1 565
Sodium	Approx. 200	Approx. 26.3	21 – 30	47.3 – 56.3	2365 – 2815
Double alkali	Approx. 220	Approx. 28.9	12 – 15	40.9 – 43.9	2046 – 2197
Calcium Carbonate Lime	Approx. 400 Approx. 400	Approx. 52.6 Approx. 52.6	Approx. 10 Approx. 15	Approx. 62.6 Approx. 67.6	Approx. 3 130 Approx. 3 380

(1) 15-year amortization period with a 10% rate of depreciation. For a plant yielding 250 000 t Al/year.

(2) Excluding revenues from the sale of subproducts and costs of disposal of waste products. (3) In Québec, the higher figure for costs should be considered.

(4) Note that costs could run higher (see Section 3.1.3).

4. CONCLUSION

When the study of the technologies for controlling and reducing emissions of sulphur dioxide was being updated, seven technologies for the treatment of SO₂ were identified and reviewed. Two of these technologies are already being used by aluminum smelters, and two conventional technologies are used in other sectors. A potential technology identified in 2000 has since been used in other sectors of the industry and was reviewed according to the progress achieved. In addition, five potential technologies that could be suitable for the aluminum industry but that would require a more in-depth analysis to verify their suitability were reviewed in brief. Investment expenses for SO₂ treatment systems range from CAN\$50 to CAN\$400/t Al (CAN\$2 500 to CAN\$20 000/t SO₂), depending on the technology. Annual operating and maintenance expenses range from CAN\$2 to almost CAN\$30/t Al, or CAN\$100 to almost CAN\$1 500/t SO₂. Note that investment expenses have greatly increased in the past few years because of the non-linear rise in the costs of labour and materials. For obtaining more precise assessments, a detailed assessment is recommended.

Appendix A

Unit costs obtained from suppliers

Unit costs of the delivered products mentioned in the study

Primary material	Information obtained ⁽¹⁾	Source
Quicklime (CaO) Slaked lime	CAN\$195/t 36-tonne truck	Graymont Graymont Graymont
Ca(OH) ₂	CAN\$205/t 28-tonne truck	
Calcium carbonate CaCO ₃	CAN\$25/t 38-tonne truck	Olin Univar Cansolv Tarif L (Hydro-Québec)
Sodium hydroxide NaOH	CAN\$600/t	Univar
Calcium chloride CaCl ₂	CAN\$900/t	
Amine	US\$5 350/t	
Electricity	CAN\$0.03/kWh	
Salts—water softeners	CAN\$550/t	

(1) The unit costs of chemicals can fluctuate according to market conditions and shipping distances. (The price shown is FOB.)

SO₂ BACT WET SCRUBBER ECONOMIC EVALUATION DOCUMENTATION

Cost Effectiveness Calculations - Potlines SO₂ Wet Scrubbing System - Sodium

Basis:

- > EPA Air Pollution Control Cost Manual, Office of Air Quality Planning and Standards, Sixth Edition, EPA/452/B-02-001, January 2002
- > Environment Canada, Report 605311, Section 3, "Assessment of technologies for the prevention and control of SO₂ emissions", 2008.

CAPITAL COSTS

Direct Costs - Wet Scrubber System

1	Purchased Equipment			
a.	Basic Equipment & Auxiliaries (A)	\$41,456,820		2006 Value based on 2008 Environment Canada Report
		201.59		CPI Average for 2006
		215.30		CPI December 2008
		\$44,276,380		December 2008 Estimate
b.	Instrumentation & Controls	\$4,145,682		0.10 A
c.	Taxes	\$1,243,705		0.03 A
d.	Freight	\$2,072,841		0.05 A
	Total Purchased Equipment Cost (B)	\$51,738,608		
2	Direct Installation Costs			
a.	Foundations & Supports	\$6,208,633		0.12 B
b.	Erection & Handling	\$20,695,443		0.40 B
c.	Electrical	\$517,386		0.01 B
d.	Piping	\$15,521,582		0.30 B
e.	Insulation	\$517,386		0.01 B
f.	Painting	\$517,386		0.01 B
g.	Site Preparation	\$7,760,791		Variable
h.	Buildings	--		Variable
	Total Direct Installation Costs	\$51,738,608		
	Total Direct Costs (TDC) (Purchased + Installation)	\$103,477,216		

Indirect Costs - Wet Scrubber System

3	Engineering & Supervision	\$5,173,861	0.10 B
4	Construction & Field Expenses	\$5,173,861	0.10 B
5	Contractor Fees	\$5,173,861	0.10 B
6	Start Up Costs	\$517,386	0.01 B
7	Performance Test	\$517,386	0.01 B
8	Contingency	\$1,552,158	0.03 B
	Total Indirect Costs	\$18,108,513	

Total Installed Capital Cost for Wet Scrubber **\$121,585,729**

Total Installed Capital Cost for Associated WWTP **\$0** Not included in estimate.

Combined Capital Cost for Complete System **\$121,585,729**

Cost Effectiveness Calculations - Potlines SO₂ Wet Scrubbing System - Sodium

Basis:

- > EPA Air Pollution Control Cost Manual, Office of Air Quality Planning and Standards, Sixth Edition, EPA/452/B-02-001, January 2002
- > Environment Canada, Report 605311, Section 3, "Assessment of technologies for the prevention and control of SO₂ emissions", 2008.

ANNUALIZED COSTS

Direct Operating Costs

1	Operating Labor			
a.	Employee Hours per Day- Wet Scrubber	1.5		0.5 hr/shift for Scrubber
	Employee Hours per Day- WWTP	0.0		Not included in estimate.
b.	Cost/Employee/Hour with Benefits	\$40.00		Assumed cost of labor
c.	Operating Days/Year	365		
	Total- Operating Labor	\$21,900		
2	Supervisory Labor	\$3,285		15% of operator labor
3	Maintenance Labor & Materials			
	Maintenance Labor	\$21,900		100% of operating labor
	Maintenance Materials	\$21,900		100% of maintenance labor
	Total- Maintenance Labor & Materials	\$43,800		
4	Replacement Parts	\$2,586,930		Assume 5% of Total Purchased Equipment Costs (0.05 B)
5	Utilities			
a.	Electricity			
	kW Consumed- Wet Scrubber	1,148		Environmental Canada Report
	kW Consumed- WWTP	0		Not included in estimate.
	Cost/kWh	\$0.05		
	Electricity Total	\$546,195		
b.	Water			
	gal/yr	130,486,066		Environmental Canada Report
	Cost/kgal	\$1.76		
	Water Total	\$229,781		
c.	Reagent	\$3,448,800		1.2 ton/ton SO ₂ @ \$500/ton
d.	WWTP Treatment Chemicals	\$0		Not included in estimate.
	Total- Utilities	\$4,224,776		
6	Solid Waste Disposal			
	Disposal of filter cake	\$258,660		Environment Canada Report

Total Direct Operating Costs

\$7,139,351

Indirect Operating Costs

7	Overhead	\$41,391		60% of Operating Labor, Supervisor Labor, and Maintenance Labor & Materials
8	Property Tax	\$1,215,857		0.01 x Total Installed Capital Cost
9	Insurance	\$1,215,857		0.01 x Total Installed Capital Cost
10	Administrative Costs	\$2,431,715		0.02 x Total Installed Capital Cost
11	Capital Recovery Factor (CRF)	0.110	\$13,349,459	CRF = $i(1+i)^n / (1+i)^n - 1$
	Interest	7.0%		
	Equipment Life:	15	years	

Total Indirect Operating Costs

\$18,254,280

Total Annualized Costs

\$25,393,631

Cost Effectiveness Calculations - Potlines SO₂ Wet Scrubbing System - Sodium

Basis:

- > EPA Air Pollution Control Cost Manual, Office of Air Quality Planning and Standards, Sixth Edition, EPA/452/B-02-001, January 2002
- > Environment Canada, Report 605311, Section 3, "Assessment of technologies for the prevention and control of SO₂ emissions", 2008.

COST EFFECTIVENESS

SO ₂ Emissions - Inlet of Scrubber (tpy)	5,748	Based on default SO ₂ Engine variables for A-398 Emissions
Control Efficiency	90%	Anticipated wet scrubber control for low SO ₂ concentration exhaust gas
SO ₂ Removed at Control Efficiency (tpy)	5,173	

Cost Effectiveness, \$/Ton SO₂ Removed

\$4,909 /ton

Cost Effectiveness Calculations - Potlines SO₂ Wet Scrubbing System - Dual Alkali

Basis:

- > EPA Air Pollution Control Cost Manual, Office of Air Quality Planning and Standards, Sixth Edition, EPA/452/B-02-001, January 2002
- > Environment Canada, Report 605311, Section 3, "Assessment of technologies for the prevention and control of SO₂ emissions", 2008.

CAPITAL COSTS

Direct Costs - Wet Scrubber System

1	Purchased Equipment			
a.	Basic Equipment & Auxiliaries (A)	\$48,513,300		2006 Value based on 2008 Environment Canada Report
		201.59		CPI Average for 2006
		215.30		CPI December 2008
		\$51,812,786		December 2008 Estimate
b.	Instrumentation & Controls	\$4,851,330		0.10 A
c.	Taxes	\$1,455,399		0.03 A
d.	Freight	\$2,425,665		0.05 A
	Total Purchased Equipment Cost (B)	\$60,545,180		
2	Direct Installation Costs			
a.	Foundations & Supports	\$7,265,422		0.12 B
b.	Erection & Handling	\$24,218,072		0.40 B
c.	Electrical	\$605,452		0.01 B
d.	Piping	\$18,163,554		0.30 B
e.	Insulation	\$605,452		0.01 B
f.	Painting	\$605,452		0.01 B
g.	Site Preparation	\$9,081,777		Variable
h.	Buildings	--		Variable
	Total Direct Installation Costs	\$60,545,180		
	Total Direct Costs (TDC) (Purchased + Installation)	\$121,090,359		

Indirect Costs - Wet Scrubber System

3	Engineering & Supervision	\$6,054,518	0.10 B
4	Construction & Field Expenses	\$6,054,518	0.10 B
5	Contractor Fees	\$6,054,518	0.10 B
6	Start Up Costs	\$605,452	0.01 B
7	Performance Test	\$605,452	0.01 B
8	Contingency	\$1,816,355	0.03 B
	Total Indirect Costs	\$21,190,813	

Total Installed Capital Cost for Wet Scrubber **\$142,281,172**

Total Installed Capital Cost for Associated WWTP **\$0** Not included in estimate.

Combined Capital Cost for Complete System **\$142,281,172**

Cost Effectiveness Calculations - Potlines SO₂ Wet Scrubbing System - Dual Alkali

Basis:

- > EPA Air Pollution Control Cost Manual, Office of Air Quality Planning and Standards, Sixth Edition, EPA/452/B-02-001, January 2002
- > Environment Canada, Report 605311, Section 3, "Assessment of technologies for the prevention and control of SO₂ emissions", 2008.

ANNUALIZED COSTS

Direct Operating Costs

1	Operating Labor			
a.	Employee Hours per Day- Wet Scrubber	1.5		0.5 hr/shift for Scrubber
	Employee Hours per Day- WWTP	0.0		Not included in estimate.
b.	Cost/Employee/Hour with Benefits	\$40.00		Assumed cost of labor
c.	Operating Days/Year	365		
	Total- Operating Labor	\$21,900		
2	Supervisory Labor	\$3,285		15% of operator labor
3	Maintenance Labor & Materials			
	Maintenance Labor	\$21,900		100% of operating labor
	Maintenance Materials	\$21,900		100% of maintenance labor
	Total- Maintenance Labor & Materials	\$43,800		
4	Replacement Parts	\$3,027,259		Assume 5% of Total Purchased Equipment Costs (0.05 B)
5	Utilities			
a.	Electricity			
	kW Consumed- Wet Scrubber	1,253		Environmental Canada Report
	kW Consumed- WWTP	0		Not included in estimate.
	Cost/kWh	\$0.05		
	Electricity Total	\$595,849		
b.	Water			
	gal/yr	130,486,066		Environmental Canada Report
	Cost/kgal	\$1.76		
	Water Total	\$229,781		
c.	Reagent	\$1,655,424		1.2 ton/ton SO ₂ @ \$240/ton;
d.	WWTP Treatment Chemicals	\$0		Not included in estimate.
	Total- Utilities	\$2,481,054		
6	Solid Waste Disposal			
	Disposal of filter cake	\$1,086,372		Environment Canada Report

Total Direct Operating Costs

\$6,663,670

Indirect Operating Costs

7	Overhead	\$41,391		60% of Operating Labor, Supervisor Labor, and Maintenance Labor & Materials
8	Property Tax	\$1,422,812		0.01 x Total Installed Capital Cost
9	Insurance	\$1,422,812		0.01 x Total Installed Capital Cost
10	Administrative Costs	\$2,845,623		0.02 x Total Installed Capital Cost
11	Capital Recovery Factor (CRF)	0.110	\$15,621,708	CRF = $i(1+i)^n / (1+i)^n - 1$
	Interest	7.0%		
	Equipment Life:	15	years	

Total Indirect Operating Costs

\$21,354,346

Total Annualized Costs

\$28,018,016

Cost Effectiveness Calculations - Potlines SO₂ Wet Scrubbing System - Dual Alkali

Basis:

- > EPA Air Pollution Control Cost Manual, Office of Air Quality Planning and Standards, Sixth Edition, EPA/452/B-02-001, January 2002
- > Environment Canada, Report 605311, Section 3, "Assessment of technologies for the prevention and control of SO₂ emissions", 2008.

COST EFFECTIVENESS

SO ₂ Emissions - Inlet of Scrubber (tpy)	5,748	Based on default SO ₂ Engine variables for A-398 Emissions
Control Efficiency	90%	Anticipated wet scrubber control for low SO ₂ concentration exhaust gas
SO ₂ Removed at Control Efficiency (tpy)	5,173	

Cost Effectiveness, \$/Ton SO₂ Removed

\$5,416 /ton

Cost Effectiveness Calculations - Potlines SO₂ Wet Scrubbing System - Limestone

Basis:

- > EPA Air Pollution Control Cost Manual, Office of Air Quality Planning and Standards, Sixth Edition, EPA/452/B-02-001, January 2002
- > Environment Canada, Report 605311, Section 3, "Assessment of technologies for the prevention and control of SO₂ emissions", 2008.

CAPITAL COSTS

Direct Costs - Wet Scrubber System

1	Purchased Equipment			
a.	Basic Equipment & Auxiliaries (A)	\$88,206,000		2006 Value based on 2008 Environment Canada Report
		201.59		CPI Average for 2006
		215.30		CPI December 2008
		\$94,205,065		December 2008 Estimate
b.	Instrumentation & Controls	\$8,820,600		0.10 A
c.	Taxes	\$2,646,180		0.03 A
d.	Freight	\$4,410,300		0.05 A
	Total Purchased Equipment Cost (B)	\$110,082,145		
2	Direct Installation Costs			
a.	Foundations & Supports	\$13,209,857		0.12 B
b.	Erection & Handling	\$44,032,858		0.40 B
c.	Electrical	\$1,100,821		0.01 B
d.	Piping	\$33,024,643		0.30 B
e.	Insulation	\$1,100,821		0.01 B
f.	Painting	\$1,100,821		0.01 B
g.	Site Preparation	\$16,512,322		Variable
h.	Buildings	--		Variable
	Total Direct Installation Costs	\$110,082,145		
	Total Direct Costs (TDC) (Purchased + Installation)	\$220,164,290		

Indirect Costs - Wet Scrubber System

3	Engineering & Supervision	\$11,008,214		0.10 B
4	Construction & Field Expenses	\$11,008,214		0.10 B
5	Contractor Fees	\$11,008,214		0.10 B
6	Start Up Costs	\$1,100,821		0.01 B
7	Performance Test	\$1,100,821		0.01 B
8	Contingency	\$3,302,464		0.03 B
	Total Indirect Costs	\$38,528,751		

Total Installed Capital Cost for Wet Scrubber **\$258,693,040**

Total Installed Capital Cost for Associated WWTP **\$0** Not included in estimate.

Combined Capital Cost for Complete System **\$258,693,040**

Cost Effectiveness Calculations - Potlines SO₂ Wet Scrubbing System - Limestone

Basis:

- > EPA Air Pollution Control Cost Manual, Office of Air Quality Planning and Standards, Sixth Edition, EPA/452/B-02-001, January 2002
- > Environment Canada, Report 605311, Section 3, "Assessment of technologies for the prevention and control of SO₂ emissions", 2008.

ANNUALIZED COSTS

Direct Operating Costs

1	Operating Labor			
a.	Employee Hours per Day- Wet Scrubber	1.5		0.5 hr/shift for Scrubber
	Employee Hours per Day- WWTP	0.0		Not included in estimate.
b.	Cost/Employee/Hour with Benefits	\$40.00		Assumed cost of labor
c.	Operating Days/Year	365		
	Total- Operating Labor	\$21,900		
2	Supervisory Labor	\$3,285		15% of operator labor
3	Maintenance Labor & Materials			
	Maintenance Labor	\$21,900		100% of operating labor
	Maintenance Materials	\$21,900		100% of maintenance labor
	Total- Maintenance Labor & Materials	\$43,800		
4	Replacement Parts	\$5,504,107		Assume 5% of Total Purchased Equipment Costs (0.05 B)
5	Utilities			
a.	Electricity			
	kW Consumed- Wet Scrubber	4,176		Environmental Canada Report
	kW Consumed- WWTP	0		Not included in estimate.
	Cost/kWh	\$0.05		
	Electricity Total	\$1,986,164		
b.	Water			
	gal/yr	217,476,776		Environmental Canada Report
	Cost/kgal	\$1.76		
	Water Total	\$382,968		
c.	Reagent	\$2,023,296		1.6 ton/ton SO ₂ @ \$220/ton
d.	WWTP Treatment Chemicals	\$0		Not included in estimate.
	Total- Utilities	\$4,392,428		
6	Solid Waste Disposal			
	Disposal of filter cake	\$1,396,764		

Total Direct Operating Costs

\$11,362,285

Indirect Operating Costs

7	Overhead	\$41,391		60% of Operating Labor, Supervisor Labor, and Maintenance Labor & Materials
8	Property Tax	\$2,586,930		0.01 x Total Installed Capital Cost
9	Insurance	\$2,586,930		0.01 x Total Installed Capital Cost
10	Administrative Costs	\$5,173,861		0.02 x Total Installed Capital Cost
11	Capital Recovery Factor (CRF)	0.110	\$28,403,105	CRF = $i(1+i)^n / (1+i)^n - 1$
	Interest	7.0%		
	Equipment Life:	15	years	

Total Indirect Operating Costs

\$38,792,218

Total Annualized Costs

\$50,154,502

Cost Effectiveness Calculations - Potlines SO₂ Wet Scrubbing System - Limestone

Basis:

- > EPA Air Pollution Control Cost Manual, Office of Air Quality Planning and Standards, Sixth Edition, EPA/452/B-02-001, January 2002
- > Environment Canada, Report 605311, Section 3, "Assessment of technologies for the prevention and control of SO₂ emissions", 2008.

COST EFFECTIVENESS

SO ₂ Emissions - Inlet of Scrubber (tpy)	5,748	Based on default SO ₂ Engine variables for A-398 Emissions
Control Efficiency	90%	Anticipated wet scrubber control for low SO ₂ concentration exhaust gas
SO ₂ Removed at Control Efficiency (tpy)	5,173	

Cost Effectiveness, \$/Ton SO₂ Removed

\$9,695 /ton

Cost Effectiveness Calculations - Potlines SO₂ Wet Scrubbing System - Lime

Basis:

- > EPA Air Pollution Control Cost Manual, Office of Air Quality Planning and Standards, Sixth Edition, EPA/452/B-02-001, January 2002
- > Environment Canada, Report 605311, Section 3, "Assessment of technologies for the prevention and control of SO₂ emissions", 2008.

CAPITAL COSTS

Direct Costs - Wet Scrubber System

1	Purchased Equipment			
a.	Basic Equipment & Auxiliaries (A)	\$88,206,000		2006 Value based on 2008 Environment Canada Report
		201.59		CPI Average for 2006
		215.30		CPI December 2008
		\$94,205,065		December 2008 Estimate
b.	Instrumentation & Controls	\$8,820,600		0.10 A
c.	Taxes	\$2,646,180		0.03 A
d.	Freight	\$4,410,300		0.05 A
	Total Purchased Equipment Cost (B)	\$110,082,145		
2	Direct Installation Costs			
a.	Foundations & Supports	\$13,209,857		0.12 B
b.	Erection & Handling	\$44,032,858		0.40 B
c.	Electrical	\$1,100,821		0.01 B
d.	Piping	\$33,024,643		0.30 B
e.	Insulation	\$1,100,821		0.01 B
f.	Painting	\$1,100,821		0.01 B
g.	Site Preparation	\$16,512,322		Variable
h.	Buildings	--		Variable
	Total Direct Installation Costs	\$110,082,145		
	Total Direct Costs (TDC) (Purchased + Installation)	\$220,164,290		

Indirect Costs - Wet Scrubber System

3	Engineering & Supervision	\$11,008,214		0.10 B
4	Construction & Field Expenses	\$11,008,214		0.10 B
5	Contractor Fees	\$11,008,214		0.10 B
6	Start Up Costs	\$1,100,821		0.01 B
7	Performance Test	\$1,100,821		0.01 B
8	Contingency	\$3,302,464		0.03 B
	Total Indirect Costs	\$38,528,751		

Total Installed Capital Cost for Wet Scrubber **\$258,693,040**

Total Installed Capital Cost for Associated WWTP **\$0** Not included in estimate.

Combined Capital Cost for Complete System **\$258,693,040**

Cost Effectiveness Calculations - Potlines SO₂ Wet Scrubbing System - Lime

Basis:

- > EPA Air Pollution Control Cost Manual, Office of Air Quality Planning and Standards, Sixth Edition, EPA/452/B-02-001, January 2002
- > Environment Canada, Report 605311, Section 3, "Assessment of technologies for the prevention and control of SO₂ emissions", 2008.

ANNUALIZED COSTS

Direct Operating Costs

1	Operating Labor		
a.	Employee Hours per Day- Wet Scrubber	1.5	0.5 hr/shift for Scrubber
	Employee Hours per Day- WWTP	0.0	Not included in estimate.
b.	Cost/Employee/Hour with Benefits	\$40.00	Assumed cost of labor
c.	Operating Days/Year	365	
	Total- Operating Labor	\$21,900	
2	Supervisory Labor	\$3,285	15% of operator labor
3	Maintenance Labor & Materials		
	Maintenance Labor	\$21,900	100% of operating labor
	Maintenance Materials	\$21,900	100% of maintenance labor
	Total- Maintenance Labor & Materials	\$43,800	
4	Replacement Parts	\$5,504,107	Assume 5% of Total Purchased Equipment Costs (0.05 B)
5	Utilities		
a.	Electricity		
	kW Consumed- Wet Scrubber	4,176	Environmental Canada Report
	kW Consumed- WWTP	0	Not included in estimate.
	Cost/kWh	\$0.05	
	Electricity Total	\$1,986,164	
b.	Water		
	gal/yr	217,476,776	Environmental Canada Report
	Cost/kgal	\$1.76	
	Water Total	\$382,968	
c.	Reagent	\$1,655,424	1.2 ton/ton SO ₂ @ \$240/ton
d.	WWTP Treatment Chemicals	\$0	Not included in estimate.
	Total- Utilities	\$4,024,556	
6	Solid Waste Disposal		
	Disposal of filter cake	\$1,396,764	

Total Direct Operating Costs

\$10,994,413

Indirect Operating Costs

7	Overhead	\$41,391	60% of Operating Labor, Supervisor Labor, and Maintenance Labor & Materials
8	Property Tax	\$2,586,930	0.01 x Total Installed Capital Cost
9	Insurance	\$2,586,930	0.01 x Total Installed Capital Cost
10	Administrative Costs	\$5,173,861	0.02 x Total Installed Capital Cost
11	Capital Recovery Factor (CRF)	0.110	CRF = $i(1+i)^n / (1+i)^n - 1$
	Interest	7.0%	
	Equipment Life:	15 years	

Total Indirect Operating Costs

\$38,792,218

Total Annualized Costs

\$49,786,630

Cost Effectiveness Calculations - Potlines SO₂ Wet Scrubbing System - Lime

Basis:

- > EPA Air Pollution Control Cost Manual, Office of Air Quality Planning and Standards, Sixth Edition, EPA/452/B-02-001, January 2002
- > Environment Canada, Report 605311, Section 3, "Assessment of technologies for the prevention and control of SO₂ emissions", 2008.

COST EFFECTIVENESS

SO ₂ Emissions - Inlet of Scrubber (tpy)	5,748	Based on default SO ₂ Engine variables for A-398 Emissions
Control Efficiency	90%	Anticipated wet scrubber control for low SO ₂ concentration exhaust gas
SO ₂ Removed at Control Efficiency (tpy)	5,173	

Cost Effectiveness, \$/Ton SO₂ Removed

\$9,624 /ton

Please see attached spreadsheet:
“11-17-09 Park Service Rio Tinto Al
plant BART & BACT summary”

APPENDIX J

Air Dispersion Modeling Report from Trinity Consultants

AIR DISPERSION MODELING REPORT

1-hour SO₂ NAAQS

Henderson-Webster Nonattainment Area SIP

For:

Century Aluminum Sebree, LLC

9404 State Route 2096
Robards, Kentucky 42452
(Agency Interest #1788)

Prepared By:

Brian Otten – Senior Consultant
Tony Schroeder, CCM, QEP, CM – Principal Consultant

TRINITY CONSULTANTS

909 Wright's Summit Pkwy, Ste 230
Covington, Kentucky 41011
(859) 341-8100

August 7, 2024

Project 231801.0017



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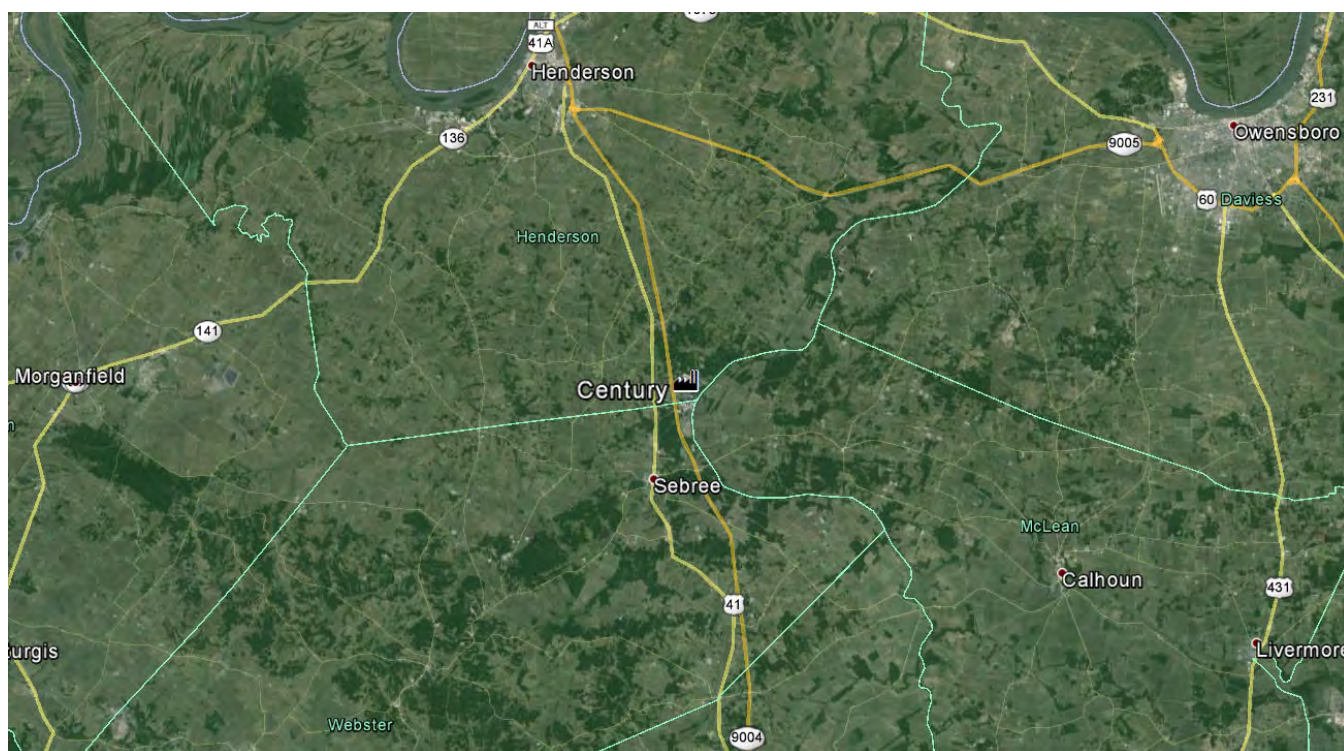
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1. INTRODUCTION

On behalf of Century Aluminum Sebree, LLC (Century), Trinity Consultants (Trinity) has prepared and is submitting this dispersion modeling report to the Kentucky Division for Air Quality (Division). This report documents the air quality modeling attainment demonstration analysis conducted for sulfur dioxide (SO₂) emissions from Century's facility in Sebree, Kentucky (Sebree Plant) and other sources in the surrounding area. The Sebree Plant is located on State Highway Junction 2096/2097, 3.8 miles (6.1 km) northeast of the city center of Sebree, Kentucky. Figure 1-1 shows the location of the Sebree Plant in western Kentucky at the confluence of Webster, McLean, and Henderson counties approximately 27 km south of Henderson, Kentucky and the Kentucky-Indiana border.

The area in the vicinity of the Sebree Plant, specifically portions of Henderson and Webster Counties, was designated as nonattainment with respect to the 1-hour SO₂ National Ambient Air Quality Standard (NAAQS) effective April 30, 2021. The modeling exercise covered by this report was conducted in support of the Division's efforts to prepare a State Implementation Plan (SIP) revision with respect to the 1-hour SO₂ NAAQS in response to this nonattainment designation.

Figure 1-1. Location of Sebree Plant Northeast of Sebree, KY

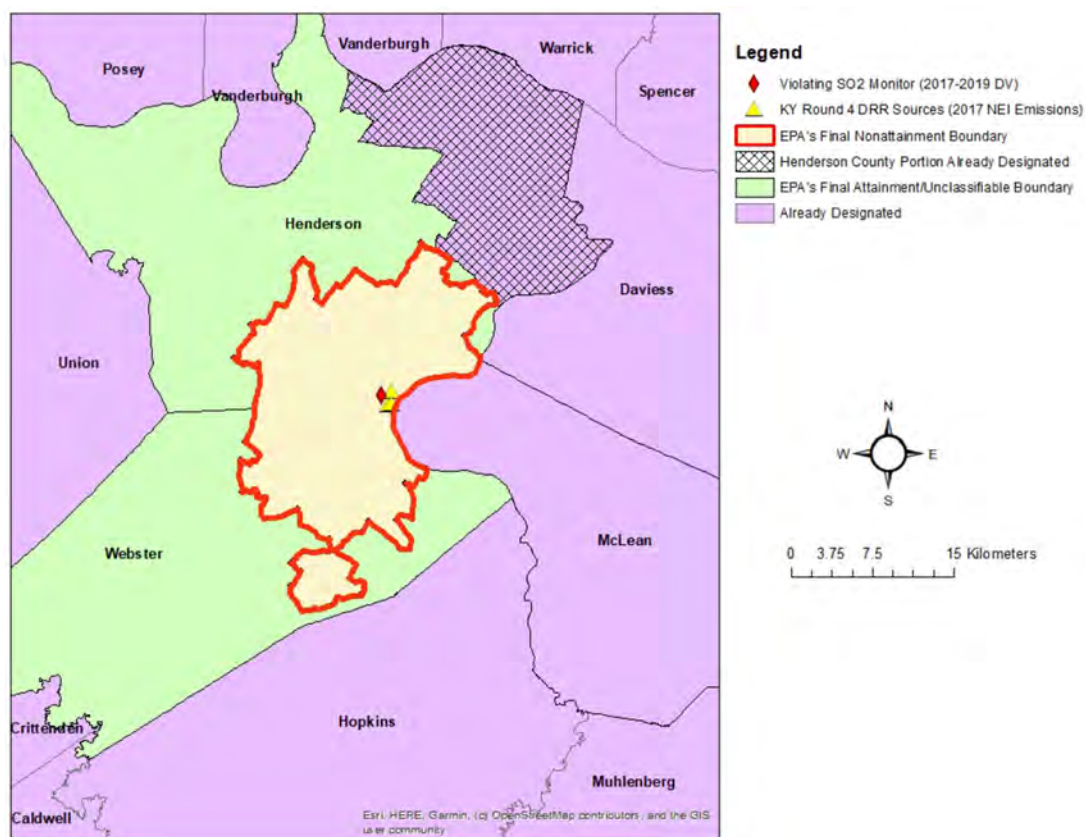


1.1 Background

The U.S. Environmental Protection Agency (EPA) promulgated the current 1-hour SO₂ NAAQS at 75 parts per billion (ppb) on June 22, 2010.¹ Compliance with the 1-hour SO₂ NAAQS is determined based on monitor data using the three-year average of the 4th highest daily maximum concentration. In August 2015, EPA promulgated the SO₂ Data Requirements Rule (DRR).² The DRR required certain sources to confirm that surrounding areas were in attainment with respect to the 1-hour SO₂ NAAQS based on either air dispersion modeling or the placement and operation of ambient SO₂ monitors if existing monitors did not already adequately characterize SO₂ concentrations near the sources. Century and the Division chose to install and operate an ambient monitoring station near the Sebree Plant with operation beginning before January 1, 2017. The design concentrations calculated from SO₂ concentration data collected over the period of 2017-2019 exceeded the NAAQS. Therefore, the area was designated as nonattainment with respect to the 1-hour SO₂ NAAQS effective in April 2021.³

The nonattainment area includes portions of Henderson and Webster Counties in Kentucky as shown in Figure 1-2. Historically, the two largest sources of SO₂ emissions in the nonattainment area have been Century Sebree and Big Rivers Electric Company (BREC), which is located south of Century Sebree.

Figure 1-2. SO₂ Nonattainment Area Boundary



¹ 75 FR 35520, June 22, 2010.

² 80 FR 51052, August 21, 2015.

³ 86 FR 16055, March 26, 2021.

1.2 SIP Revision and Purpose of Modeling Report

The nonattainment designation triggers the requirement for the Division to develop a revision to the Kentucky SIP to demonstrate that attainment with the 1-hour SO₂ will be achieved as quickly as possible, but no later than 5 years after the effective date of the designation (i.e., by April 30, 2026). One component of the SIP is a modeling analysis demonstrating that the NAAQS will be attained. Trinity has prepared this dispersion modeling report to describe the SIP modeling analysis conducted for the Sebree plant. The report documents the data and procedures that were used to complete the dispersion modeling analyses and the results. As discussed in Section 4 of this report, a weight of evidence analysis is provided to demonstrate that compliance with the 1-hour SO₂ NAAQS can be expected following certain planned changes to Sebree Plant operations and the imposition of new limits on potential SO₂ emissions from Sebree Plant emission units. The modeling analysis was conducted in accordance with the modeling protocol that was originally submitted to the Division on October 31, 2023, revised to address comments from the Division and EPA, and resubmitted on February 9, 2024.

2. SIP DISPERSION MODELING METHODOLOGIES

The purpose of the SIP air dispersion modeling analysis is to demonstrate that compliance with the 1-hour SO₂ NAAQS will be achieved throughout the nonattainment area (via the emission reductions or other measures to be implemented to reduce ambient SO₂ concentrations). The purpose of this report is to demonstrate that ambient air concentrations will meet the 1-hour SO₂ NAAQS throughout the Henderson-Webster SO₂ nonattainment area when the stack configuration planned by Century are implemented and when SO₂ emission rates are at or below those represented in the modeling analysis. The Title V air permit for the Seabree Plant (V-19-010 R2)⁴ will be amended to include federally enforceable conditions governing the stack configuration and emission limits that are relied upon in the modeling demonstration. These stack and emission changes are further detailed in Section 2.8 of this report.

The remainder of this section describes the tools and methods that were employed to conduct the SO₂ NAAQS dispersion modeling analysis.

2.1 Model Selection

For nonattainment SIP modeling, a number of guidance documents and resources are available to facilitate and provide detail on the methodologies required for conducting dispersion modeling. While no Kentucky-specific guidance is available, Trinity has prepared protocols and modeling reports for several industrial permitting activities within Kentucky over the past fifteen years and thus is familiar with the methods that are generally acceptable by the Division. As documented in the modeling protocol submitted for this SIP demonstration analysis, the dispersion modeling methodologies followed are consistent with EPA procedures specified in the *Guideline on Air Quality Models (Guideline)*.⁵ These guidelines are cited by reference in the Kentucky Administrative Regulations (refer to 401 KAR 51:017, Section 10).⁶ Additional EPA guidance, specific to 1-hour SO₂ nonattainment area SIP submissions, was also followed.⁷ In general, as documented in the February 9, 2024 modeling protocol, the air dispersion modeling analyses conducted were in accordance with applicable EPA guidance documents, including the following:

- ▶ EPA's *Guideline on Air Quality Models*, 40 CFR Part 51, Appendix W (Published, January 17, 2017), which Kentucky cites by reference in Section 10 of 401 KAR 51:017.
- ▶ EPA's AERMOD Implementation Guide (October 2023)⁸
- ▶ EPA's User's Guide for the AMS/EPA Regulatory Model – AERMOD (October 2023)⁹
- ▶ EPA's Guidance for 1-Hour SO₂ Nonattainment SIP Submissions (April 2014)

⁴ An application to renew the Title V permit was submitted by Century to the Kentucky Division for Air Quality on May 9, 2024.

⁵ 40 CFR 51, Appendix W, *Guideline on Air Quality Models*

⁶ 40 CFR 51, Appendix W, *Guideline on Air Quality Models* cited in 401 KAR 51:017 at <http://www.lrc.ky.gov/kar/401/051/017.htm>.

⁷ Guidance for 1-Hour SO₂ Nonattainment SIP Submissions, Memorandum from Stephen D. Page, Director, to Regional Air Division Directors, Regions 1-10, dated April 23, 2014. https://www.epa.gov/sites/default/files/2016-06/documents/20140423guidance_nonattainment_sip.pdf

⁸ EPA, *AERMOD Implementation Guide*, October 2023, available at https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/aermod_implementation_guide.pdf

⁹ *User's Guide for the AMS/EPA Regulatory Model (AERMOD)*, EPA-454/B-23-008, EPA, OAQPS, Research Triangle Park, NC, October 2023.

Given these guidance documents and typical modeling practices, Century used the EPA-recommended AERMOD Model in its most recent Version 23132 released in October 2023. AERMOD is a refined, steady-state (both emissions and meteorology are constant over a one hour time step), multiple source, dispersion model and was promulgated by EPA in December 2005 as the preferred model to use for industrial sources in this type of air quality analysis.¹⁰ AERMOD was used to model each stack and other types of sources at the Century Sebree facility as well as other nearby sources. Century applied AERMOD using the regulatory default options in all cases.

2.2 Rural/Urban Option Selection in AERMOD

For any dispersion modeling exercise, the “urban” or “rural” determination of the area surrounding the subject source is important in determining the applicable atmospheric boundary layer characteristics that affect a model's calculation of ambient concentrations. Thus, a determination must be made of whether the area in the modeling domain should be treated as urban or rural to yield the most accurate simulation of dispersion of emissions from the subject facilities.

The first method for selecting the urban or rural designation discussed in Section 5.1 of the *AERMOD Implementation Guide* (also referring therein to Section 7.2.1.1 of the *Guideline on Air Quality Models*, Appendix W) is called the “land use” technique because it examines the various land use within 3 km of a source and quantifies the percentage of area in various land use categories. If greater than 50% of the land use in the prescribed area is considered urban, then the urban option is recommended for use in AERMOD. However, EPA cautions that the use of this technique may not be appropriate in all cases, such as for sources close to a body of water because the water body may result in a predominately rural land use classification despite being located in an urban area, and that professional judgment is necessary to make an appropriate urban or rural determination. If necessary, the second recommended urban/rural classification method in Appendix W Section 7.2.1.1.b is the Population Density Procedure. This technique evaluates the total population density within 3-kilometers of a source. If the population density is greater than 750 people per square kilometer, then EPA recommends the use of urban dispersion coefficients.

Based on aerial imagery of the area surrounding the Century Sebree Plant, the nearby land use is primarily rural (approximately 95% rural and 5% urban based on the Auer land use method). However, certain types of industrial facilities are of sufficient size and generate sufficient heat to create localized “heat islands”, which can cause similar atmospheric dispersion conditions to those generated by urban areas. Primary aluminum smelters use a large quantity of electricity in the smelting operation, a good portion of which (up to 50%) is dissipated as heat loss from the aluminum production cells.¹¹ This heat loss results in continued heating of the atmosphere above the plant, even during nighttime conditions, such that the atmosphere remains more unstable at night compared with nearby, rural areas in much the same manner as urban areas. The presence of a “heat island” in the vicinity of the Century Sebree Plant is confirmed through the use of satellite thermal imagery,¹² as shown in Figure 2-1.

In these cases where industrial facilities result in large heat releases to the atmosphere, the urban option can be employed in AERMOD to better characterize atmospheric turbulence whereas rural dispersion can be

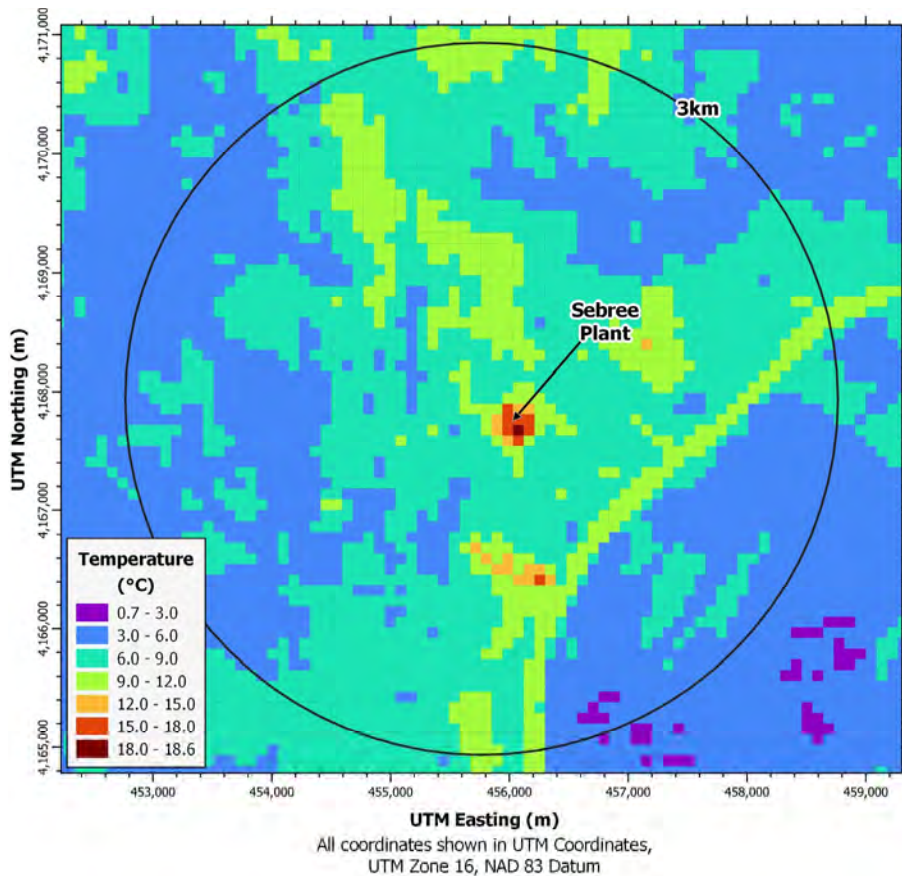
¹⁰ 40 CFR 51, Appendix W—*Guideline on Air Quality Models*, Appendix A.1—AMS/EPA Regulatory Model (AERMOD).

¹¹ <http://www.tms.org/pubs/journals/JOM/9905/Welch-9905.html>.

¹² Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Level 1 Precision Terrain Corrected Registered At-Sensor Radiance (AST_L1T) imagery, taken November 17, 2016 at 3:51AM. AST_L1T thermal imagery was queried from USGS Earth Explorer.

assumed for other emission sources in the model. This technique has been the subject of at least one peer-reviewed journal article¹³ and has been employed in EPA-approved modeling completed under the SO₂ DRR for another primary aluminum smelter located in the Ohio River valley.¹⁴

Figure 2-1. Satellite Thermal Imagery of Century Sebree Plant (November 17, 2016)



An additional input to AERMOD necessary for implementation of the urban option is the estimated population of the urban area. As discussed in Section 5.9 of the AERMOD Model Formulation,¹⁵ the difference in temperature between a nearby urban and rural area can be expressed as a function of the population of the urban area as follows.

$$\Delta T_{u-r} = \Delta T_{max} [0.1 \ln(P/P_o) + 1.0]$$

where $\Delta T_{max} = 12^{\circ}\text{C}$, $P_o = 2,000,000$, and P is the population of the urban area being modeled.

¹³ Paine, R., L. Warren, G. Moore, 2016. Source Characterization Refinements for Routine Modeling Applications. *Atmospheric Environment*, **129**, 55-67.

¹⁴ Technical Support Document, Final Round 3 Area Designations for the 2010 1-Hour SO₂ Primary National Ambient Air Quality Standard for Indiana. <https://www.epa.gov/sites/default/files/2017-12/documents/13-in-so2-rd3-final.pdf>

¹⁵ EPA, AERMOD Model Formulation, EPA-454/B-23-010, October 2023.
https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/aermod_mfd.pdf

This empirical formula was developed based on data collected by Oke^{16,17} for a number of cities with varying populations. These data represent the maximum urban effect for each city because they were collected during ideal conditions of clear skies, low winds, and low humidity values.

This equation can be rearranged to solve for P, yielding:

$$P = P_o \exp[10(\Delta T_{u-r}/\Delta T_{max} - 1.0)]$$

Figure 2-1 represents the ASTER satellite image available with maximum temperature difference between Century Sebree and nearby rural areas over the years 2000-2022. The difference in temperature between the center of the plant and nearby rural areas shown in Figure 2-1, is approximately 12°C. The temperature difference is estimated based on the difference in temperature at the plant (18°C) and the mid-point of the majority of pixels within 3 km of the plant. The majority of the pixels are in the 3 to 6°C or 6 to 12°C temperature range. Using the mid-point of this range of 6°C yields a temperature difference between the plant and nearby rural areas of 12°C. Using this temperature difference in the equation above yields an equivalent population of 2,000,000.

Use of this image, presenting the maximum temperature difference between the plant and nearby locations, is consistent with the data used to develop the empirical relationship in the equations above, which were taken under ideal conditions to maximize the urban-rural temperature difference. This method is likely to result in a conservative under representation of the maximum temperature difference between the smelter and nearby areas because the dates of the satellite images available do not necessarily capture days with clear skies, low winds, and low relative humidity. A total of 24 nighttime images of the area around the Sebree Plant are available from 2000-2022. The extracted temperatures from the thermal imagery are presented in Table 2-1 for comparison. As provided beside Table 2-1, the temperature differential of 12°C represents the maximum of the 13 available temperature differentials. Relatively few clear nighttime images were available over the time period included in this analysis. Therefore, it is very likely that situations occurred with larger temperature differences between the plant and nearby areas, meaning that the use of the 12°C temperature differential is a conservative assumption.

An AERMOD model performance evaluation is presented in Appendix A that documents the more realistic, but conservatively high, model output concentrations versus monitored data collected near the Century Sebree facility with use of the urban option. This evaluation shows that the use of AERMOD with the urban option selected and a population of 2,000,000 provides more realistic, but still conservatively high, model output concentrations for the Century Sebree SO₂ emission sources to be included in this SIP modeling analysis compared with the use of rural dispersion characteristics.

Based on the analysis presented, Century used the urban option for all Century Sebree sources with an equivalent population of 2 million, and rural dispersion characteristics for other modeled sources.

¹⁶ Oke, T.R., 1973: City size and the urban heat island. *Atmospheric Environment*, **7**, 769-779.

¹⁷ Oke, T.R., 1982: The energetic basis of the urban heat island. *Quart. J. Roy. Meteor. Soc.*, **108**, 1-24.

Table 2-1. Thermal Imagery Data for Sebree Plant

Year	Month	Day	Max Temp. at Sebree Plant¹ (°C)	Surrounding Area Temperature (°C)	Temperature Differential² (°C)	
2003	06	30	7.8	2.5	5.3	Min 5.3
2003	06	30				
2006	11	13				
2006	11	13				
2007	02	10				Avg 7.5
2011	10	03	17.1	5.9	11.2	
2012	10	21				
2015	05	07				
2015	08	27	23.1	14.9	8.2	Max 12.0
2016	10	16				
2016	11	17	18.6	6.6	12.0	
2017	05	19	24.3	17.0	7.3	
2017	05	19				95th Perc. 11.5
2017	10	03	21.5	15.6	5.9	
2017	11	20	4.9	-3.5	8.4	
2018	02	08	-0.6	-6.2	5.6	
2018	09	20	25.0	18.0	7.0	90th Perc. 10.7
2019	01	10	3.3	-4.0	7.3	
2020	05	04				
2021	08	18				
2021	09	28	22.8	17.0	5.8	75th Perc. 8.2
2022	05	10	24.9	17.9	7.0	
2022	07	13				
2022	10	01	23.1	17.1	6.0	

¹ In some instances, the Sebree Plant was not located within the boundaries of the image, despite the USGS download utility indicating such. For these instances and for images with clouds covering the Sebree Plant, the table entries are grayed out.

² The temperature difference is estimated based on the difference in temperature at the plant and the mid-point of the majority of pixels within 3 km of the plant based on random sampling of data points.

2.3 Building Downwash

The *Guideline* requires the evaluation of the potential for physical structures to affect the dispersion of emissions from stack sources. The exhaust from stacks that are located within specified distances of buildings may be subject to “aerodynamic building downwash” under certain meteorological conditions. This determination is made by comparing actual stack height to the Good Engineering Practice (GEP) stack height. The modeled emission units at the Century Sebree facility and the BREC facility were evaluated in terms of their proximity to nearby structures.

In accordance with recent AERMOD updates, an emission point is assumed to be subject to the effects of downwash at all release heights even if the stack height is above the EPA formula height, which is defined by the following formula:

$$H_{GEP} = H + 1.5L, \text{ where:}$$

where,

H_{GEP} = GEP stack height,

H = structure height, and

L = lesser dimension of the structure (height or maximum projected width).

This equation is limited to stacks located within 5L of a structure. Stacks located at a distance greater than 5L are not subject to the wake effects of the structure.

Direction-specific equivalent building dimensions used as input to the AERMOD model to simulate the impacts of downwash were calculated using the EPA-sanctioned Building Profile Input Program (BPIP-PRIME), version 04274 and used in the AERMOD Model.¹⁸ BPIP-PRIME is designed to incorporate the concepts and procedures expressed in the GEP Technical Support document, the Building Downwash Guidance document, and other related documents and has been adapted to incorporate the PRIME downwash algorithms.¹⁹

A GEP analysis of all modeled point sources at the Century and BREC facilities in relation to each building was performed to evaluate which building has the greatest influence on the dispersion of each stack's emissions. The GEP height for each stack calculated using the dominant structure's height and maximum projected width was also determined.

According to EPA dispersion modeling guidance,²⁰ stacks with actual heights greater than either 65 meters or the calculated GEP height, whichever is greater, generally cannot take credit for their full stack height in a SIP modeling analysis. All modeled source stacks at the Century Seabree facility are less than 65 meters tall and therefore meet the requirements of GEP and credit for the entire actual height of each stack was used in this modeling analysis. Some stacks at BREC are greater than 65 meters tall; therefore, a GEP stack height analysis was also completed for BREC stacks to determine the heights that could be modeled.

2.4 Elevated Terrain

Terrain elevations were considered in the modeling analysis. The elevations of receptors, buildings, and sources impact modeled concentrations in cases where there are sources at one elevation and receptor locations at various other elevations at the ambient air boundary and beyond. Elevation data were processed for input to AERMOD through the use of the AERMOD terrain preprocessor called AERMAP (latest version 18081), which generates base elevations above mean sea level of sources, buildings, and/or receptors as specified by the user. For all receptors, AERMAP was used to determine an effective hill height

¹⁸ Earth Tech, Inc., Addendum to the ISC3 User's Guide, The PRIME Plume Rise and Building Downwash Model, November 1997, <http://www.epa.gov/scram001/7thconf/iscprime/useguide.pdf>.

¹⁹ U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Guidelines for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised)*, Research Triangle Park, North Carolina, EPA 450/4-80-023R, June 1985.

²⁰ Section 7.2.2.1 of 40 CFR 51, Appendix W.

scale that determines the magnitude of each source plume-elevated terrain feature interaction. AERMOD uses both of these receptor-related values to calculate the effect of terrain on each plume. Base elevations for select sources and buildings, terrain elevations for receptors, and other regional source base elevations input to the model were read and interpolated from 1 arc second (approximately 30-meter resolution) National Elevation Dataset (NED) data obtained from the U.S. Geological Survey (USGS).²¹

2.5 Meteorological Data

To perform modeling in AERMOD, meteorological data must be preprocessed to input in a format that AERMOD can use. This was accomplished using the AERMET processor (Version 23132) along with nearby sets of site-specific meteorological data and National Weather Service (NWS) data from surface and upper air stations. Since the time that the Sebree SO₂ monitor began operation the beginning of 2017, Century has also operated a meteorological tower, which has collected continuous, site-specific meteorological data. The meteorological tower is located approximately 350 ft east-southeast of the SO₂ monitor. The tower collects data on wind speed and direction, temperature, net and solar radiation, barometric pressure, and relative humidity. The tower was originally installed by Trinity Consultants' Ambient Monitoring Services group and continues to be serviced and calibrated by Trinity. Data collected at this meteorological station were used as the primary surface data for input to AERMET. These data were supplemented with surface data from a representative NWS station. Upper air data were obtained from a nearby station at which radiosonde observations are taken. The most recent, readily available three full years of meteorological data from the site-specific station that were available at the time that the modeling protocol for this analysis was submitted are from 2020 through 2022. Therefore, these years were used in conjunction with NWS data from the same time period.

An evaluation of the NWS meteorological data sites within approximately 120 km of the Sebree Plant reveals that several airports are located in the region (other non-airport data sets were determined to be deficient in terms of data collection and quality). Figure 2-2 shows the locations of the airports (indicated by four letter designations beginning with K) having meteorological data sets that were considered to supplement the site-specific surface data for this modeling. Unfortunately, most of the airports within the vicinity of Sebree Plant do not utilize Automated Surface Observing Systems (ASOS) to record 1-minute data for use in the AERMINUTE preprocessor. Proximity of the meteorological station to the modeled facility is also an important consideration in meteorological station selection. The only meteorological station sites utilizing ASOS one-minute recording systems and falling within 120 km of Sebree Plant were the Evansville Regional Airport (KEVV, 22.3 km north of Sebree Plant) and the Clarksville (TN) Regional Airport/Outlaw Field (KCKV, 114.6 km south of Sebree Plant). Table 2-2 presents the results of an NWS identification and selection analysis based on proximity to Sebree Plant where meteorological stations without adequate data are designated with gray highlighting and candidate stations for the modeling analysis are designated without highlighting.

²¹ U.S. Geological Survey, USGS 3D Elevation Program (3DEP), accessed October 21, 2021 at <https://apps.nationalmap.gov/downloader/#/>

Figure 2-2. Meteorological Stations and SO₂ Monitors in the Area Near Sebree Plant

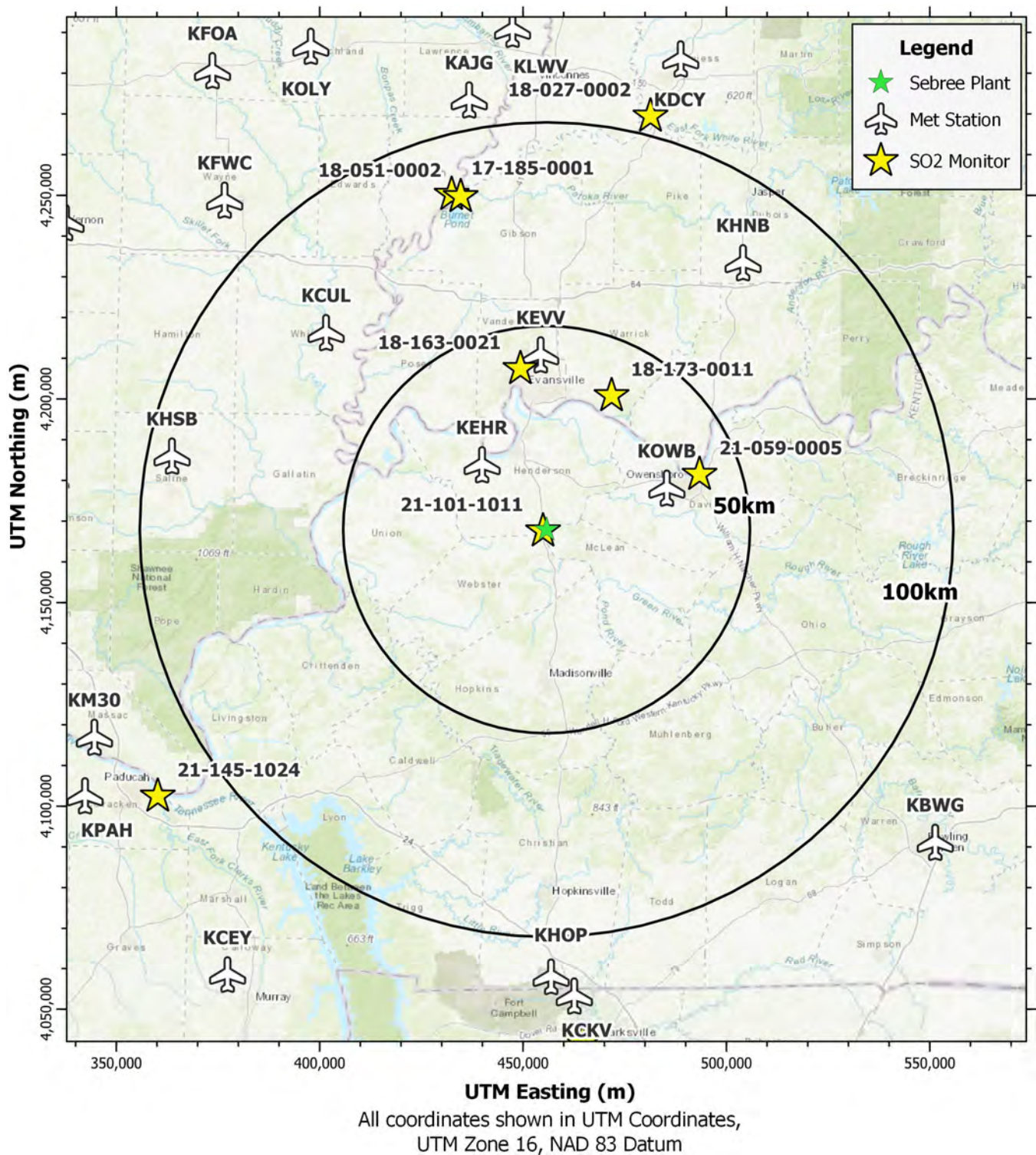


Table 2-2. Proximity Analysis of Meteorological Stations to Sebree Plant

Station Name	WBAN Station ID	Station Call Sign	Lat.	Long.	ASOS One Minute Data Available	Distance to Sebree Plant (km)
Henderson City-County Airport	53886	KEHR	37.800	-87.683	No	22.5
Owensboro-Daviess County Airport	53803	KOWB	37.750	-87.167	No	31.2
Evansville Regional Airport	93817	KEVV	38.044	-87.521	Yes	43.0
Carmi Municipal Airport	63840	KCUL	38.089	-88.123	No	72.7
Huntingburg Airport	53896	KHNB	38.249	-86.954	No	81.4
Harrisburg-Raleigh Airport	53897	KHSB	37.811	-88.549	No	93.7
Mount Carmel Municipal Airport	63853	KAJG	38.607	-87.727	No	107.4
Campbell AAF Airport	13806	KHOP	36.667	-87.483	No	110.1
Fairfield Municipal Airport	53891	KFWC	38.379	-88.413	No	113.2
Clarksville Regional/Outlaw Field Airport	3894	KCKV	36.624	-87.419	Yes	115.1

2.5.1 Meteorological Data Processing – Site Specific Data

Hourly average meteorological parameters were used in AERMET derived from the data collected at the site-specific monitor described earlier. The following parameters were input: wind speed and wind direction at 10 meters above ground level, temperature at 2 meters and 10 meters above ground level, relative humidity, solar radiation, net radiation, barometric pressure, and precipitation. The default ADJ_U* option was used in the meteorological data processing because full site-specific turbulence parameter data are not collected.

The Quality Assurance Project Plan (QAPP) for the site-specific meteorological station is provided in Appendix B of this modeling report. The QAPP was implemented and semi-annual calibrations and performance audits were completed such that either a calibration or audit was completed each calendar quarter. The only exceptions to quarterly audits or calibrations were during the 1st and 2nd quarters of 2020 when travel was restricted due to COVID19, and calibrations and performance audits could not be performed. However, the 3rd quarter 2020 calibration, which was completed in September 2020, found no issues with the instrumentation that would invalidate the data collected between the December 2019 and September 2020 calibrations. Additionally, during the August 4, 2022 calibration, the wind direction and temperature sensors were determined to be outside acceptance tolerances. Therefore, these sensors were replaced and data for these sensors since the previous calibration were flagged as invalid and not used in the met data processing.

2.5.2 Meteorological Data Processing – NWS Surface Data

Unprocessed hourly surface meteorological field data were obtained from the U.S. National Climatic Data Center (NCDC) for the Evansville Regional Airport (KEVV) for 2020-2022 in the standard ISHD (integrated surface hourly data) format²². These data were supplemented with TD-6405 (so-called “1-minute”) wind data for the station²³ and processed using the latest version of the AERMINUTE pre-processing tool (version 15272). A threshold wind speed of 0.5 m/s was used in AERMET as per EPA guidance. The “Ice-Free Winds

²² <ftp://ftp.ncdc.noaa.gov/pub/data/noaa/>

²³ <ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin>

Group” AERMINUTE option was selected due to the fact that a sonic anemometer has been installed at KEVV since September 26, 2006²⁴.

2.5.3 Meteorological Data Processing - Upper Air Data

In addition to surface meteorological data, AERMET requires the use of data from an upper air sounding to estimate mixing heights. Upper air data from the nearest representative U.S. National Weather Service (NWS) radiosonde equipped station were utilized in the modeling analysis. In this case, two upper air stations were considered, namely, from the Nashville International Airport (KBNA, WBAN No. 13897), which is about 176 km south of the Sebree Plant, and from the Lincoln-Logan County Airport (KILX, WBAN No. 04833), which is about 318 km northwest of the Sebree Plant. The proximity of the Nashville station compared with the Lincoln station makes the Nashville station the most representative choice for the Sebree area. Data were obtained from the National Oceanic and Atmospheric Administration (NOAA) in FSL (Forecast Systems Laboratory) format²⁵ for the same period of record, namely, 2020-2022.

2.5.4 Meteorological Data Processing – Land Use Analysis

Parameters derived from analysis of land use data (surface roughness parameter, Bowen ratio, and albedo) are also required by AERMET. In accordance with EPA guidance, these values were determined using the latest version of the AERSURFACE tool (version 20060)²⁶ for both the site-specific surface station and the Evansville Regional Airport (KEVV) surface station using NLCD 2016 data including land cover, canopy, and impervious surface data. AERSURFACE reads gridded land use and land cover data as provided by the United States Geological Survey (USGS)²⁷ and associates such data with representative values of the three parameters listed above. The parameters were defined using a 1 km radius for surface roughness and seasonally varying characteristics for all parameters. The surface roughness was defined using customized sectors for both the site-specific station and KEVV, as shown in Figure 2-3 and Figure 2-4. Using professional judgement, these customized sectors were determined based on an evaluation of aerial imagery, tree canopy data, impervious surface data, and land use categories within a 1 km radius of the meteorological data towers. All sectors at the site-specific station were defined as “non-airport” sectors. Sectors from 0-30 degrees, and 216-261 degrees were defined as “airport” sectors at KEVV and the remaining sectors were defined as “non-airport” sectors.

²⁴ http://www.nws.noaa.gov/ops2/Surface/documents/IFW_stat.pdf

²⁵ <http://www.esrl.noaa.gov/raobs/>

²⁶ U.S. Environmental Protection Agency. 2020. “AERSURFACE User’s Guide.” EPA-454/B-20-008, Revised February 2020. Available Online: https://gaftp.epa.gov/Air/aqmg/SCRAM/models/related/aersurface/aersurface_ug_v20060.pdf

²⁷ <http://www.mrlc.gov/viewerjs/>

Figure 2-3. Land Use and Surface Roughness Sectors for Site-Specific Station

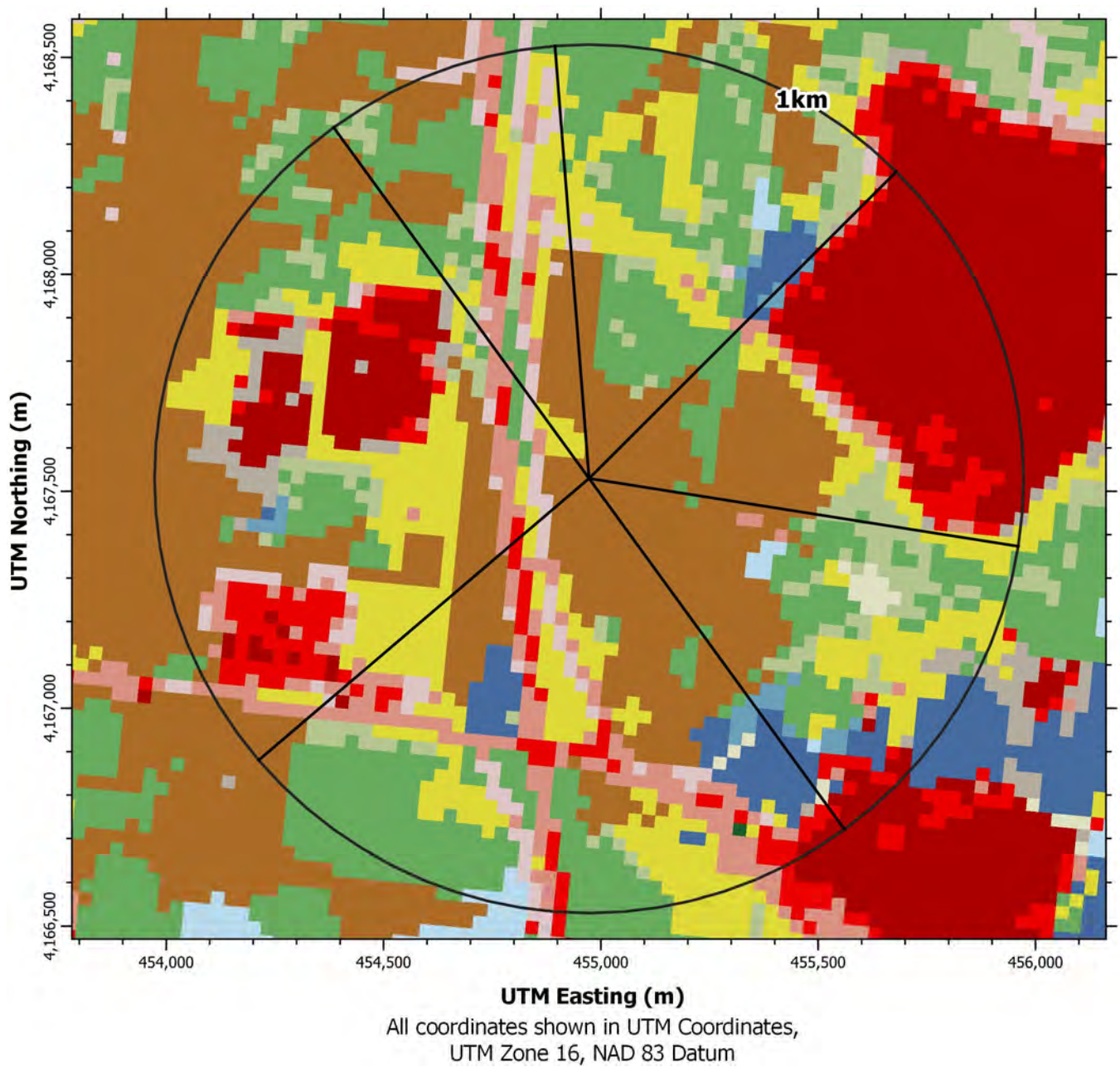
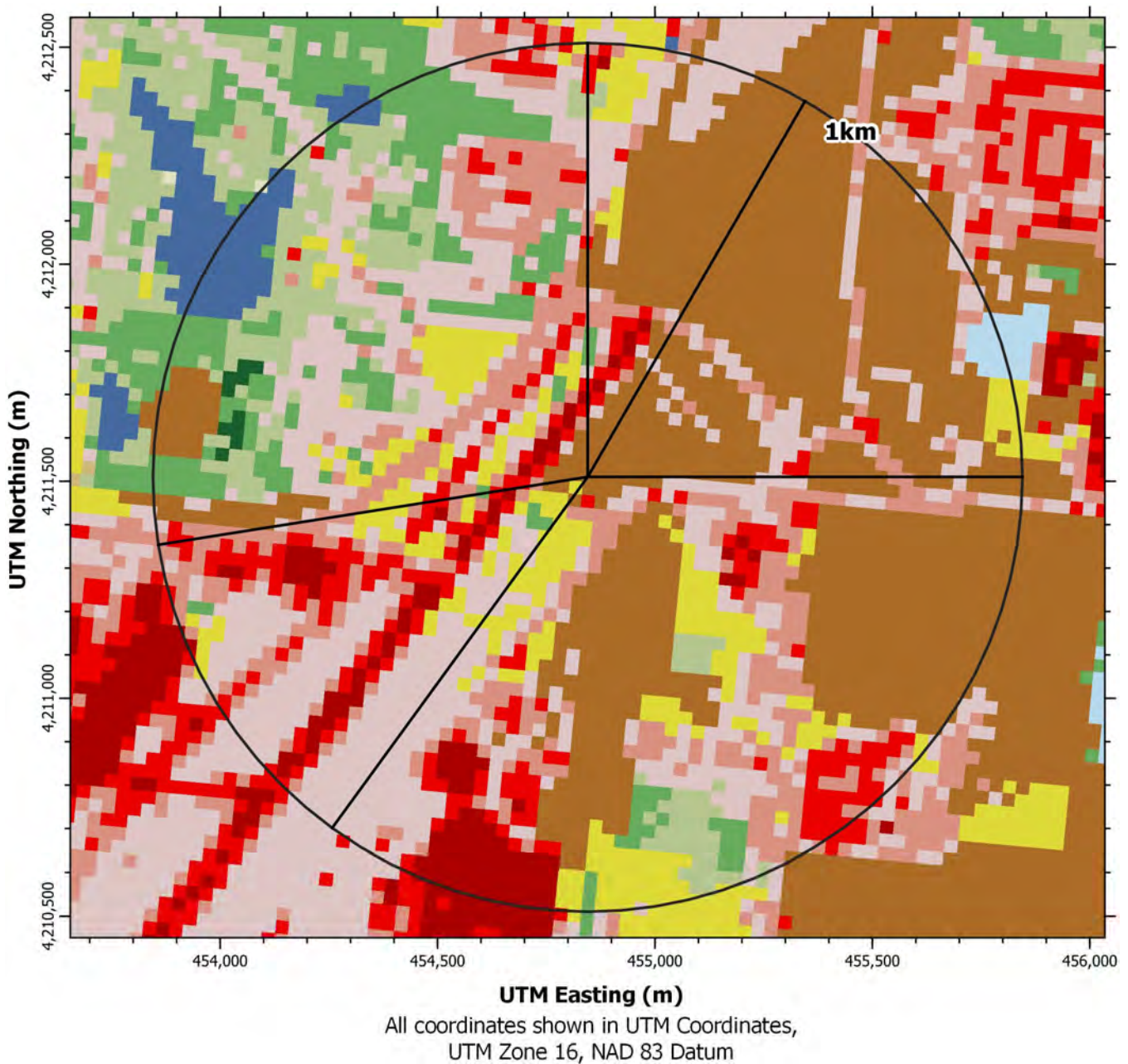


Figure 2-4. Land Use and Surface Roughness Sectors for KEVV



The land use-related parameters can be varied based on moisture conditions (wet, dry, or average) at the location of the surface meteorological data station. To make the moisture conditions determination, the annual precipitation in each modeled year (2020 through 2022) is compared to the 1991-2020 climatological record.²⁸ Table 2-3 shows the 30-year precipitation by month for KEVV along with the seasonal totals, averages, and 30th percentile high and low values. These were compared to the actual rainfall in each season for each year of the 2020-2022 modeling period which determined the average, wet, or dry

²⁸ For Evansville Regional Airport annual and daily rainfall data were retrieved from the National Climatic Data Center. The 2020 Local Climatological Data (LCD) Report was accessed by <https://www.ncdc.noaa.gov/IPS/lcd/lcd.html>. Missing data from the LCD report was filled using daily precipitation data accessed through <https://www.ncdc.noaa.gov/cdo-web/datatools/lcd>.

precipitation option in AERSURFACE. Other specific AERSURFACE settings were used that represent the locations of the site-specific meteorological tower and KEVV. These settings include location coordinates, monthly versus seasonal differentiation, aridity, and, of course, the surface moisture determination which was just discussed. This determination is used in AERSURFACE to adjust the Bowen ratio estimated by AERSURFACE, which in turn affects the calculation of the daytime mixing heights calculated in AERMET and used in AERMOD.

Table 2-3. Moisture Calculation for Evansville Regional Airport, KEVV (inches of precipitation)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	Winter	Spring	Summer	Fall
1993	3.57	2.61	3.23	4.38	4.20	4.65	2.37	2.17	5.59	3.76	6.62	2.68	45.83	8.86	11.81	9.19	15.97
1994	3.18	2.32	1.88	5.77	0.94	3.45	2.30	2.52	2.61	2.67	6.52	2.59	36.75	8.09	8.59	8.27	11.8
1995	2.82	2.98	2.53	5.59	13.51	4.56	2.88	3.60	0.47	2.01	2.32	3.19	46.46	8.99	21.63	11.04	4.8
1996	3.51	1.50	5.19	11.83	7.32	7.78	4.56	1.20	8.45	2.53	6.66	3.50	64.03	8.51	24.34	13.54	17.64
1997	4.20	3.35	6.90	4.16	7.57	6.12	1.71	4.02	1.31	1.73	4.17	2.34	47.58	9.89	18.63	11.85	7.21
1998	2.24	2.71	3.07	8.50	5.91	5.31	3.89	3.91	0.49	3.38	2.78	3.48	45.67	8.43	17.48	13.11	6.65
1999	6.00	1.94	4.30	6.15	3.21	6.27	2.00	0.64	0.39	2.80	0.51	5.13	39.34	13.07	13.66	8.91	3.7
2000	4.36	7.26	3.21	2.35	2.60	5.86	4.14	5.60	5.03	0.59	3.43	4.12	48.55	15.74	8.16	15.6	9.05
2001	1.29	3.26	2.23	1.60	3.82	3.82	5.54	6.09	2.40	7.27	5.40	7.16	49.88	11.71	7.65	15.45	15.07
2002	3.72	0.74	6.20	8.58	5.70	2.86	4.32	0.63	5.22	3.75	2.97	5.65	50.34	10.11	20.48	7.81	11.94
2003	0.90	4.92	2.60	3.91	6.48	4.50	4.38	1.88	3.17	1.61	4.36	1.20	39.91	7.02	12.99	10.76	9.14
2004	2.95	0.59	2.17	1.91	9.31	1.66	7.56	3.08	0.09	5.62	6.23	2.31	43.48	5.85	13.39	12.3	11.94
2005	4.59	2.77	2.85	2.13	2.33	4.88	2.69	8.51	2.00	0.73	5.93	1.76	41.17	9.12	7.31	16.08	8.66
2006	4.09	2.17	9.36	3.44	5.77	3.73	6.46	7.41	8.75	5.46	4.95	4.59	66.18	10.85	18.57	17.6	19.16
2007	5.47	3.41	2.66	2.88	2.73	2.71	1.97	0.99	2.22	4.64	1.77	6.34	37.79	15.22	8.27	5.67	8.63
2008	3.97	5.97	12.34	5.07	8.07	3.09	3.90	0.52	1.16	1.61	3.42	4.76	53.88	14.7	25.48	7.51	6.19
2009	2.85	2.76	3.32	6.01	6.47	2.20	6.46	1.91	5.17	8.21	1.22	3.62	50.20	9.23	15.8	10.57	14.6
2010	2.41	1.58	3.97	3.27	3.03	2.49	3.51	0.84	0.36	1.06	8.46	1.80	32.78	5.79	10.27	6.84	9.88
2011	1.65	4.52	5.34	11.77	7.90	6.52	6.66	0.62	8.20	2.49	8.32	6.04	70.03	12.21	25.01	13.8	19.01
2012	3.39	1.75	2.51	1.44	2.29	0.15	2.34	4.10	7.60	2.90	1.19	3.47	33.13	8.61	6.24	6.59	11.69
2013	6.76	2.77	4.08	3.86	5.08	7.55	3.59	1.64	2.81	6.07	2.04	7.33	53.58	16.86	13.02	12.78	10.92
2014	1.69	2.26	2.85	10.97	3.72	3.87	4.02	4.80	2.55	4.20	2.85	3.43	47.21	7.38	17.54	12.69	9.6
2015	2.97	2.56	6.85	6.62	3.44	7.39	4.67	3.06	1.05	3.01	5.12	5.20	51.94	10.73	16.91	15.12	9.18
2016	2.00	4.34	5.87	5.49	4.05	4.37	9.20	3.14	4.01	0.49	2.70	3.92	49.58	10.26	15.41	16.71	7.2
2017	2.27	1.00	3.85	9.89	3.99	3.60	5.66	2.15	3.24	3.71	1.70	2.42	43.48	5.69	17.73	11.41	8.65
2018	2.97	9.24	5.22	3.76	5.75	5.16	3.75	0.95	7.00	2.15	4.14	6.15	56.24	18.36	14.73	9.86	13.29
2019	4.05	7.34	7.27	5.46	5.63	7.53	3.53	5.19	0.08	6.26	5.95	2.93	61.22	14.32	18.36	16.25	12.29
2020	5.58	3.76	7.36	3.59	6.03	7.08	6.45	6.02	2.43	6.85	3.45	2.01	60.61	11.35	16.98	19.55	12.73
2021	3.41	4.69	4.57	2.87	3.04	2.36	4.01	6.74	4.82	3.36	1.61	4.12	45.60	12.22	10.48	13.11	9.79
2022	3.84	7.29	4.97	3.85	3.75	0.97	5.93	2.46	6.13	1.37	1.16	3.60	45.32	14.73	12.57	9.36	8.66

* Bolded values were either blank or unavailable in the 2022 30-yr LCD Report for KEVV. As such, daily data was downloaded and summed for the appropriate month. Source: <https://www.ncdc.noaa.gov/cdo-web/datatools/lcd>

Upper 30th	12.21	17.60	13.62	12.05
Lower 30th	8.79	12.34	9.71	8.66
2017	D	W	A	D
2018	W	A	A	W
2019	W	W	W	W
2020	A	A	W	W
2021	W	D	A	A
2022	W	A	D	D

A = Average Precipitation
D = Dry Precipitation
W = Wet Precipitation

As shown in Table 2-4, the surface data used in AERMOD is greater than 90% complete (i.e., less than 10% missing) each year. The number of calm and missing hours from are shown for each year in Table 2-4.

Table 2-4. Meteorological Data Valid Hours

Year	Number of Calm Hours	Number of Missing Hours	Missing Hours (%)
2020	8	405	4.61%
2021	22	469	5.35%
2022	81	464	5.30%

2.6 Coordinate System

In this modeling analysis, the location of emission sources, structures, and receptors were represented in the Universal Transverse Mercator (UTM) coordinate system. The UTM grid divides the world into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central 500 km meridian of each UTM zone, where the world is divided into 36 north-south zones). The datum for the Century and BREC modeling analysis is based on North American Datum 1983 (NAD 83). UTM coordinates for this analysis all reside within UTM Zone 16, which served as the reference point for all Century Sebree data as well as all regional receptors and sources.

2.7 Receptor Grids

Ground-level concentrations of SO₂ were calculated on a receptor grid that covers the Henderson-Webster SO₂ nonattainment area and extend outside the nonattainment area to the east of the Green River adjacent to the Century Sebree and BREC plants. The following nested grids were used:

- ▶ **Ambient Air Boundary Grid:** “Ambient air boundary line” grid consisting of evenly spaced receptors 50 meters apart placed along the ambient air boundary for the Century Sebree and BREC plants,
- ▶ **Fine Cartesian Grid:** A “fine” grid containing 100-meter spaced receptors extending approximately 3 km from the center of the property and beyond the ambient air boundary within the nonattainment area (including within BREC property),
- ▶ **Medium Cartesian Grid:** A “medium” grid containing 250-meter spaced receptors within the nonattainment area extending from 3 km to 5 km from the center of the Century Sebree plant, exclusive of receptors on the fine grid,
- ▶ **Coarse Cartesian Grid:** A “coarse grid” containing 500-meter spaced receptors within the nonattainment area extending from 5 km to 10 km from the center of the Century Sebree plant, exclusive of receptors on the fine and medium grids, and
- ▶ **Very Coarse Cartesian Grid:** A “very coarse grid” containing 1,000-meter spaced receptors within the nonattainment area extending from 10 km to 20 km from the center of the Century Sebree plant, exclusive of receptors on the fine, medium, and coarse grids.

This configuration and extent captured the area of maximum modeled concentrations. The receptor grid is shown in Figure 2-5.

The ambient air boundary grid, shown in Figure 2-6, surrounds the property owned, secured, and patrolled by Century. Because access by the general public is precluded, these areas are not considered “ambient air”. A permanent fence is currently in place on the western property boundary from Moss and Moss Road (an east-west road traversing the property) down to the main plant entrance. Century is currently in a process of extending the permanent fence down along the remaining western property boundary and then east over to the river. This new extended fencing is anticipated to be in place by the time the nonattainment SIP to be submitted by the Division is approved by EPA.

As shown in Figure 2-6, the entire southeast edge of the Century property runs along the river, which itself acts as a barrier to access. To the south and directly adjacent and abutting the Century property, the entire BREC property is fenced restricting public access.

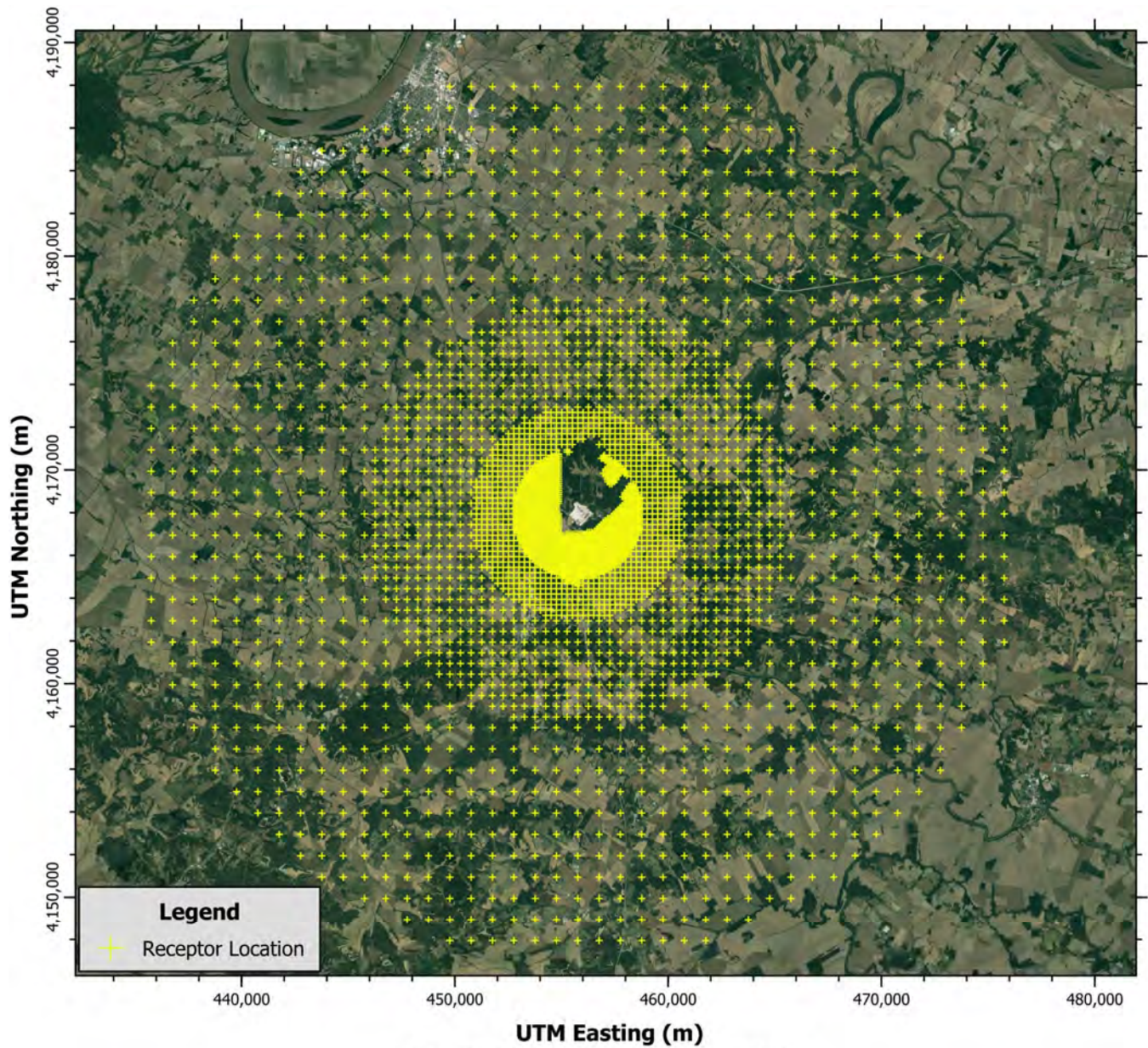
The areas of Century property north of Moss and Moss Road are not fenced. However, these property boundaries exist along areas of dense vegetation that preclude access to the general public from these undeveloped areas of the property.

Century does allow certain non-industrial uses of its property (e.g., farming) by individuals not directly employed by Century; however, these individuals are only granted access based on the conditions of a contractual agreement with Century which makes them not part of the “public” that the NAAQS are designed to protect.

The ambient air boundary for Century Sebree as represented in Figure 2-6 is consistent with that approved for modeling conducted as part of the Prevention of Significant Deterioration (PSD) permits issued in 2007 and 2010 for the facility. It is also consistent with the latest EPA guidance on “ambient air”.²⁹

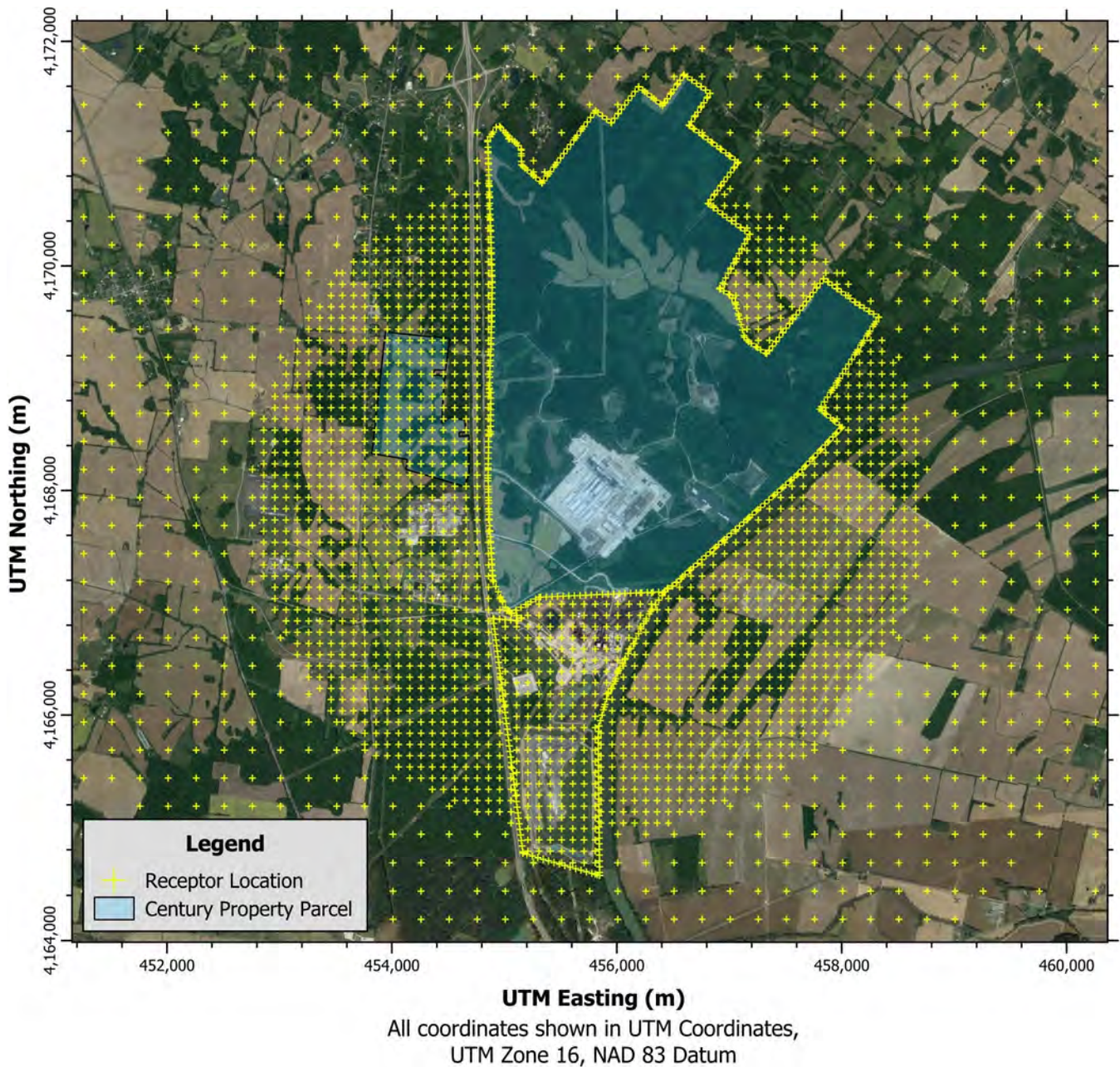
²⁹ https://www.epa.gov/sites/default/files/2019-12/documents/revised_policy_on_exclusions_from_ambient_air.pdf

Figure 2-5. Receptor Grid



All coordinates shown in UTM Coordinates,
UTM Zone 16, NAD 83 Datum

Figure 2-6. Ambient Air Boundary View of Receptor Grid and Property



2.8 Century Sebree Emission and Release Inventories

At the Sebree Plant, Century produces primary aluminum through the electrolytic reduction of raw alumina (Al_2O_3) in vessels termed reduction cells or “pots”. Century operates three nearly identical potlines at the Sebree plant. Each pot is constructed as a complete electrolytic circuit with anode, cathode, and electrolyte. When electric current is applied through metal rods to the carbon anodes, alumina is reduced producing molten aluminum metal and carbon dioxide (CO_2). Pots are periodically tapped and molten aluminum is either transferred in crucibles to customers or is first cast into aluminum sows, billets, ingots or other hard forms and then shipped off-site.

Raw material inputs to the pots include alumina, bath, carbon anodes, and various other additives to the aluminum production process such as aluminum fluoride. Each potline is composed of two potrooms that each contain 64 reduction cells for a total of 128 cells per potline. The emissions from the reduction cells in each potline are captured through hooding systems and are sent to two Alcoa A-398 alumina fluidized bed dry scrubbers, each of which has five reactors. Emissions from the pots not captured by the hooding system are released as secondary emissions through the centerline roof vent of each potroom building.

To provide baked carbon anodes to the reduction cells, Century operates an anode paste mixing and forming operation and an anode bake furnace, in which the “green anodes” are baked. The green anodes are formed from petroleum coke, recycled spent anode material, and pitch, which serves as a binder. The formed anodes are compressed and placed within the bake furnace, where they are baked to remove volatiles, leaving a solid carbon block. The emissions from the paste mixing and anode forming units are vented to a common control device, a Proceadair dry coke scrubber. The emissions from the anode bake furnace are sent to an Alcoa A-446 alumina fluidized bed scrubber.

The Sebree Plant has a number of miscellaneous sources of SO₂ emissions, including a natural gas fired Remelt Furnace, two groups of natural gas fired Holding Furnaces, four Homogenizing Furnaces, small natural gas boilers and pre-heaters, and six emergency generators. However, these emission sources make up less than one tenth of one percent (0.1%) of the total SO₂ emissions at the Sebree Plant. **The vast majority of SO₂ emissions (>99.9%) are emitted from the potlines and anode bake furnace.**

2.8.1 Emission Sources Modeled

The SO₂ emission units at the facility (and their corresponding Subject Item Designations) included in the modeling analysis are the following:

1. Potlines 1-3 (E1, E3, and E5)
2. Remelt Furnace (A6-90)
3. Holding Furnaces (F1 & F2)
4. Homogenizing Furnaces (H1-H4)
5. Anode Bake Furnace (N2)
6. Indirect Heat Exchanger (S6)³⁰
7. Green Mill Boiler (S7)
8. Small Natural Gas Boilers (A3, A4, A7, A9, I4)³¹
9. Five (5) Crucible Pre-Heater Stations (Insignificant Activities)
10. Auto Sow Casting Pre-Heater Stations (Insignificant Activities)

All of these sources were modeled as point sources except for the crucible pre-heater stations, auto-sow casting pre-heater stations, and potline roof vents. The crucible pre-heater stations and auto sow casting pre-heater stations are located inside the casting building and do not have dedicated stacks. Therefore, each of these sources were modeled as a single volume source based on the building dimensions. The potline roof vents were modeled as buoyant line sources.

Source parameters for each Century Sebree source used in the modeling analysis are listed in Appendix C.

³⁰ Note that in the model files, this unit is referenced as the Electrode Boiler (S5). The Electrode Boiler has been removed but has identical heat input capacity and stack parameters to the Indirect Heat Exchanger (S6); therefore, the model represents emissions from S6.

³¹ The Building 004 Water Heater (A7) and Building 004 Miller Pickling Boiler (A9) have been removed from service. However, they are retained in the model files to remain consistent with the previously submitted modeling protocol.

2.8.2 Planned Replacement of Stack for Anode Bake Furnace

The source parameters for the Anode Bake Furnace (ABF) take into account the planned redirect of the exhaust from the three existing adjacent 4.2-ft diameter, 70-ft tall stacks on the A-446 scrubber modules to a new 213.2-ft tall, 8.5-ft diameter stack to be situated adjacent to the existing A-446 scrubber system. This stack change along with the establishment of new lower limits on allowable SO₂ emissions from the ABF and potlines are the primary measures being proposed to reduce ambient SO₂ concentrations surrounding the Sebree Plant.

2.8.3 Potline Roof Vents

To account for the buoyancy of the emissions from the potline roof vents, the buoyant line source type requires the following parameters. Values used in the modeling analysis for the Century Sebree potline roof vents are provided with each parameter.

- ▶ Average Building Width, Length, and Height (19.81, 369.11, and 14.78 m, respectively);
- ▶ Average Line Source Width (2.44 m);
- ▶ Average Separation Between Buildings (35.0 m); and
- ▶ Average Buoyancy Parameter, which is a function of line source width, average building length, exit velocity, vent temperature, and ambient temperatures ($330.0 \text{ m}^4/\text{s}^3$).

Periodic performance testing of the roof vents is required under Century's current Title V air permit. Potline roof vent parameters were derived from performance tests conducted during the three-year period modeled (i.e., 2020-2022). Although the buoyancy parameter for the roof vents would be subject to seasonal variations, the performance tests on the roof vents are conducted semi-annually at regular intervals. As such, insufficient data was available to derive a monthly or seasonally varying buoyancy parameter, so an annual average buoyancy parameter was selected for the modeling analysis. Physical dimensions of the roof vents and potroom buildings were taken from the design drawings and the average separation between buildings was measured from aerial imagery.

2.8.4 Alumina Fluidized Bed Dry Scrubbers

The A-398 alumina fluidized bed dry scrubbers for Potlines 1 and 2 each consist of five reactors and are configured with ten stacks, two for each reactor, located in close proximity to one another as illustrated in Figure 2-7.³² As there is a separate dry scrubber for the north and south sides of the potrooms of each potline, there are two groups of stacks associated with Potline 1 (a north group and a south group) and two groups of stacks associated with Potline 2 (north and south groups) with each group having ten stacks. The close proximity of these stacks can result in enhanced plume rise due to the merging of the plumes compared with modeling each stack individually in AERMOD, which does not account for plume interaction. For each group of A-398 scrubber stacks (four groups total between Potlines 1 and 2), the common stack height and exit velocity were retained and entered into AERMOD. However, an equivalent stack diameter was input to AERMOD based on the combined stack top area of the A-398 stacks.³³ A similar approach has been employed in EPA approved modeling completed under the SO₂ DRR for another primary aluminum

³² Each stack has a diameter of 1.21 meters and is located approximately 6 meters from its nearest neighboring stack.

³³ Each stack is round with a diameter of 1.21 meters and an exhaust exit area of 1.155 m^2 based on the formula for the area of a circle ($\pi \times (D/2)^2$). The equivalent area of ten stacks would be 11.55 m^2 (i.e., $1.155 \text{ m}^2 \times 10$). Using the formula for the area of a circle ($D = 2 \times \text{SQRT}(A/\pi)$), the equivalent diameter for the ten stacks is 3.84 m.

smelter located in the Ohio River valley.³⁴ Additionally, the AERMOD model performance evaluation presented in Appendix A documents more realistic model output concentrations versus monitored data collected near the Century Sebree facility when the stack merging technique is used.

Potline 3 has a different exhaust configuration for the A-398 scrubbers compared with Potlines 1 and 2. There are two groups of scrubbers associated with Potline 3 (north and south groups), but all five of the scrubber reactors associated with each group exhaust to a common stack. The common stack is located in the center of the yellow rectangle shown in Figure 2-8. For this reason, the A-398 scrubbers associated with Potline 3 are modeled as a single points source for each of the two A-398 scrubbers associated with Potline 3 (one for the north A-398 and one for the south A-398).

Figure 2-7. Aerial Image of Potline 1 South A-398 Stack Configuration



³⁴ Technical Support Document, Final Round 3 Area Designations for the 2010 1-Hour SO₂ Primary National Ambient Air Quality Standard for Indiana. <https://www.epa.gov/sites/default/files/2017-12/documents/13-in-so2-rd3-final.pdf>

Figure 2-8. Aerial Image of Potline 3 South A-398 Stack Configuration



2.8.5 Intermittent Sources

The remaining sources of SO₂ emissions are emergency use engines (termed intermittent sources) and thus, do not normally contribute to the annual distribution of daily maximum 1-hour SO₂ concentrations. The engines are typically only run for testing and maintenance purposes, which does not occur simultaneously for multiple engines. The list of emergency use engines and their associated maximum hours of operation in the 5 years from 2018 to 2022 is presented below.

1. Natural Gas Emergency Generator (Z2) – 1.1 hours/year
2. Cummins Propane Generator (Z3) – 24.5 hours/year
3. Detroit Diesel Fire Pump Engine (Z4) – 14.8 hours/year
4. Building 001 Natural Gas Emergency Generator (Z5) – 11.5 hours/year
5. Rock House Natural Gas Emergency Generator (Z6) – 18.1 hours/year
6. Lift Station Propane-Fired Emergency Generator (Z7) – 29.8 hours/year
7. Building 044 Natural Gas Emergency Generator (Z8) – 4.8 hours/year
8. Building 001 IT Generator – 7.4 hours/year

Due to their infrequent operation, these engines were excluded from the modeling analysis in accordance with EPA's guidance on intermittent source modeling for the 1-hour SO₂ NAAQS.³⁵

³⁵ Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO₂ National Ambient Air Quality Standard, Memorandum from Tyler Fox, Leader, Air Quality Modeling Group, to Regional Air Division Directors, date March 1, 2011.

2.8.6 SO₂ Emission Rates

Emission rates representative of future allowable SO₂ emission rates were used for all Century Sebree sources consistent with requirements specified in Section 6.1 of Appendix A to EPA's Nonattainment SIP Guidance.³⁶

Century utilizes a mass balance approach, as required by the current Title V permit, to quantify 12-month rolling total SO₂ emissions from the potlines and ABF combined. This approach has been reviewed and scrutinized by the Division as part of two past PSD permit actions as well as several Title V permit actions and yields accurate estimates of total monthly emissions. With regard to variability of emissions within a month, because each potline has numerous pots (128 per potline) in continuous operation, even while each pot individually operates on a batch cycle, it is reasonable to treat each potline as a whole as operating in a continuous, steady-state manner. It is further reasonable to expect that the SO₂ emission rate from the potlines is relatively stable and that short-term variability in SO₂ emissions from the potlines is relatively low. In a similar vein, although the anodes within a given pit in the ABF are processed on a batch cycle, because there are multiple firing trains in operation continuously and so many pits moving stepwise through their respective baking cycle, a relatively stable SO₂ emission rate from the ABF is also assumed.

In parallel with work on the model attainment demonstration, Century will be working with the Division to facilitate the issuance of a Title V permit significant revision, and through this process Century anticipates that a new set of 30-day average SO₂ emission limits will be set along with appropriate compliance demonstration methods. However, rather than modeling SO₂ emissions at these proposed allowable emission rates, the values modeled for the SIP modeling demonstration were inflated in consideration of the short-term (1-hour) form of the SO₂ NAAQS. Due to this form, EPA's Nonattainment SIP Guidance suggests that while a 30-day average emission rate is suitable for the purpose of establishing enforceable emission limits, the 30-day average values should be inflated (adjusted upward) to define a conservative 1-hour emission rate for the modeling analysis.

In the case of the Century Sebree SO₂ emission sources, the actual spread between the minimum and maximum 1-hour emission rates in a 30-day period should be relatively small as a percentage of the average. Also, it is statistically improbable that a peak 1-hour emission rate occurring from one of the dry alumina scrubber systems (i.e., two separate systems for each potline half and one for the ABF) would coincide with a peak occurring in the same hour at another scrubber system at the plant. Regardless, in spite of the expected relatively steady-state nature of SO₂ emissions from the key Century emission units (i.e., the potlines and ABF), in line with EPA's Nonattainment SIP Guidance and as documented in the modeling protocol for this SIP demonstration analysis, an inflation factor was applied to the proposed 30-day average SO₂ emission limits to yield higher 1-hour emission rates for input to the AERMOD model. Specifically, Century used the 30-day to 1-hour ratio of 0.79 specified for uncontrolled SO₂ sources in Appendix C of the Nonattainment SIP Guidance to define the 1-hour emission rates that are input to AERMOD for the potlines and ABF (i.e., emission rates used in the AERMOD model are 1.266 times the 30-day average emission limit values). The inflated modeled emission rates are documented in Appendix C of this report.

While Century is proposing to establish new federally enforceable 30-day average emission limits on the ABF and potlines combined, it is necessary to account for month-to-month variability in the distribution of SO₂ emissions between the ABF and potlines. Emissions variability can be affected by numerous process factors

³⁶ Guidance for 1-Hour SO₂ Nonattainment SIP Submissions, Memorandum from Stephen D. Page, Director, to Regional Air Division Directors, Regions 1-10, dated April 23, 2014.

such as variations in green anode sulfur content, anode bake furnace performance, and potline anode consumption rates. Therefore, Century will be proposing one combined 30-day average emission limit for both the potlines and ABF based on a normal expected distribution of emissions between the two sources. Then, in anticipation of a determination from the Division that individual emissions limits on each source (ABF and potlines) will also be needed, the individual emission limits for the ABF and potlines will be set at expected source-specific maximums to account for the month-to-month variability. Because SO₂ emissions combined will be capped, in months when the SO₂ emissions from the ABF are higher, the SO₂ from the potlines will necessarily be lower, and in months when the SO₂ emissions from the potlines are higher, the SO₂ from the ABF will necessarily be lower. Separate “highest ABF” and “highest potline” emission scenarios are represented in Table 2-5. Modeling was performed for each of these three emissions scenarios: base, highest ABF, and highest potline.

Table 2-5. 30-Day Average Allowable Emission Rates for Three Modeling Conditions

Emissions Scenario	ABF (lb/hr) ^a	Potline A398 (lb/hr each)	Potline Potroom Building (lb/hr each)	Potlines (lb/hr total) ^a	ABF + Potlines (lb/hr total) ^a	ABF + Potlines (tpy)
Base (Normal Emissions)	157.77	158.65	3.24	971.35	1,129.12	4,945.54
Highest ABF Emissions	237.12	145.69	2.97	892.00	1,129.12	4,945.54
Highest Potline Emissions	110.65	166.35	3.39	1,018.47	1,129.12	4,945.54

a. Bolded values in table correspond to the anticipated 30-day average emission limits to be established in the Century Title V permit. The emission rates modeled were inflated by a factor of 1.266 as documented in this section to account for the 1-hour form of the SO₂ NAAQS.

2.9 BREC Emission and Release Inventories

SO₂ emissions from BREC sources were also modeled as allowable emission rates. Operations at BREC have changed over recent years. These changes, which include permanent shutdowns of certain emission units and fuel conversions of others, were considered in the SIP modeling analysis. After consideration of these changes, the following emission units at BREC were included in the analysis:

1. Green Unit #1
2. Green Unit #2
3. Green Fuel Gas Heater
4. Reid Combustion Turbine

All of these sources were modeled as point sources. Source parameters for each BREC source are shown in Appendix D.

The remaining sources of SO₂ emissions at BREC are emergency use engines (termed intermittent sources) and thus, do not normally contribute to the annual distribution of daily maximum 1-hour SO₂ concentrations. The engines are typically only run for testing and maintenance purposes, which does not occur simultaneously for the two engines. The list of emergency use engines and their associated maximum hours of operation for 2019 to 2022 is presented below.

1. Cummins Fire Pump Engine (EU09) – 35.8 hours/year
2. Generac Emergency Generator (EU10) – 30.2 hours/year

Due to their infrequent operation, these engines were excluded from the modeling analysis in accordance with EPA's guidance on intermittent source modeling for the 1-hour SO₂ NAAQS.³⁷

2.10 Background Concentrations

As described in Section 8.3 of the *Guideline*, background concentrations consist of two categories: 1) nearby sources and 2) other sources. "Nearby sources" are those individual sources located in the vicinity of the sources that are the primary focus on the modeling analysis that are not adequately represented by ambient monitoring data. These sources should be few in number (*Guideline* Section 8.3.3(b)(iii)) and are accounted for by explicitly modeling their emissions. "Other sources" are that portion of the background attributable to natural sources, other unidentified sources in the vicinity, and regional transport contributions from more distant sources. Other sources are typically accounted for through the use of ambient monitoring data.

2.10.1 Other Sources

As described in Section 8 of Appendix A to EPA's Nonattainment SIP Guidance, the inclusion of background ambient monitored concentrations as part of the modeled concentrations is important in determining and deciphering the cumulative ambient air impacts. The monitor located near Century Sebree is source oriented and therefore does not represent background. Therefore, a regional site was appropriate for use to characterize the background concentrations. An appropriate and suggested technique in EPA's Nonattainment SIP Guidance is to generate a temporally varying background. This is based on the 99th percentile monitored concentrations by hour of day and season or month. For example, each season may have a 24-hour sequence of concentrations used for every hour and day in the appropriate season.

The background concentrations, thus, considered the above-mentioned factors. Figure 2-2 shows the locations of the nearest ambient monitors. The closest continuous and operating SO₂ monitor in the area is the Evansville-Buena Vista monitor (18-163-0021) located about 40 km north of the Sebree Plant.³⁸ Choosing a monitor located in the near vicinity of a large town or city would mean city-related sources influencing the monitoring data and therefore providing a conservative estimate of the background sources in the area surrounding the Sebree Plant. The Evansville-Buena Vista monitor is also located in the general vicinity of several larger sources of SO₂ emissions located in Indiana north of Century Sebree, as shown in Figure 2-9 (namely SIGECO A.B. Brown, Alcoa Warrick Power Plant, SIGECO F.B Culley, and Warrick Newco LLC). These sources are not, however, located so close to the monitor that it is considered source-oriented and such that the monitor would be too heavily influenced by a particular source to serve as a reasonable background monitor. SO₂ concentrations at this monitor likely are influenced by combined emissions from these Indiana sources and the monitor can be used to account for both background and concentrations resulting from operation of these sources, as discussed further in the next section.

The next closest operating SO₂ monitor is the Owensboro Primary (21-059-0005) monitor located about 40 km east northeast of Sebree Plant. The Owensboro monitor is located approximately 2 km from the Owensboro Utilities Elmer Smith Station and is therefore likely heavily influenced by emissions from this facility and would not provide a representative picture of background concentrations in the area surrounding the Sebree Plant. The Elmer Smith Station permanently shut down on June 1, 2020, but the three calendar

³⁷ Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO₂ National Ambient Air Quality Standard, Memorandum from Tyler Fox, Leader, Air Quality Modeling Group, to Regional Air Division Directors, date March 1, 2011.

³⁸ A closer monitor, located at the Baskett Fire Department approximately 25 km north of Sebree Plant, operated until 2019 but is no longer operational.

year period of ambient concentrations from this monitor for 2020 to 2022 would continue to be influenced by the Elmer Smith Station.

2.10.2 Nearby Sources

Other sources of SO₂ emissions in the area surrounding the Century Sebree Plant that are not adequately characterized by ambient monitor data were included, as required, in the modeling. Sources within approximately 20 km of the Sebree Plant were considered for inclusion and were derived from available inventories from the Division and IDEM. In the interest of being complete, significant sources in the 20 km to 50 km distance range from Sebree Plant (i.e., those with $Q/d > 1$) were also reviewed to determine if they should be included in the modeling (i.e., if they are not adequately characterized by monitor data) and were derived from the same inventories. Figure 2-9 shows an assessment of nearby source locations as well as an SO₂ emissions magnitude indicator (size and color of the source marker on the map). The inner black ring shows SO₂ sources located within 20 km of Century Sebree and the outer black ring shows sources located within 50 km of Century Sebree.

The inventory of sources for regional consideration was pared down by eliminating very small sources or very distant sources using the “20D method”. The 20D method says that if the ratio of the emissions to the distance between sources is less than 20 ($Q/d < 20$), a source does not need to be included in the modeling. The specification of the variables in the 20D analysis include:

Q = Source emissions in tons/year

d = Distance from the target source in kilometers

Every effort was made to ensure emission datasets are as up-to-date as possible for the modeling analysis, including the use of the most recent statewide emission inventories provided by the Division and IDEM, as well as incorporating any novel SO₂ permit limits for regional sources. The actual emission rates, distances from Century Sebree, and the Q/d values are also shown in Table 2-6. As can be seen, the majority of the sources have resulting Q/d values that are considerably less than 20. While this Q/d threshold is not a bright line, it can provide an indication of the expected relative magnitude of concentrations expected near the location of peak modeled concentrations near the Century Sebree and BREC plants.

A review of emissions data and distance from Century Sebree yields the following list of sources that do not screen out using the 20D method.

- ▶ SIGECO A.B. Brown (32.9 km from Century)
- ▶ Alcoa Warrick Power Plant (33.1 km from Century)
- ▶ SIGECO F.B Culley (33.1 km from Century)
- ▶ Warrick Newco LLC (38.3 km from Century)
- ▶ Big Rivers Electric Corp. – Wilson Station (43.7 km from Century)

SIGECO retired the coal-burning units at the A.B. Brown Station in October 2023, leaving only smaller SO₂ sources at the facility. However, at this time SIGECO A.B. Brown retains a permit to operate the coal-burning units. As indicated in the nearby source map (Figure 2-9), A.B. Brown Station can be seen as the orange dot southwest of Evansville and north of the Ohio River. For comparison, the wind rose for Evansville Regional Airport (KEVV) is provided in Figure 2-10. As indicated in the wind rose, a significant portion (approximately 6.5%) of the winds in Evansville blow from the southwest. As such, the Evansville monitor is frequently impacted by SIGECO A.B. Brown Station at a distance of 16.3 kilometers. Due to the distance between Century and the SIGECO A.B. Brown Station (33.4 km), it is reasonable to conclude that the SIGECO A.B. Brown Station is adequately captured in the Evansville-Buena Vista monitor background.

The source release data that were modeled for each of the remaining facilities are provided in Appendix E. The emissions from all explicitly modeled regional sources represented the maximum hourly SO₂ emission rate as provided by either the Division or IDEM. This is a more conservative approach than allowed by Table 8-1 of the *Guideline*, which allows the use of emissions based on the temporally representative level of operation for each unit for “nearby sources”.

Figure 2-9. Map Showing Nearby Sources and SO₂ Emissions Magnitude Near Sebree Plant

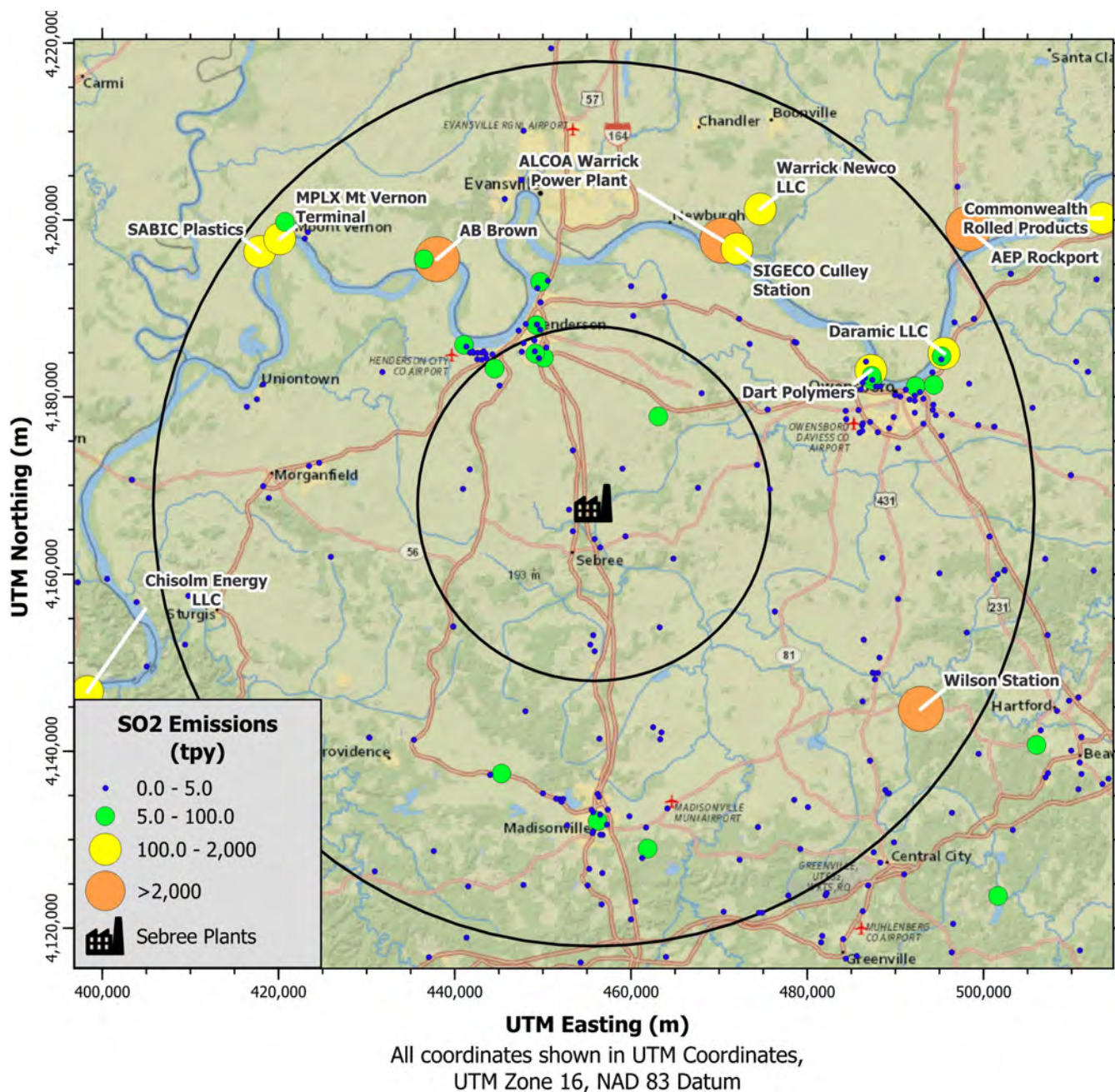


Table 2-6. Sources within 50 km of Century Sebree (Excluding BREC)

AI ID	Facility Name	UTM East (m)	UTM North (m)	Distance to Century, (d) (km)	Plant-wide Potential Emissions (Q) (tpy)	Q/d (tpy/km)	Screened Out?	Basis for Screening
894	Daramic LLC	495,506	4,184,910	43.2	333.3	7.7	Y	A
895	Dart Polymers Inc	487,221	4,182,989	34.9	363.1	10.4	Y	A
939	Owensboro Grain Edible Oils	487,370	4,181,892	34.6	89.0	2.6	Y	A
978	Yager Materials Inc - Owensboro Paving Co	495,235	4,184,578	42.8	85.9	2.0	Y	A
1786	Accuride Corp Henderson	450,105	4,184,409	17.4	93.5	5.4	Y	B
1820	AMG Aluminum North America LLC	452,954	4,167,240	2.9	0.1	<0.1	Y	B
1833	Rogers Group Henderson Asphalt Plant	449,117	4,184,892	18.2	13.0	0.7	Y	B
3240	Texas Gas Transmission LLC - Dixie Transmission Station	440,919	4,169,576	14.9	0.1	<0.1	Y	B
3319	Big Rivers Electric Corp - Wilson Station	492,898	4,144,764	43.8	8,865.2	202.5	N	--
5506	International Paper Company	447,589	4,185,090	19.0	0.8	<0.1	Y	B
11663	Tyson Food Hatchery	459,366	4,164,226	5.2	0.8	0.2	Y	B
38551	Madisonville State Office	456,200	4,132,089	35.8	69.9	2.0	Y	A
40143	Tyson Chicken Inc - Sebree Feed Mill	453,388	4,164,799	3.9	0.1	<0.1	Y	B
40591	Powerscreen - Metrotrack Portable Plant	449,075	4,185,136	18.5	1.6	<0.1	Y	B
44049	ANR Pipeline Co - Madisonville Transmission Station	445,278	4,137,458	32.2	73.0	2.3	Y	A
44327	Texas Gas Transmission LLC - Slaughters Compressor Station	455,858	4,151,291	16.6	0.7	<0.1	Y	B
45238	Tyson Chicken Inc - Robards Facility	454,623	4,167,819	1.1	2.6	2.3	Y	B
116288	American Tower Corp - Audubon Cell Tower Engine	463,090	4,177,776	12.3	19.6	1.6	Y	B
130997	JH Rudolph & Co Inc - Portable Asphalt Plant	441,031	4,185,870	23.2	41.2	1.8	Y	A
169648	Pratt Paper (KY) LLC/ Pratt (Henderson Corrugating) LLC	444,485	4,183,196	19.0	8.7	0.5	Y	B
18129-00002	SABIC Innovative Plastics Mt Vernon LLC	417,845	4,196,428	47.4	582.5	12.3	Y	A
18129-00005	MPLX Terminals LLC - Mt Vernon Terminal	420,117	4,197,868	46.5	349.7	7.5	Y	A
18129-00010	SIGECO AB Brown Generating Station	437,970	4,195,565	32.9	3,904.3	118.8	N	C
18129-00050	Green Plains Mount Vernon LLC	436,479	4,195,559	33.7	47.2	1.4	Y	A
18173-00001	SIGECO - FB Culley Generating Station	472,005	4,196,736	33.1	1,519.1	45.9	N	--
18173-00002	ALCOA Power Generating Inc Warrick Powe	470,354	4,197,663	33.1	2,663.7	80.4	N	--
18173-00007	Warrick Newco LLC	474,656	4,201,231	38.3	1,736.9	45.4	N	--

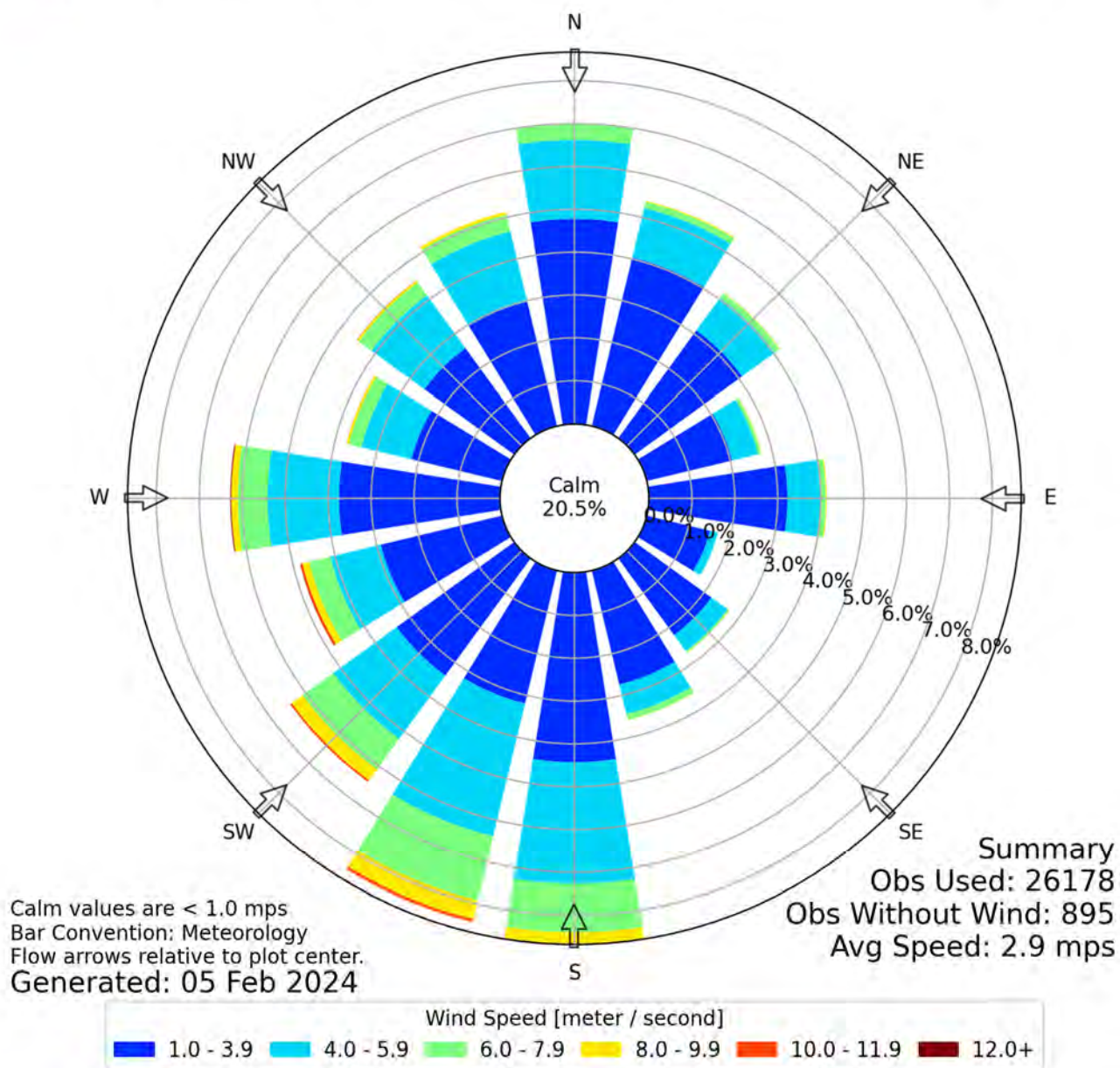
A - Source is beyond 20km distant from Century and has a relatively small Q/d, indicating SO2 emissions from the source are unlikely to significantly impact receptors in the vicinity of the Sebree Plant.
B - Source is within 20km from Century, however the source has a relatively small Q/d, indicating SO2 emissions from the source are unlikely to significantly impact receptors in the vicinity of the Sebree
C - Coal units (major SO2 emission sources) at facility will be shut down in late 2023.

Figure 2-10. Evansville Regional Airport Meteorological Tower Wind Rose 2020-2022



Windrose Plot for [EVV] EVANSVILLE

Obs Between: 01 Jan 2020 12:54 AM - 31 Dec 2022 10:54 PM America/Chicago



2.11 Modeling Files

All modeling files will be provided to the Division in electronic format via email. Specifically, as documented in Appendix F, all model and processor input, output, and data files will be provided. Spreadsheets tabulating source, emission, and other input data sets will also be provided.

3. MODEL RESULTS

The purpose of the SIP air dispersion modeling analysis is to demonstrate that compliance with the 1-hour SO₂ NAAQS will be achieved throughout the nonattainment area (via the emission reductions and other measures to be implemented to reduce ambient SO₂ concentrations). As discussed further in Section 4, this can be accomplished through a weight of evidence analysis that includes, among other data, an air dispersion modeling analysis.

This section of this report presents the modeling results of the 1-hour SO₂ dispersion modeling while Section 4 provides the additional weight of evidence analysis to reach a determination of compliance.

3.1 1-hour SO₂ NAAQS Modeling Results

Table 3-1 summarizes the 1-hour SO₂ NAAQS dispersion modeling results. As shown in the table, the 3-year average of the maximum highest 4th high (H4H) impacts modeled using AERMOD are above the NAAQS. Section 4 of this report explains how these results are overly conservative and how weight of evidence is employed to demonstrate compliance with the NAAQS.

Table 3-1. 1-hour SO₂ NAAQS Results Summary

Averaging Period	Year for Meteorological Data	NAAQS (µg/m ³)	Emissions Scenario	Model Impact ^{a,b} (µg/m ³)	UTM East ^c (m)	UTM North ^c (m)
1-hour	Maximum 3-Year Average from 2020-2022	196	Base	222.3	455,871.9	4,167,073.1
			Highest ABF	212.1	454,859.2	4,167,934.8
			Highest Potline	230.2	455,871.9	4,167,073.1

a. The highest 4th high (H4H) impact is compared against the standard.

b. Background concentrations of SO₂ were incorporated into AERMOD based on data from the Evansville-Buena Vista monitor (AQS ID 18-163-0021).

c. UTM coordinates are in NAD83.

As shown in Table 3-2, the area (by fraction of total receptors modeled) of which there were modeled ambient concentrations above the NAAQS is minimal. For instance, in the base emissions scenario, there were only thirty (30) receptors where modeled concentrations exceeded the NAAQS; this is less than 0.6% of receptors included in the modeling analysis. As shown in Figure 3-1 and Figure 3-2, the exceedances (i.e., orange dots) all occur on or very near the Century Sebree property line for the base emissions scenario. The locations of the exceedances for the highest ABF and highest potline emissions scenario are similar to the locations of the exceedances for the base emissions scenario. Even with model overprediction of the results, the modeled exceedances are very limited and occur at locations that the public are not expected to access.

Table 3-2. Number of Receptors with Modeled Exceedances

Total Receptors	Emissions Scenario	Exceeded Receptors ^a	Percent of Exceeded Receptors
5,306	Base	30	0.57%
	Highest ABF	20	0.38%
	Highest Potline	35	0.66%

a. Number of receptors at which the model impact exceeded the 1-hour SO₂ NAAQS.

Figure 3-1. Base Emissions Scenario Modeled Impacts (Full Extent)

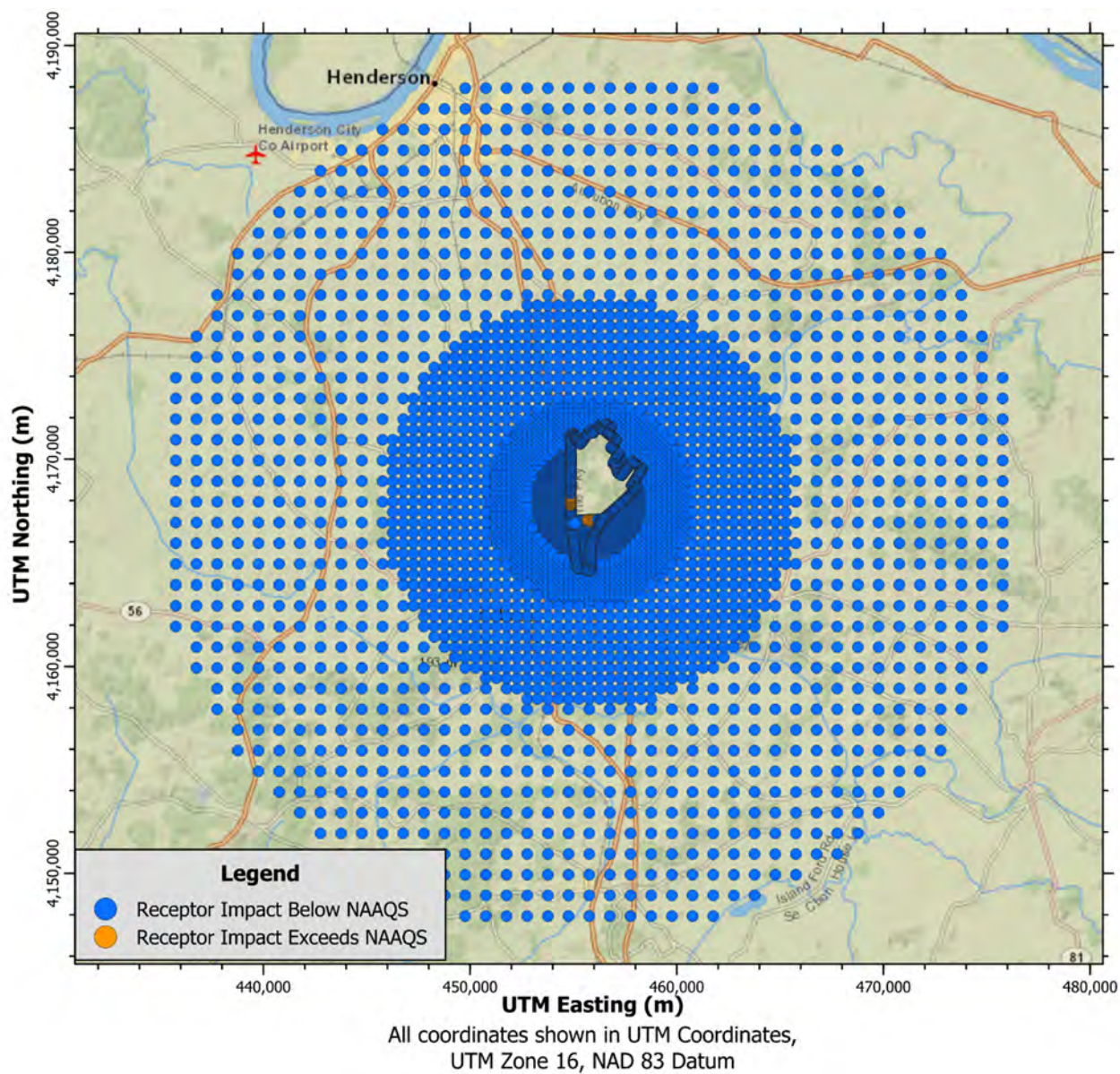
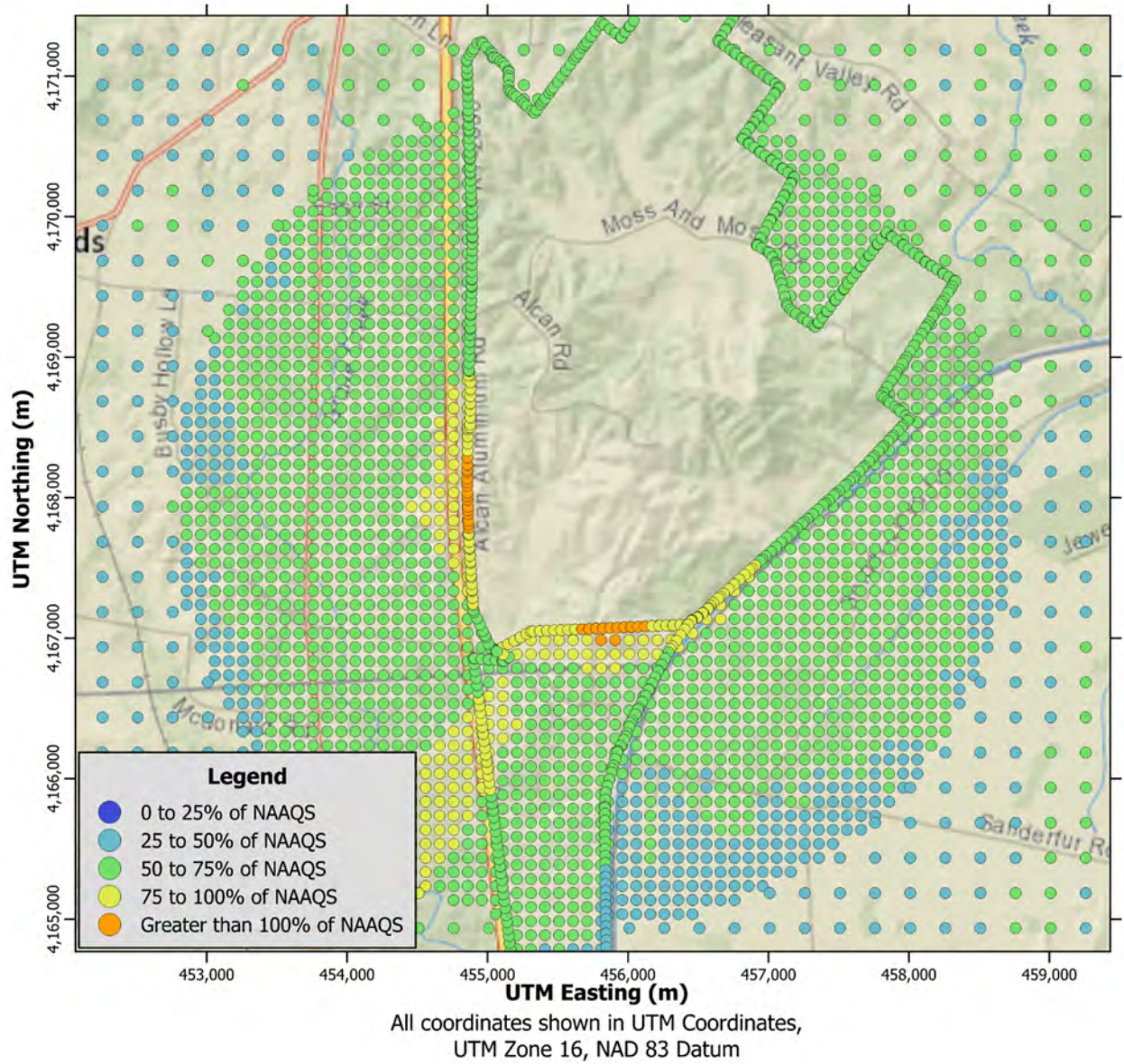


Figure 3-2. Base Emissions Scenario Modeled Impacts (Zoomed)



4. WEIGHT-OF-EVIDENCE ANALYSIS

In many SIP modeling demonstration analyses, the determination that compliance will be achieved is made solely via an air dispersion modeling analysis using AERMOD that shows modeled results below the NAAQS. However, a weight-of-evidence analysis can also be used to show that compliance with the NAAQS can be expected even if some maximum ambient concentration values predicted in a “standard” overly conservative AERMOD modeling analysis are above the NAAQS.

In the “stipulations” for Part 51 of EPA’s *Guideline on Air Quality Models*, there is flexibility in attainment demonstration plans wherein EPA states that nothing in Part 51 will be construed in any manner:

...to preclude a State from employing techniques other than those specified in this part for purposes of estimating air quality or demonstrating the adequacy of a control strategy, provided that such other techniques are shown to be adequate and appropriate for such purposes.³⁹

Therefore, any means of estimation of air quality is acceptable in attainment demonstration plans as long as it is “adequate and appropriate” for the purposes.

In the following three court cases for attainment demonstration plans, the modeled concentrations were above the NAAQS. In two of the cases, the model was overpredicting the monitor, and the states and EPA adjusted the model. EPA also adopted a “weight of the evidence” approach to consider other information even if the model continued to not demonstrate attainment. Note that all three of these cases deal with ozone attainment plans; however, the concepts and resulting court approvals apply equally to any modeling demonstration.

1. **2004 D.C. Circuit Case – Washington D.C. Ozone Nonattainment⁴⁰**

EPA determined that the model overpredicted known ozone concentrations by an average of 19%. EPA therefore adjusted the model’s calculations using a variety of supplemental statistical techniques including a “relative reduction factor” to correct the overpredictions under a “weight of evidence” approach. The Court went on to state that “the adjustments were necessary to ensure consistency with real-world observations and thus to ensure reliable prognostications about the future.”

2. **2001 Fourth Circuit Case – Maryland Ozone Nonattainment⁴¹**

In comparing base case modeling to monitors, EPA determined the models overpredicted the monitors by 22%. After EPA accounted for the model over-prediction, local scale modeling still identified concentrations above the standard. EPA concluded that the local scale modeling results were close enough to attainment to warrant consideration of “weight of evidence” arguments to support a demonstration of attainment. EPA defined the “weight of evidence” determination as “a diverse set of technical analyses performed to assess the confidence one has in modeled results and to help assess the adequacy of a proposed strategy when the outcome of local scale modeling is close to attainment.” EPA thereafter employed “adjustment factors” as well as consideration of other emissions reductions that were not modeled. The court cited EPA statements that if the “weight of evidence” approach leads

³⁹ 40 CFR 51, Appendix W—*Guideline on Air Quality Models*, § 51.101(c)

⁴⁰ *Sierra Club v. EPA*, 356 F.3d 296 (D.C. Cir. 2004)

⁴¹ *1000 Friends of Maryland v. Browner*, 265 F.3d 216 (4th Cir. 2001)

to compelling evidence that attainment is likely, then EPA will conclude that attainment has been demonstrated even if the modeled levels are too high.

3. **2003 Fifth Circuit Court Case – Texas Ozone Nonattainment**⁴²

Texas' modeled control strategy alone did not demonstrate attainment. Texas therefore employed a "weight of evidence" approach. Texas used a quadratic equation to calculate the gap in NO_x emissions reductions between those achieved by the modeled control strategy and the levels required to achieve the NAAQS. Texas then revised its control strategy to eliminate the gap and achieve attainment. The court held that the Clean Air Act allows for a "weight of evidence" analysis, and that "Congress could not have intended to bar EPA from considering data in addition to modeled results." The court noted EPA's position that the modeling results constitute the principal component of the agency's analysis, "with supplemental information designed to account for uncertainties in the model." The court therefore upheld EPA's approach with the attainment demonstration plan.

EPA has more recently used a "weight of evidence" approach in other attainment contexts, including for SO₂ attainment. For example, in 2022 EPA employed a "weight of evidence" approach to address the SO₂ nonattainment for an area in Iowa.⁴³ EPA stated that it did not have evidence (including modeling) to determine if the monitors were located in the area of highest concentration, and that the available modeling of permitted allowable emissions did not on its own provide a basis for determining attainment. To determine attainment, EPA therefore relied upon: "SO₂ emissions data and trends, relevant air monitoring data and trends, SO₂ monitoring data incorporated with local meteorological data, as well as available modeling information."

In consideration of these and other precedents, it is appropriate for Kentucky to include in the attainment demonstration plan a model that does not overpredict the monitor that is located in the area of maximum concentration. Through the Clean Air Act, EPA has the authority to approve such a plan, as supported by several Courts of Appeals. To the contrary, use of a model that substantially overpredicts the monitor and results in significant unnecessary expenditures by Century would be arbitrary and unlawful. Any potential uncertainty with using a weight of evidence approach can be addressed in the contingency plan submitted with the attainment demonstration plan.

As documented in the following sections, the weight of evidence in this case demonstrates that the 1-hour SO₂ NAAQS will be achieved in the Henderson-Webster SO₂ nonattainment area following implementation of the represented changes in emissions and stacks at the Century Sebree facility.

4.1 Historical Monitor Data

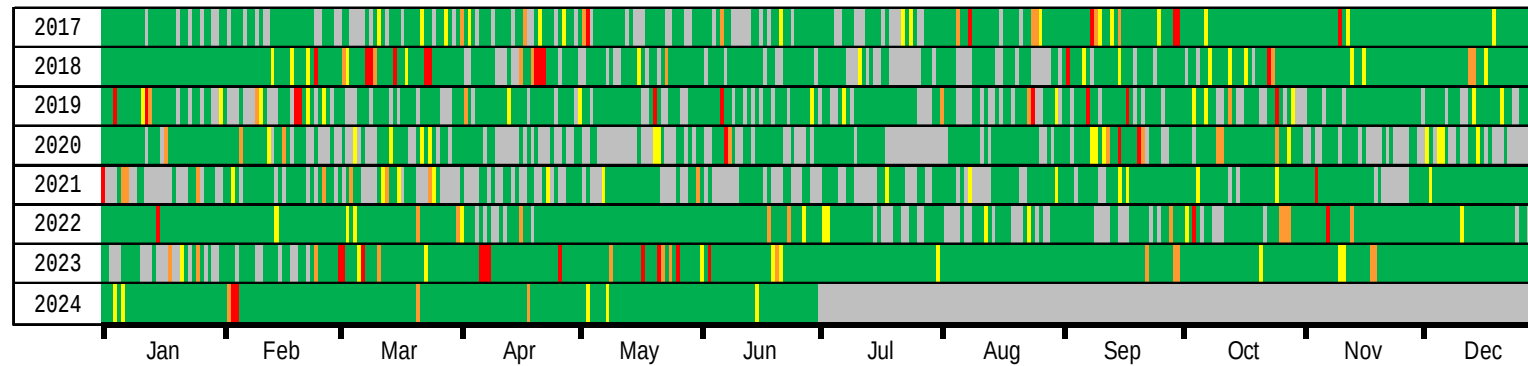
The Division commenced collection of SO₂ concentration data at the Sebree ambient monitoring station in January 2017. At the time of writing this report, SO₂ data is available through June 2024. The monitored maximum daily 1-hour SO₂ data measured over this time period is summarized in Figure 4-1 and Figure 4-2. As revealed in these figures, the frequency of measured SO₂ concentrations greater than the magnitude of the 1-hour SO₂ NAAQS has been generally trending down since 2017. One short-term exception to this trend is the higher frequency of elevated SO₂ concentrations observed in the first half of 2023. There are numerous factors that could potentially influence measured SO₂ concentrations year by year, including variations in operational parameters at the Sebree Plant, actual emissions at the Sebree Plant and nearby

⁴² *BCCA Appeal Group v. EPA*, 355 F.3d 817 (5th Cir. 2003)

⁴³ 67 Fed. Reg. 20329 (April 7, 2022).

sources, wind frequencies, and other meteorological parameters. Regardless, Century has reviewed operational data for 2023 to seek an explanation for the elevated SO₂ concentrations measured in the first half of the year. Based on this review, Century determined that the likely reason for the elevated SO₂ concentrations was the use of anode material recycled from the Century Hawesville Plant (which was idled in June 2022) in the production of anodes at the Sebree Plant. The recycled anode material from the Hawesville Plant elevated the SO₂ content in the green anodes. The elevated SO₂ content caused higher SO₂ emissions and in turn elevated SO₂ concentrations at the Sebree monitor during the first half of 2023. Although Century would like to recover additional material from the Hawesville Plant, the processing of recycled anode material ceased in June 2023 due to elevated SO₂ concentrations observed at the Sebree monitor. Since that time, nearly a full year has passed and only two maximum daily concentrations have been measured above the magnitude of the 1-hour SO₂ NAAQS. The frequency of measured SO₂ concentrations above 75% of the magnitude of the 1-hour SO₂ NAAQS has similarly decreased. As indicated in Table 4-2, if the SO₂ data measured during the first half of 2023 were excluded from the 99th percentile calculation for that year, the design value for 2021-2023 would have complied with the 1-hour SO₂ NAAQS.

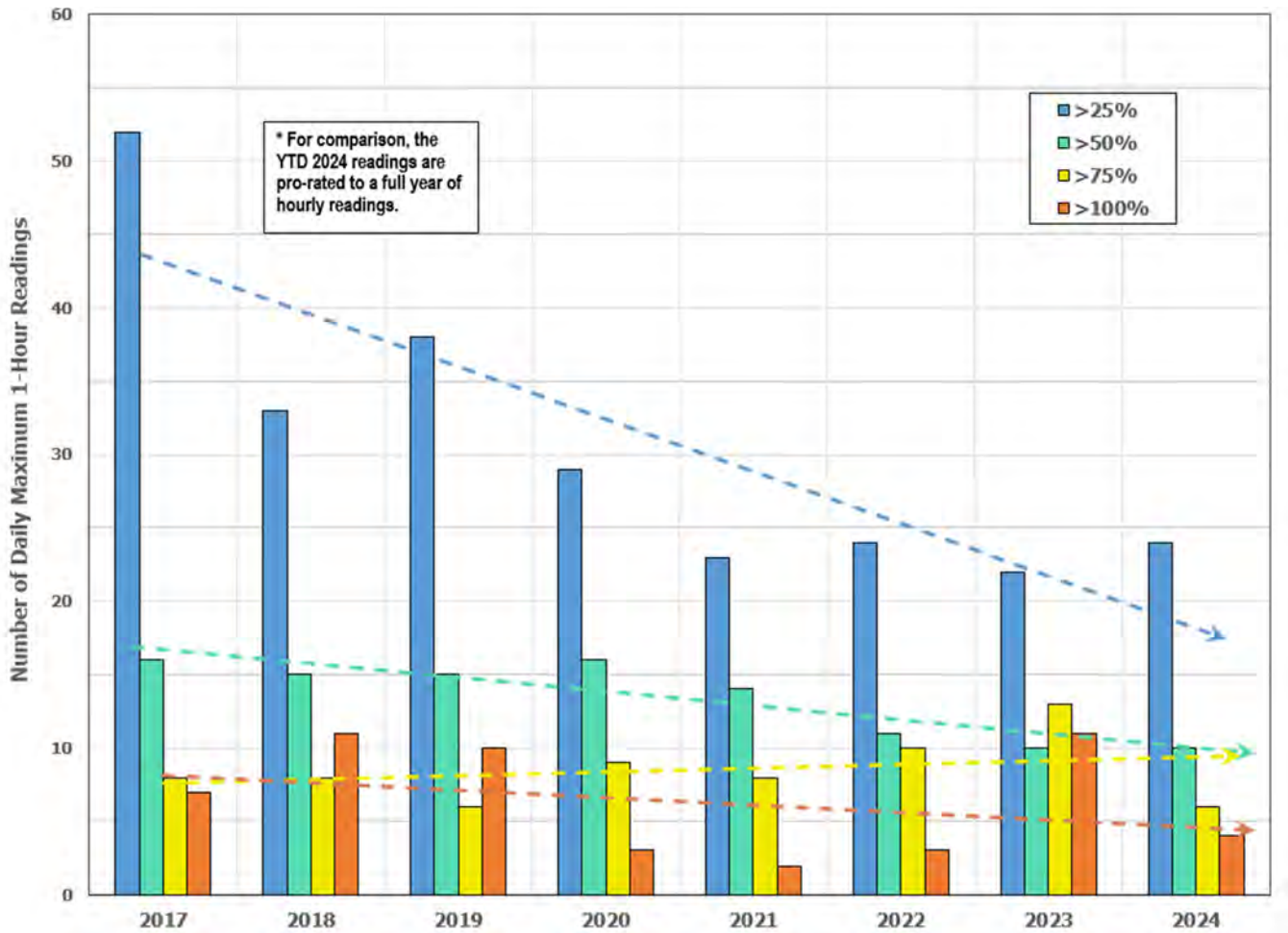
Figure 4-1. Tile Plot for Historical Max Daily SO₂ Data¹



1. The frequency of “zero or missing” data indicated in Figure 4-1 is significant. However, the majority of these data points are measured SO₂ concentrations of zero (or rounded to zero) ppb. More than 98.5% of all hourly data recorded at the Seabee monitor during the 2017 through 2023 time period was valid data, as defined in 40 CFR 50, Appendix T.

> 100% SO ₂ NAAQS
> 75% SO ₂ NAAQS
> 50% SO ₂ NAAQS
< 50% SO ₂ NAAQS
Zero or Missing

Figure 4-2. Counts of Max Daily Monitored SO₂ Data by Year¹



1. The full 2024 dataset is not yet available. As such, for comparison purposes, it was assumed that the average concentration frequencies for 2024 year-to-date continue for the remainder of the year. In other words, if 9 maximum daily 1-hour concentrations above 50% of the magnitude of the NAAQS occurred over the January to June 2024 time frame, then it was assumed that a total of 18 concentrations (=9 events / 182 days x 365 days) above 50% of the magnitude of the NAAQS will occur in 2024.

Table 4-1. Historical SO₂ Design Value Concentrations for Sebree Monitor

High Rank	Year	Date	Daily Maximum 1-hr Concentration (ppb)	Design Value (ppb)	Design Value (µg/m ³)	Percent of NAAQS ^a
4	2017	10/1/17	94.0	--	--	--
4	2018	3/10/18	102.0	--	--	--
4	2019	9/8/19	99.0	98.3	257.0	131.1%
4	2020	1/17/20	73.0	91.3	238.7	121.8%
4	2021	2/26/21	68.0	80.0	209.1	106.7%
4	2022	3/22/22	72.6	71.2	186.1	94.9%
4	2023	3/8/23	94.3	78.3	204.6	104.4%

^a The 1-hour National Ambient Air Quality Standard (NAAQS) for sulfur dioxide is 75 ppb (196 µg/m³), which is applied in the form of the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour concentrations.

Table 4-2. Historical SO₂ Design Values Excluding 1st Half 2023 Data

High Rank	Year	Date	Daily Maximum 1-hr Concentration ^a (ppb)	Design Value (ppb)	Design Value (µg/m ³)	Percent of NAAQS
4	2017	10/1/17	94.0	--	--	--
4	2018	3/10/18	102.0	--	--	--
4	2019	9/8/19	99.0	98.3	257.0	131.1%
4	2020	1/17/20	73.0	91.3	238.7	121.8%
4	2021	2/26/21	68.0	80.0	209.1	106.7%
4	2022	3/22/22	72.6	71.2	186.1	94.9%
2	2023	10/1/23	62.8	67.8	177.2	90.4%

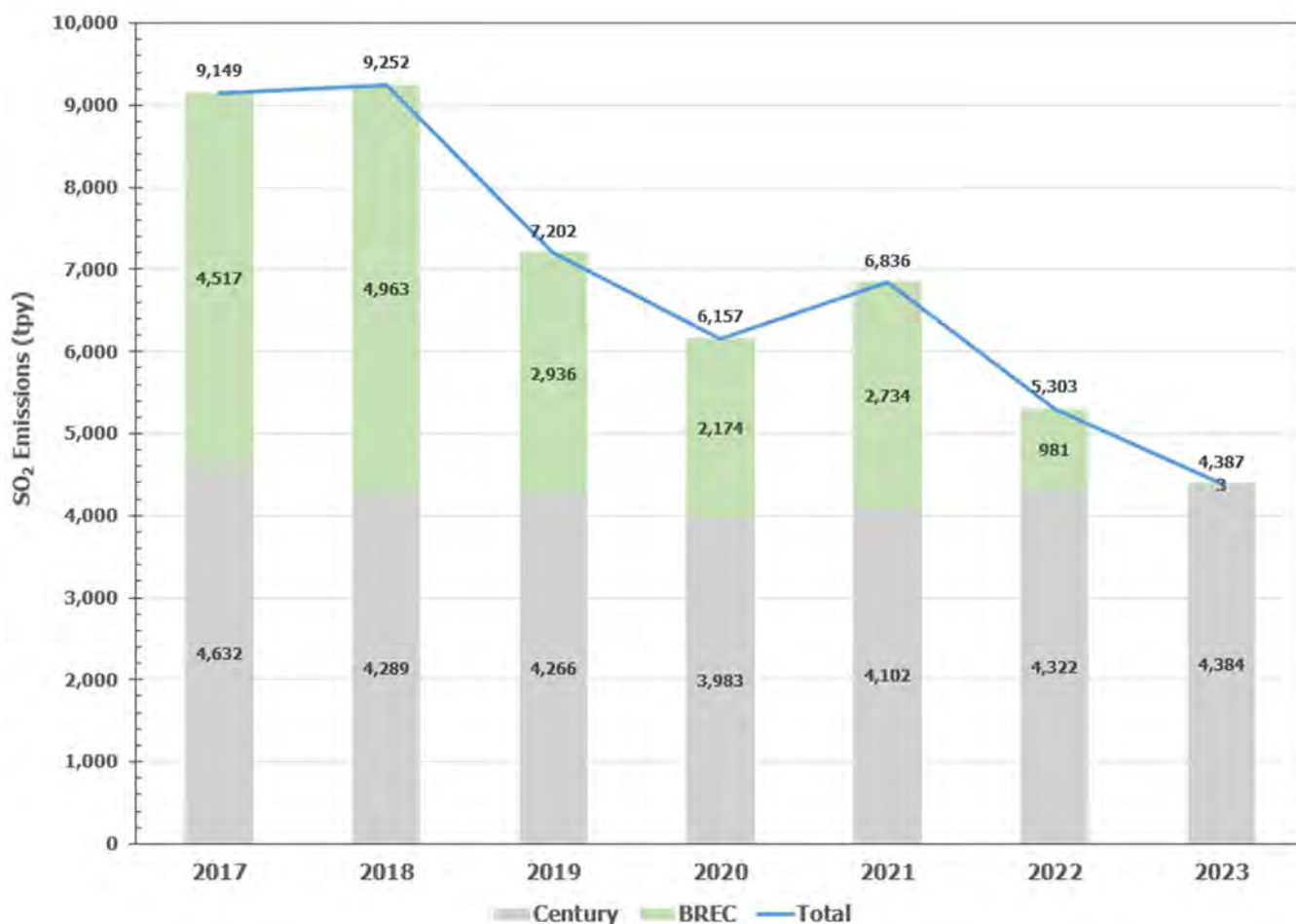
^a The 99th percentile (2nd-high) monitored SO₂ concentration for 2023 excludes all data for the 1st half of 2023 as this was the time period when material recycled from the Century Hawesville Plant was being processed.

4.2 Historical Emissions Trends

Although other factors may influence the measured concentrations at the Sebree monitor, the principal element influencing measured SO₂ concentrations is SO₂ emissions released in the surrounding area. Century and BREC have historically been the only sources of significant SO₂ emissions near the Sebree monitor. However, as shown in Figure 4-3, the overall SO₂ emissions in the area have dropped substantially. This is due to the shutdown of the Henderson Municipal Power & Light (HMP&L) coal-fired boilers in 2019 and the conversion of the coal-fired boilers at the Green Station to natural gas in 2022. In addition to the substantial reductions in SO₂ emissions from BREC, SO₂ emissions at Century Sebree also decreased by 14% from 2017 to 2020. The trend in emission reductions overlaps to some degree with the trend reductions in the absolute magnitude of high monitored SO₂ concentrations as well as the frequency of higher monitored SO₂ concentrations.

Between 2020 and 2022 during which time the 3-year design value achieved compliance with the NAAQS (see Table 4-1 above and Appendix Figure A-3), SO₂ emissions from Century trended back up slightly but remained below 4,322 tpy. Actual SO₂ emissions in the future are likely to remain consistent within the same range as occurred during the past five years. Thus, even without any stack improvements, the monitor data shows that attainment of the NAAQS is likely to be achieved. Although Century is proposing to establish a new federally enforceable allowable SO₂ emission limit equivalent to an annual emissions level of 4,946 tpy (down from 5,853 tpy currently), it is unlikely actual SO₂ emissions will reach these levels. However, even at these allowable levels, the following sections identify that with the planned stack change for the Anode Bake Furnace, attainment of the NAAQS will still be maintained.

Figure 4-3. Century and BREC - Annual SO₂ Emissions Trend



4.3 AERMOD Modeling with Correction for Overprediction

As discussed in Section 2.2 and presented in Appendix A, the use of the rural option in AERMOD results in a very large overprediction compared with the ambient data collected at the SO₂ monitor located near Century Sebree. The use of AERMOD with the urban option selected and a population of 2,000,000 provides improved performance versus the monitor data, but still overpredicts concentrations recorded by the ambient monitor. In the performance evaluation presented in Appendix A, the urban 2 million AERMOD model outputs are shown to overpredict the 1-hour SO₂ impacts from the Sebree Plant by 1.21 times when

compared to the Sebree monitor values. This overprediction value is based on the ratio of the average of the four most-recently available three-year average design concentrations predicted by the model (269.6 $\mu\text{g}/\text{m}^3$) to the average of the four three-year average design value concentrations at the monitor (222.7 $\mu\text{g}/\text{m}^3$), as shown in Table 4-3.

Table 4-3. Ratio of Model Concentration to Monitor Concentration

Average Monitor Concentration^{a,c} ($\mu\text{g}/\text{m}^3$)	Average Model Concentration^{b,c} ($\mu\text{g}/\text{m}^3$)	Model to Monitor Ratio
222.7	269.6	1.21

- The average of the design concentrations of the 4th highest daily maximum 1-hour SO₂ concentration recorded at the Sebree monitor (Site No. 21-101-1011) each year from 2017 to 2022.
- The average of the design concentrations of the 4th highest daily maximum 1-hr SO₂ concentration modeled using an urban 2 million population and merged A-398 stack set plumes for Potlines 1 and 2 each year from 2017 to 2022.
- Refer to the performance evaluation in Appendix A for the data behind the average design value concentrations listed here.

To evaluate compliance with the NAAQS in the absence of this model overprediction, in Table 4-4, the model-to-monitor ratio is applied to the model impacts from Table 3-1 resulting in a set of “data-corrected” future maximum impacts that account for the removal of the model overprediction. This result shows that with the planned stack change for the ABF and at the proposed reduced maximum allowable SO₂ emission levels, the area will be in attainment under all Century emissions scenarios. Specifically, the data-corrected future maximum impact, assuming the maximum allowable SO₂ emissions permissible from every source occurred continuously (something that will not actually occur in practice), is 183.6 $\mu\text{g}/\text{m}^3$, 6.3% below the NAAQS for the base emissions scenario (i.e., expected normal distribution of SO₂ emissions between the ABF and potlines). Similarly, the data-corrected impact for the highest ABF and highest potline emissions scenarios are less than the NAAQS.

Table 4-4. Data Corrected Future Predicted Modeled SO₂ Ambient Concentrations

Emissions Scenario	Model Impact^a ($\mu\text{g}/\text{m}^3$)	Model to Monitor Ratio^b	NAAQS ($\mu\text{g}/\text{m}^3$)	Data Corrected Impact^c ($\mu\text{g}/\text{m}^3$)	Exceeds NAAQS?
Base	222.3	1.21	196	183.6	No
Highest ABF	212.1			175.2	No
Highest Potline	230.2			190.1	No

- 4th highest daily maximum 1-hour SO₂ model impact as presented in Table 3-1. Modeling methodology uses urban 2 million population, merged A-398 stack set plumes for Potlines 1 and 2, and future increased height of ABF stack.
- Ratio from Table 4-3.
- Applies ratio of model to monitor data to the model impact.

4.4 Response Factor Applied to Monitor Data

While the analysis of data-corrected modeled impacts identify that the NAAQS will be achieved, an alternative approach for refining the model predicted data using model response factors is presented in this section. The concept of model response factors has been used by EPA for decades in modeling analyses supporting SIP planning. For example, in the 2004 D.C. Circuit Case discussed at the beginning of this section, a “relative reduction factor”, or relative response factor, used the relationship between the modeled peak predictions in the base year and the attainment year to determine the decrease in ozone

concentrations predicted to result from the control measures. This relationship was then applied to the measured base year design value concentration to estimate the design value in the attainment year. The response factor therefore corrected the overpredicting model to correspond to the monitor. As per the EPA's *Modeling Guidance for Demonstrating Air Quality Goals for Ozone, PM_{2.5}, and Regional Haze*⁴⁴, relative response factors are the ratios in air pollutant concentrations between the model future year and model base year. The recommended method uses model estimates in a "relative" rather than "absolute" sense to estimate future year design values.

To provide additional evidence that changes proposed to the Sebree Plant will result in future monitored compliance with the 1-hour SO₂ NAAQS, a response factor analysis is presented here. For this analysis, the AERMOD modeling for the "base" emission scenario presented in Section 3.1 has been modified to reflect the proposed limited SO₂ emissions with the current ABF stack parameters to provide a base scenario (i.e., "Current Stack Configuration"). The ratio of the future stack configuration modeled concentration (i.e., result presented in Table 3-1) to the current stack configuration modeled concentration defines the relative response factor. This represents the expected relative reduction in future ambient concentrations that is associated specifically with the planned installation of the new ABF stack. As shown in Table 4-5, the response factor is determined to be 0.73. Multiplying the most recent (i.e., 2021-2023) monitor design concentration by this response factor yields the expected future design concentration, which is shown in Table 4-6.

Table 4-5. Ratio of Current to Future Stack Configuration Model Concentrations

Current Stack Configuration Model Impact^a (µg/m ³)	Future Stack Configuration Model Impact^b (µg/m ³)	Relative Response Factor^c
303.0	222.3	0.73

- 2021-2023 4th highest daily maximum 1-hour SO₂ model impact using urban 2 million population, merged A-398 stack set plumes for Potlines 1 and 2, and current stack for ABF at proposed limited PTE.
- 2021-2023 4th highest daily maximum 1-hour SO₂ model impact as presented in Table 3-1. Modeling methodology uses urban 2 million population, merged A-398 stack set plumes for Potlines 1 and 2, and new stack for ABF at proposed limited PTE.
- Ratio of future stack configuration model impact to current stack configuration model impact.

Table 4-6. Predicted Future Design Concentration

2021-2023 Monitor Design Concentration^a (µg/m ³)	Relative Response Factor	Predicted Future Design Concentration^b (µg/m ³)
204.6	0.73	150.1

- The 3-year average of the 4th highest daily maximum 1-hour SO₂ concentration recorded at the Sebree monitor (Site No. 21-101-1011) from 2021-2023.
- Applies ratio to the future model impact.

Based on the relative response factor of 0.73, which takes into account the predicted beneficial impact of the planned installation of a new stack for the Anode Bake Furnace, the predicted future design

⁴⁴ Modeling Guidance for Demonstrating Air Quality Goals for Ozone, PM_{2.5}, and Regional Haze, Memorandum from Richard A. Wayland, Division Director, to Regional Air Division Directors, Regions 1-10, dated November 29, 2018.

concentration is 150.1 $\mu\text{g}/\text{m}^3$. This is 23.4% below the 1-hour SO_2 NAAQS of 196 $\mu\text{g}/\text{m}^3$. Thus, based on the relative response factor analysis, the area will be in attainment of the 1-hour SO_2 NAAQS.⁴⁵

4.5 Conclusion

Based on the technical assessments provided in this section, the 1-hour SO_2 NAAQS will be achieved in the Henderson-Webster SO_2 nonattainment area following implementation of proposed changes at Century Sebree (i.e., establishment of new reduced allowable SO_2 emission limits and construction of new stack for the Anode Bake Furnace). This conclusion is demonstrated using historical monitoring data and modeling of the future limited emissions and stack configuration for Century Sebree.

Even under the current stack configuration and at representative actual SO_2 emission levels, which are not expected to substantively increase, the area around the Century Sebree facility already reached attainment level SO_2 concentrations for the 2020-2022 period. Excluding a short period in the first half of 2023, when elevated emissions occurred due to a well-intentioned effort to recycle anode material from the idled Century Hawesville plant in the making of green anodes, the 2021-2023 period would have also shown attainment. These analyses are without any stack changes or reductions in SO_2 emissions from current levels. Thus, any benefit in reductions of maximum ambient impacts due to installation of a new ABF stack simply provides even greater assurance that attainment will be achieved and maintained.

Even if the proposed future allowable emission rates (equivalent to an annual emission rate of 4,945.5 tpy), which are significantly reduced from the current allowable emission rate (5,853 tpy), are assumed to occur from all sources simultaneously 8,760 hours per year, then the model predicted impacts (taking into account the presence of a new stack on the ABF), and corrected to account for the multi-year consistent overprediction of the AERMOD model relative to actual monitored concentrations in the separate performance evaluation study (see Appendix A), are below the NAAQS with an over 6.3% margin. In reality, the margin can be expected to be higher because actual SO_2 emissions (which are currently 13.7% lower than the proposed annual allowable SO_2 emissions) are expected to trend consistent with actual emissions from the past 4 years. As additional buttressing evidence, if the model-predicted benefits of the installation of a new ABF stack (i.e., the relative response factor) are applied to the latest three-year monitor design concentration (2021-2023), the predicted results are also well below the NAAQS, even if they are scaled up to account for the difference between the future allowable SO_2 emission rate and actual SO_2 emission rates during the time the monitor data was collected.

⁴⁵ Consistent with EPA's methodology, the relative response factor is applied to the actual monitor design concentration, which reflects historical actual emission levels rather than potential future allowable emission levels. However, even if predicted future design concentration was scaled up by the ratio of the proposed allowable annual SO_2 emissions (4,945.5 tpy) to the 2021-2023 average actual SO_2 emissions (4,269.3 tpy), the predicted future design concentration would still only be 173.9 $\mu\text{g}/\text{m}^3$, which is approximately 11% below the NAAQS.

APPENDIX A. SITE-SPECIFIC MODEL OPTIONS EVALUATION

This appendix provides a description and results of a site-specific model evaluation completed for Century Sebree. In this analysis, actual emissions of SO₂ are modeled from Century Sebree and other nearby sources for comparison with monitored SO₂ concentrations observed at the Kentucky Division for Air Quality (Division) run SO₂ monitor located just inside the fenceline of the Century Sebree property. Model performance is evaluated for different combinations of model options, including the “urban” option and source parameters for stacks associated with A-398 scrubbers for Potlines 1 and 2 at Century Sebree.

Modeling Options Evaluation Scope

This AERMOD performance evaluation includes model scenarios designed to test differing model inputs relating to the urban option and to plume rise for potline stacks. The latest version of the AERMOD model (Version 23132) was used for this performance evaluation.

Urban Option Evaluation

As discussed in Section 2.2 of this report, the “urban” or “rural” determination of the area surrounding the subject source is important in determining the applicable boundary layer characteristics that affect a model's calculation of ambient concentrations. In many cases, EPA recommends that this determination be completed based on the population of the area surrounding the source or the land use of the area. However, certain types of industrial facilities are of sufficient size and generate sufficient heat to create localized “heat islands”, which can cause similar atmospheric dispersion conditions to those generated by urban areas. Primary aluminum smelters are one type of source to which the urban option has been applied even in locations where a traditional population or land use analysis would suggest use of rural dispersion characteristics.

The following scenarios were modeled in AERMOD (version 23132) to evaluate AERMOD performance for Century Sebree with and without the use of the urban option:

- ▶ **Rural:** no urban option selected
- ▶ **Urban with 1 million population:** urban option selected with 1,000,000 input for the equivalent population⁴⁶
- ▶ **Urban with 2 million population:** urban option selected with 2,000,000 input for the equivalent population

In the urban option analyses, the urban option was used for Century Sebree sources, and rural dispersion characteristics for other modeled sources.

⁴⁶ Note that an evaluation of the temperature differences between Century Sebree and nearby areas indicates that a population of 2,000,000 is appropriate for input to AERMOD, as discussed in Section 2.2. However, a smaller population is included in this scenario to provide information on the performance of AERMOD with varying input populations.

Potline Stack Representation Evaluation

As discussed in Section 2.8.3 of this report, the A-398 alumina fluidized bed dry scrubbers for Potlines 1 and 2 are configured with ten stacks located in close proximity to one another. Potlines 1 and 2 each have two groups of reactors (identified as north and south); therefore, there are four total groups of stacks associated with the Potline 1 and 2 A-398 scrubbers. The close proximity of these stacks can result in enhanced plume rise due to the merging of the plumes compared with modeling each stack individually in AERMOD, which does not account for plume interaction. For each group of A-398 scrubber stacks, an iteration was first completed with the emissions modeled assuming that the plumes for each stack on an A-398 do not interact. In this case, all emissions for each A-398 associated with Potlines 1 and 2 are modeled from one stack with source parameters representative of a single stack. In this iteration, a total of four stacks were modeled, each representing one of the four total A-398s associated with Potlines 1 and 2. A second iteration was then completed with ten stacks modeled for each A-398 for a total of 40 stacks representing the Potlines 1 and 2 A-398. For this second iteration, emissions were divided evenly amongst the ten stacks associated with each A-398. A third iteration was then completed with stack parameters representative of a combined plume from each A-398 for Potlines 1 and 2, with a total of four stacks representing the Potline 1 and 2 A-398s. For each group of A-398 scrubber stacks for Potlines 1 and 2, the common stack height, temperature, and exit velocity was retained and entered into AERMOD. An equivalent stack diameter was input to AERMOD based on the combined stack top area of the A-398 stacks as discussed in Section 2.8.3 of this report.

The A-398 stack parameters modeled for each scenario in this evaluation are shown in Appendix Table A-1.

Appendix Table A-1. Century Sebree A-398 Stack Parameters

Model ID	Description	Stack Height (m)	Stack Temp (K)	Stack Velocity (m/s)	Stack Diameter (m)
E1_02N	North Potline #1 A-398 Scrubbers (Single Representative Stack)	24.57	372.04	10.54	1.21
E1_02S	South Potline #1 A-398 Scrubbers (Single Representative Stack)	24.57	372.04	10.58	1.21
E3_02N	North Potline #2 A-398 Scrubbers (Single Representative Stack)	24.57	372.04	11.72	1.21
E3_02S	South Potline #2 A-398 Scrubbers (Single Representative Stack)	24.57	372.04	11.76	1.21
E1_02N1-10	North Potline #1 A-398 Scrubbers (Each of 10 Modeled Stacks)	24.57	372.04	10.54	1.21
E1_02S1-10	South Potline #1 A-398 Scrubbers (Each of 10 Modeled Stacks)	24.57	372.04	10.58	1.21
E3_02N1-10	North Potline #2 A-398 Scrubbers (Each of 10 Modeled Stacks)	24.57	372.04	11.72	1.21
E3_02S1-10	South Potline #2 A-398 Scrubbers (Each of 10 Modeled Stacks)	24.57	372.04	11.76	1.21
E1_02N	North Potline #1 A-398 Scrubbers (Merged)	24.57	372.04	10.54	3.84
E1_02S	South Potline #1 A-398 Scrubbers (Merged)	24.57	372.04	10.58	3.84
E3_02N	North Potline #2 A-398 Scrubbers (Merged)	24.57	372.04	11.72	3.84
E3_02S	South Potline #2 A-398 Scrubbers (Merged)	24.57	372.04	11.76	3.84

Model Inputs

This section describes the procedures and data resources utilized in the air dispersion modeling analysis.

Emission Sources

Actual emissions from Century Sebree and BREC sources were modeled for each year from 2017 to 2022. SO₂ emissions from Century Sebree are based on the mass balance SO₂ calculation methodology required by Century's Title V permit, which accurately defines actual SO₂ emissions based on known information on sulfur inputs to and outputs from the processes. This calculation methodology provides monthly emissions, which were then formatted into an hourly emission rate file for input to AERMOD (with hourly emission rates

varying for each month based on that month's monthly emissions). SO₂ emissions from BREC sources are based on hourly varying data from the Clean Air Markets Division (CAMD) database. Emissions for other nearby sources (e.g., Big Rivers Electric Corp. – Wilson Station) were based on actual emissions data obtained from Kentucky Emission Inventory System (EIS) reports submitted by the facilities or, in the case of sources located in Indiana, from IDEM's NAAQS inventory.

All sources were modeled as point sources with the exception of the Century Sebree potline roof vents, which were modeled using the buoyant line source type. Input parameters for the buoyant line sources were consistent with those discussed in Section 2.8.2 of this report. Source parameters for the sources included in the modeling analysis are shown in Appendix Table A-2 to Appendix Table A-5.

Appendix Table A-2. Century Sebree Point Source Input Parameters

Model ID	Description	UTM Easting (m)	UTM Northing (m)	Elevation (m)	Stack Height (m)	Stack Temp ³ (K)	Stack Velocity ³ (m/s)	Stack Diameter ² (m)
A6_02	Remelt Furnace (90); Gas Burners	455802.4	4168312.8	135.94	13.11	719.82	7.35	1.50
F1_01	Holding Furnaces (11); Metal Processing	456128.7	4167785.8	135.94	27.43	431.48	7.83	0.97
F1_02	Holding Furnaces (12); Metal Processing	456139.3	4167798.0	135.94	27.43	431.48	7.83	0.97
F1_03	Holding Furnaces (13); Metal Processing	456161.3	4167821.1	135.94	27.43	431.48	7.83	0.97
F1_04	Holding Furnaces (14); Metal Processing	456173.5	4167834.6	135.94	27.43	431.48	7.83	0.97
F1_05	Holding Furnaces (15); Metal Processing	456189.8	4167853.6	135.94	27.43	431.48	7.83	0.97
F1_06	Holding Furnaces (16); Metal Processing	456200.8	4167865.9	135.94	27.43	431.48	7.83	0.97
F2_01	Holding Furnaces (17); Metal Processing	456217.4	4167883.3	135.94	27.43	431.48	7.83	0.97
F2_02	Holding Furnaces (18); Metal Processing	456227.6	4167894.9	135.94	27.43	431.48	7.83	0.97
H1_01	Homogenizing Furnace (1I)	456219.8	4167811.4	135.94	18.90	755.37	12.53	1.22
H2_01	Homogenizing Furnace (2I)	456229.2	4167822.1	135.94	18.90	755.37	12.53	1.22
H3_01	Homogenizing Furnace (3I)	456238.3	4167832.8	135.94	18.90	755.37	12.53	1.22
H4_01	Homogenizing Furnace (13I)	456287.5	4167896.2	135.94	21.34	794.26	17.53	0.46
N2_02	Anode Bake Furnace (261 Furnace)	456070.9	4168064.0	135.94	21.34	360.93	11.93	1.28
S5_01	Electrode Boiler (S5) (EI)	455952.2	4168046.4	135.94	29.87	433.15	2.13	0.91
S7_01	Green Mill Boiler	455953.7	4168044.3	135.94	29.87	433.15	2.13	0.91
E1_02N	North Potline #1 A-398 Scrubbers	455864.8	4167888.6	134.21	24.57	372.04	10.54	--
E1_02S	South Potline #1 A-398 Scrubbers	455807.6	4167824.3	134.21	24.57	372.04	10.58	--
E3_02N	North Potline #2 A-398 Scrubbers	455796.7	4167949.7	134.21	24.57	372.04	11.72	--
E3_02S	South Potline #2 A-398 Scrubbers	455740.1	4167885.5	134.21	24.57	372.04	11.76	--
E5_02N	North Potline #3 A-398 Scrubbers	455694.3	4168040.9	134.21	31.98	366.48	12.61	3.44
E5_02S	South Potline #3 A-398 Scrubbers	455636.0	4167975.9	134.21	31.98	366.48	12.56	3.44

¹ Emission rates for the potlines and anode bake furnace are derived from monthly SO₂ mass balance calculations and input to AERMOD through an hourly emissions file. As such, the table above does not provide a single emission rate for these emission sources.

² As indicated in Table A-1, the stack diameters for the A-398 scrubbers vary depending on whether plume merging is considered.

³ For the Anode Bake Furnace (N2_02) and the Potline A-398 Stacks (E1-02N/S, E3-02N/S, E5-02N/S), the average flow rates and temperatures recorded from the stack testing events during the past 6 years covering 2017-2022 are used in the modeling analyses. Annual stack testing is required on these units for PMACT compliance, which means at least one set of test data for each year was used to determine the averages.

Appendix Table A-3. Century Sebree Buoyant Line Source Input Parameters

Model ID	Description	UTM Easting (m)	UTM Northing (m)	Elevation (m)	Release Height (m)	End X Coordinate (m)	End Y Coordinate (m)
E1_01A	E1-1- Potroom 101 Roof Vent	455735.6	4167704.8	135.9	14.8	455977.1	4167978.0
E1_01B	E1-1- Potroom 102 Roof Vent	455698.4	4167737.8	135.9	14.8	455939.3	4168011.0
E3_01A	E3-1- Potroom 103 Roof Vent	455668.0	4167765.0	135.9	14.8	455909.4	4168038.0
E3_01B	E3-1- Potroom 104 Roof Vent	455631.3	4167797.5	135.9	14.8	455871.8	4168071.0
E5_01A	E5-1- Potroom 105 Roof Vent	455566.6	4167854.3	135.9	14.8	455808.1	4168127.0
E5_01B	E5-1- Potroom 106 Roof Vent	455529.5	4167887.3	135.9	14.8	455770.1	4168161.0

¹ Emission rates for the potline roof vents are derived from monthly SO₂ mass balance calculations and input to AERMOD through an hourly emissions file. As such, the table above does not provide a single emission rate for these emission sources.

² Refer to Appendix C for derivation of buoyancy flux parameter.

Appendix Table A-4. BREC Point Source Input Parameters

Model ID	Description	UTM Easting (m)	UTM Northing (m)	Elevation (m)	Stack Height (m)	Stack Temp ² (K)	Stack Velocity ² (m/s)	Stack Diameter (m)
GREEN1	Green Unit #1	455889.8	4166717.6	125.58	106.68	327.04	22.01	4.57
GREEN2	Green Unit #2	455835.9	4166726.9	125.58	106.68	327.04	26.00	4.57
HMPL1	Henderson Power & Light Unit #1	455632.6	4166794.6	130.15	106.68	329.82	15.00	4.88
HMPL2	Henderson Power & Light Unit #2	455632.6	4166788.3	130.15	106.68	332.04	15.00	4.88
REIDTURB	Reid Combustion Turbine (Diesel Combustion)	455595.4	4166758.2	130.15	33.53	844.26	9.57	4.88

¹ Emission rates for the Big Rivers emission units were retrieved from Clean Air Markets Database and input to AERMOD through an hourly emissions file. As such, the table above does not provide a single emission rate for these emission sources.

² Hourly stack temperatures and exit velocities derived from CEMS data for the Green units and HMP&L units were provided by Big Rivers and included in the hourly emissions file input to AERMOD. The temperatures and exit velocities indicated in the table above for these units are based on maximum potential operating conditions.

Appendix Table A-5. Nearby Source Input Parameters

Stack ID	Model ID	Description	UTM East ² (m)	UTM North ² (m)	Elevation ¹ (m)	SO ₂ Emission Rate ² (g/s)	Stack Height ² (m)	Stack Temperature ² (K)	Exit Velocity ² (m/s)	Diameter ² (m)
3319-EU 01-1	REG01	Big Rivers Electric Corp - Wilson Station	492898	4144764	119.13	2.058939E+02	182.88	325.93	7.59	10.36
3319-EU 06-1	REG02	Big Rivers Electric Corp - Wilson Station	492898	4144764	119.13	6.652682E-05	2.36	836.48	45.64	0.13
18173-00001-4-18173	REG03	SIGECO - FB Culley Generating Station	472005	4196736	120.93	4.369917E+01	152.10	326.48	18.59	6.10
18173-00001-EDF-18173	REG04	SIGECO - FB Culley Generating Station	472005	4196736	120.93	6.391554E-04	3.05	0.00	0.001	0.001
18173-00002-070-18173	REG05	ALCOA Power Generating Inc Warrick Powe	470354	4197663	118.54	1.142030E-03	3.05	0.00	0.001	0.001
18173-00002-10-18173	REG06	ALCOA Power Generating Inc Warrick Powe	470354	4197663	118.54	1.556315E+01	152.40	327.04	20.16	5.79
18173-00002-4-18173	REG07	ALCOA Power Generating Inc Warrick Powe	470354	4197663	118.54	5.710148E-04	3.05	0.00	0.001	0.001
18173-00002-6-18173	REG08	ALCOA Power Generating Inc Warrick Powe	470354	4197663	118.54	1.713044E-03	3.05	0.00	0.001	0.001
18173-00002-65-18173	REG09	ALCOA Power Generating Inc Warrick Powe	470354	4197663	118.54	5.710148E-04	3.05	0.00	0.001	0.001
18173-00002-7-18173	REG10	ALCOA Power Generating Inc Warrick Powe	470354	4197663	118.54	2.580395E+01	115.82	328.15	18.88	4.22
18173-00002-8-18173	REG11	ALCOA Power Generating Inc Warrick Powe	470354	4197663	118.54	2.032373E+01	115.82	327.59	19.73	4.11
18173-00002-9a-18173	REG12	ALCOA Power Generating Inc Warrick Powe	470354	4197663	118.54	1.493002E+01	115.82	327.59	19.87	4.11
18173-00007-102-18173	REG13	Warrick Newco LLC	474656	4201231	136.92	3.252434E+00	28.96	350.93	49.18	1.17
18173-00007-162-18173	REG14	Warrick Newco LLC	474656	4201231	136.92	1.470600E+01	60.66	359.82	7.74	6.10
18173-00007-163-18173	REG15	Warrick Newco LLC	474656	4201231	136.92	1.589579E+01	60.66	359.82	7.74	6.10
18173-00007-164-18173	REG16	Warrick Newco LLC	474656	4201231	136.92	1.610923E+01	14.94	357.04	7.01	6.10

¹ Imported sources into AERMOD and ran AERMAP with 1-arc second (approximately 30 meter resolution) NED data to get source elevations.

² Actual emission rate, source locations, and stack parameters retrieved from 2021 KYEIS for sources located in Kentucky and from IDEM's 2022 NAAQS inventory for sources located in Indiana.

Meteorological Data

Meteorological data for 2017 to 2022 were used in the model evaluation study to correspond with the years of available monitor data. The meteorological data were obtained from the site-specific meteorological tower operated at Century Sebree and supplemented with National Weather Service data obtained from the Evansville Regional Airport (KEVV). Upper air data were obtained from Nashville International Airport (KBNA). The AERMET processing was completed with the input options discussed in Section 2.5 of this modeling report.

Building Downwash

Direction-specific equivalent building dimensions used as input to the AERMOD model to simulate the impacts of downwash were calculated using the EPA-sanctioned Building Profile Input Program (BPIP-PRIME), version 04274 and used in the AERMOD Model.⁴⁷ BPIP-PRIME is designed to incorporate the concepts and procedures expressed in the GEP Technical Support document, the Building Downwash Guidance document, and other related documents and has been adapted to incorporate the PRIME downwash algorithms.⁴⁸

Receptors

The receptors used in this evaluation are consistent with those described in Section 2.7 of this modeling report. Receptors covered the nonattainment area (plus an area outside the nonattainment area to the east of Century Sebree) with variable density with finer resolution closest to Century Sebree and BREC.

Background

Background concentrations of SO₂ were incorporated into AERMOD based on data from the Evansville-Buena Vista monitor (AQS ID 18-163-0021). Data for the most recent three-year period (2020-2022) were processed to provide seasonal and hour-of-day varying backgrounds. These background concentrations are shown in Appendix Table A-6.

Appendix Table A-6. Seasonal and Hour-of-Day Varying Backgrounds (µg/m³)

Season	Hour of Day											
	01	02	03	04	05	06	07	08	09	10	11	12
Winter	6.97	7.32	5.40	5.92	8.10	7.06	7.40	7.32	9.58	10.19	10.10	11.15
Spring	5.92	6.18	6.71	6.01	6.88	6.71	7.58	9.93	11.76	11.85	13.85	11.32
Summer	6.62	6.01	6.36	6.18	6.36	6.01	7.93	10.02	9.76	12.72	9.76	8.71
Fall	4.97	5.66	6.36	4.97	5.31	5.14	5.05	5.40	7.58	13.07	13.42	14.20
Season	13	14	15	16	17	18	19	20	21	22	23	24
Winter	13.68	10.37	12.37	10.45	8.97	7.06	9.23	7.14	7.75	7.14	6.53	6.01
Spring	10.19	10.02	8.97	9.67	9.41	11.50	14.02	7.93	6.88	9.23	6.01	6.97
Summer	8.28	8.36	7.75	8.97	8.97	10.89	9.50	6.97	5.84	5.31	5.40	5.05
Fall	14.20	9.84	8.28	10.02	12.46	10.63	5.75	4.18	5.14	5.84	6.45	6.88

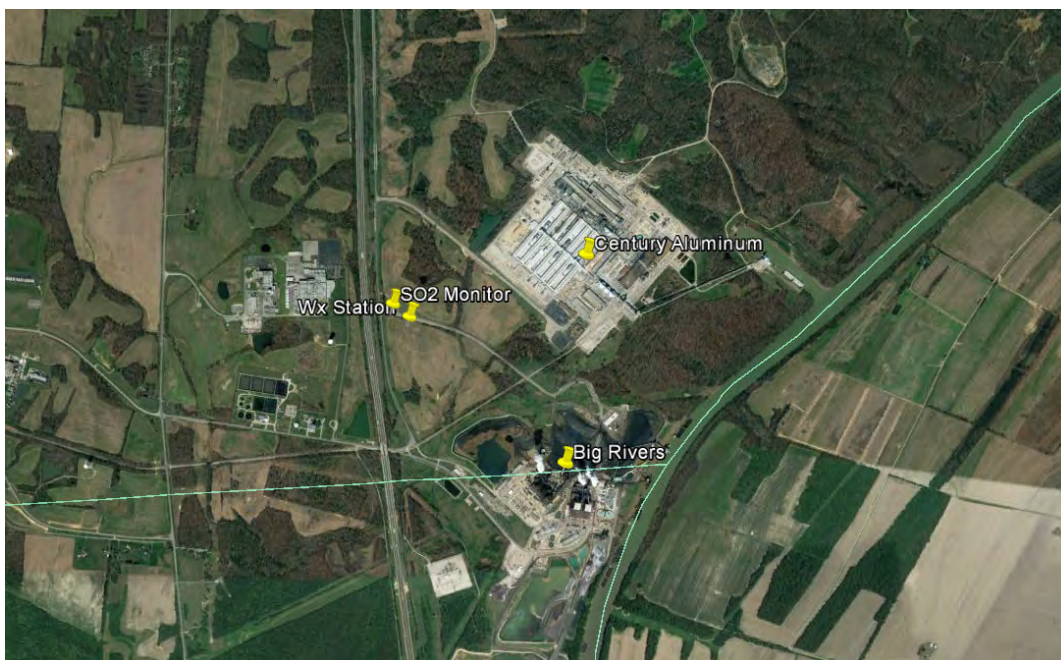
⁴⁷ Earth Tech, Inc., Addendum to the ISC3 User's Guide, The PRIME Plume Rise and Building Downwash Model, November 1997, <http://www.epa.gov/scram001/7thconf/iscprime/useguide.pdf>.

⁴⁸ U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Guidelines for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised)*, Research Triangle Park, North Carolina, EPA 450/4-80-023R, June 1985.

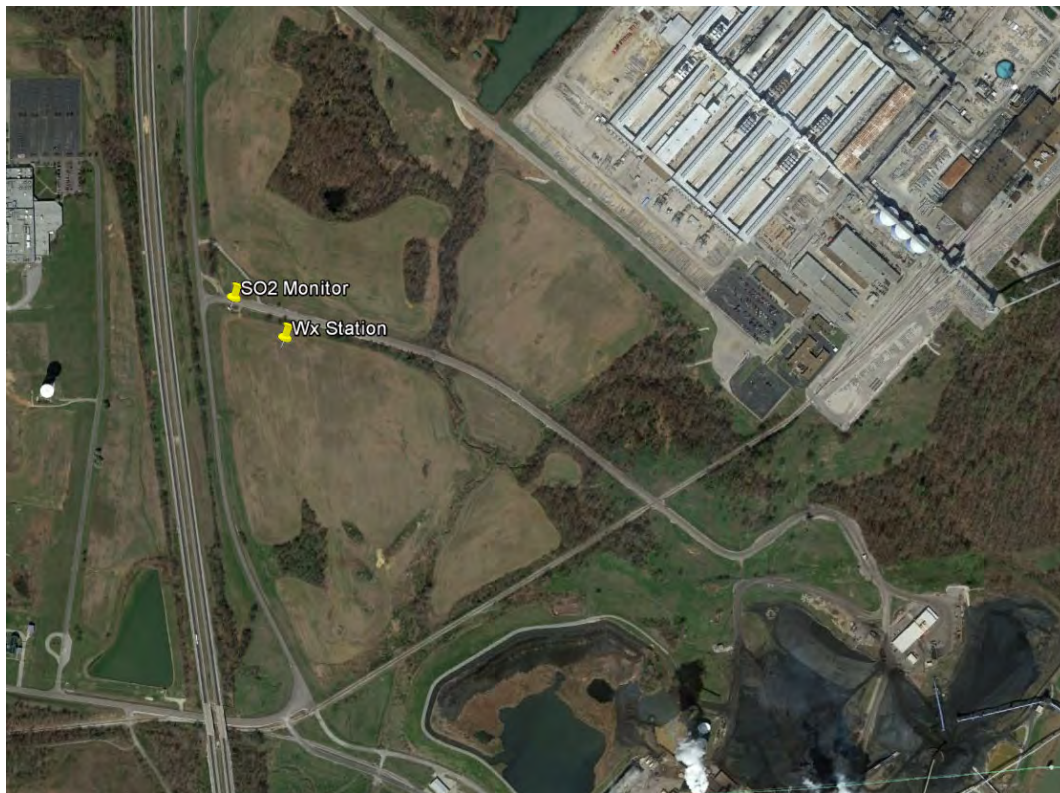
Monitor Data

Beginning in January 2017, 5-minute and 1-hour average SO₂ concentration data has been collected by the Division at the Sebree monitoring site (Site No. 21-101-1011), which is located on the Century Aluminum property at the southeast corner of the intersection of Alcan-Aluminum Road (State Route 2096) and the Big Rivers coal haul access road. Century reviews the SO₂ concentration data monthly as it is made available. The concentration data is analyzed in conjunction with the meteorological data from the co-located meteorological data station. Appendix Figure A-1 and Appendix Figure A-2 show the location of the meteorological and SO₂ monitoring station locations in relation to the Century Aluminum Sebree Plant and the BREC Facility.

Appendix Figure A-1. Area Surrounding the Century Sebree and BREC Facilities

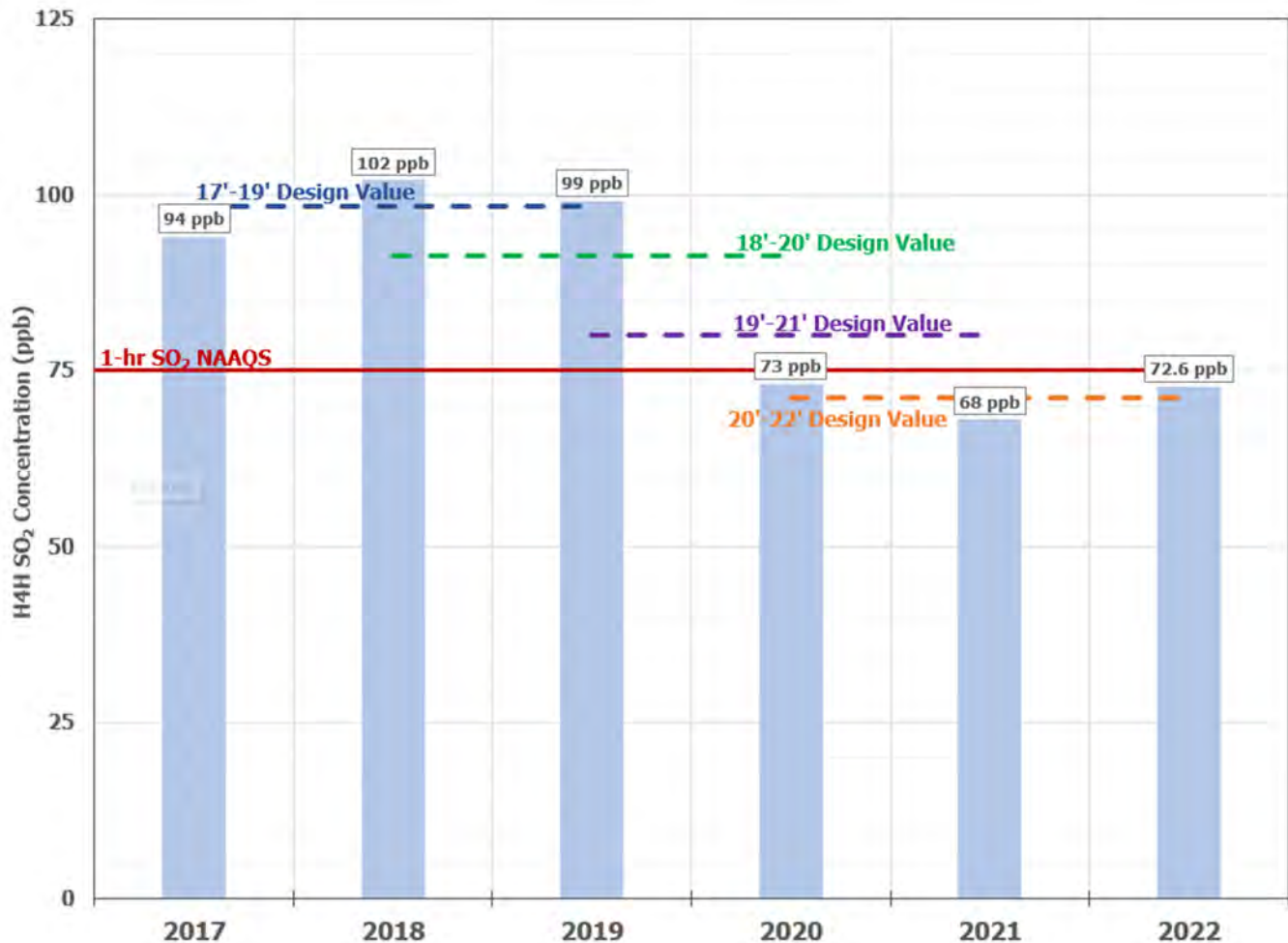


Appendix Figure A-2. Close Up View of the Location of the Meteorological and SO₂ Monitoring Stations



Appendix Figure A-3 summarizes the 4th highest daily maximum 1-hour SO₂ concentration recorded at the monitor each year since 2017 through 2022. The concentration trend has been generally downward over this 5-year period.

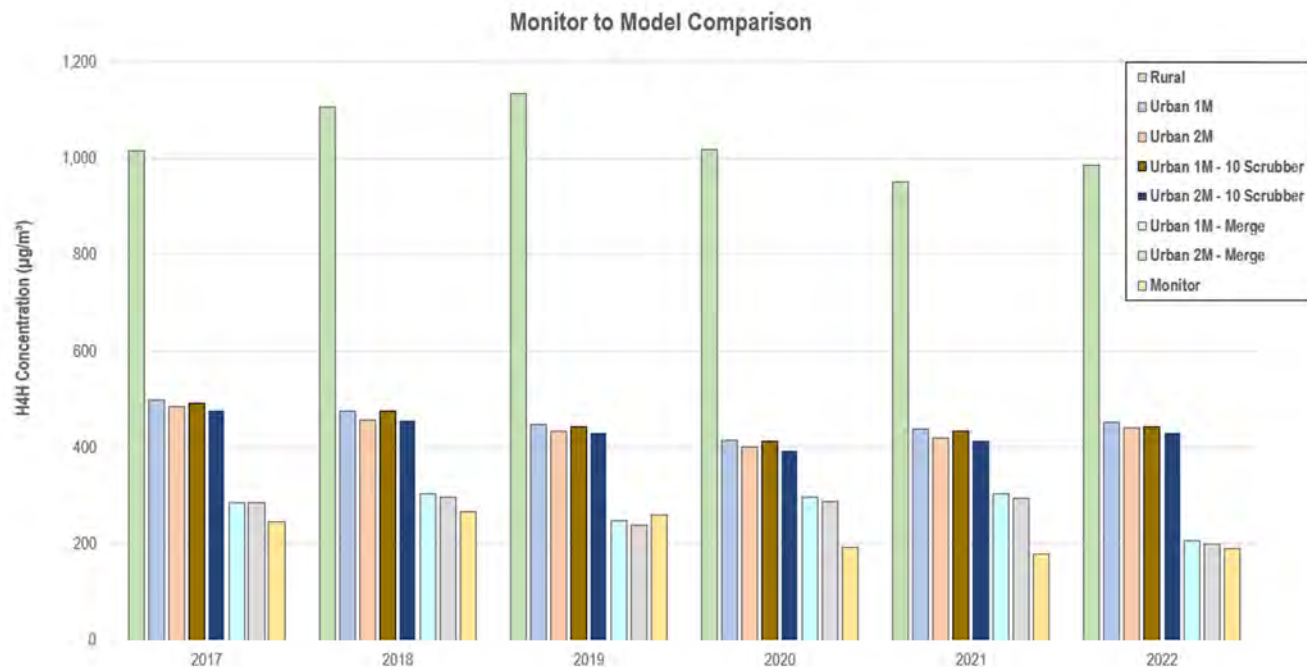
Appendix Figure A-3. 4th Highest Daily Maximum 1-hour SO₂ Concentrations at the Sebree Monitor



Results

The results of the model performance evaluations for the 4th-highest daily maximum concentrations are shown in Appendix Table A-7 and Appendix Table A-8. The maximum modeled 4th highest daily maximum 1-hour SO₂ modeled concentration from each year over the receptor grid is compared with the 4th highest daily maximum 1-hour SO₂ concentration recorded at the Sebree monitor for each year. The evaluation of the use of the urban option shows considerably better model performance, but continued overprediction, with both 1 million and 2 million population. Without the use of the urban option, AERMOD is overpredicting the 4th highest daily maximum 1-hour SO₂ concentration on average by 4.7 times. Through the use of the urban option, this overprediction is reduced to 2.0 times on average. The 2 million population scenario results in slightly better agreement with the monitored concentrations (1.9 times overprediction) compared with the 1 million population scenario (2.0 times overprediction). The results of the analyses with the urban option including 10 stacks per A-398 for Potlines 1 and 2 show results slightly lower than concentrations with one representative stack per A-398. These analyses continue to show an overprediction of 1.9 to 2.0 times on average. When A-398 potline stack merging is added to the urban option scenarios, model performance is further improved compared with monitored concentrations, resulting in average overprediction of the 4th highest daily maximum 1-hour SO₂ concentration of 1.2 times.

Appendix Figure A-4. Model Performance Evaluation Graph



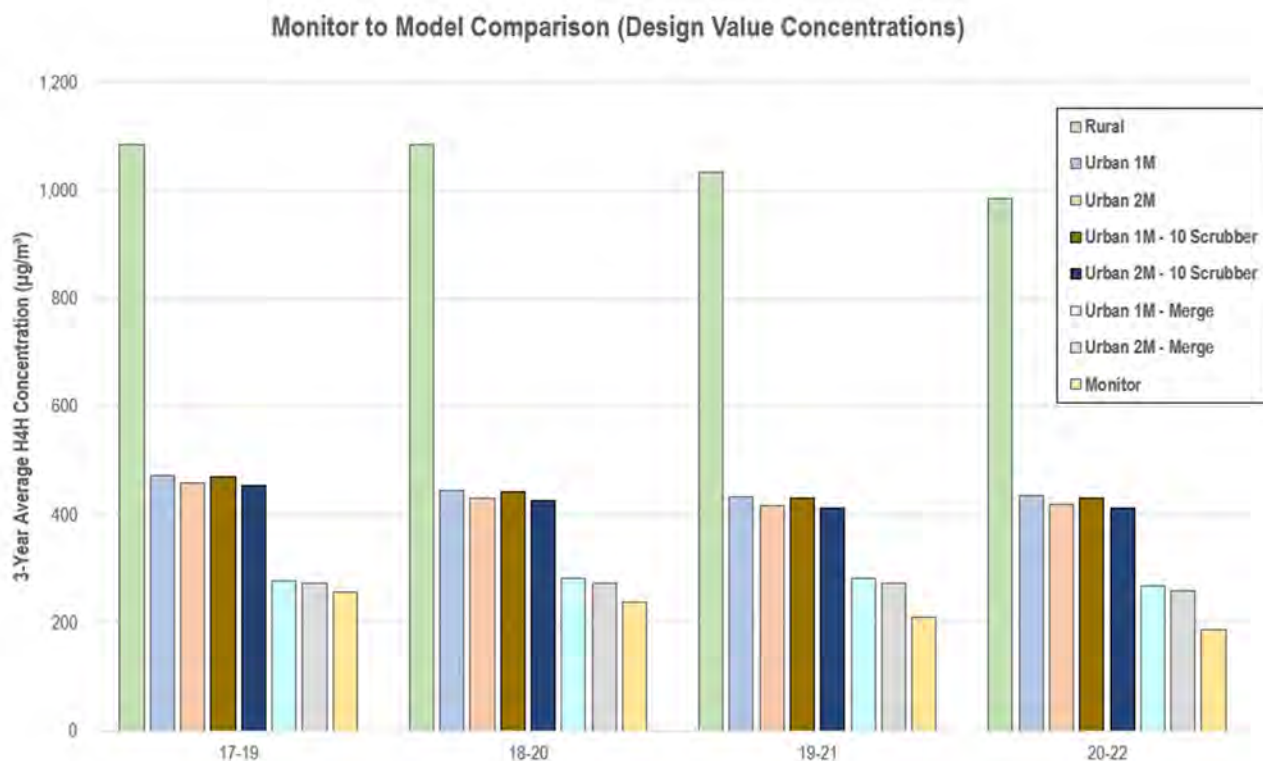
Appendix Table A-7. Model Performance Monitor to Model Ratios

Description	2017	2018	2019	2020	2021	2022	Average
	H4H Concentration (µg/m ³)						
Monitor	245.7	266.6	258.7	190.8	177.7	189.7	221.5
Rural	1014.4	1105.1	1133.3	1018.2	950.1	985.2	1034.4
Urban 1M	497.5	474.6	446.2	415.0	438.3	451.3	453.8
Urban 2M	483.6	456.4	433.1	400.0	418.0	440.2	438.6
Urban 1M - 10 Scrubber	490.9	474.3	441.8	412.7	434.1	442.4	449.4
Urban 2M - 10 Scrubber	477.0	455.8	429.2	392.7	412.4	430.5	432.9
Urban 1M - Merge	283.6	303.0	247.3	296.6	303.4	204.8	273.1
Urban 2M - Merge	283.6	295.4	238.2	286.2	294.2	199.8	266.2
Description	Ratio to Actual Monitor						
Monitor	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rural	4.1	4.1	4.4	5.3	5.3	5.2	4.8
Urban 1M	2.0	1.8	1.7	2.2	2.5	2.4	2.1
Urban 2M	2.0	1.7	1.7	2.1	2.4	2.3	2.0
Urban 1M - 10 Scrubber	2.0	1.8	1.7	2.2	2.4	2.3	2.1
Urban 2M - 10 Scrubber	1.9	1.7	1.7	2.1	2.3	2.3	2.0
Urban 1M - Merge	1.2	1.1	1.0	1.6	1.7	1.1	1.3
Urban 2M - Merge	1.2	1.1	0.9	1.5	1.7	1.1	1.2

* H4H indicates the highest fourth high (or 99th percentile) of the daily maximum hourly concentrations.

In addition to evaluating the individual 4th-highest daily maximum concentrations, the 3-year average of the 4th-highest daily maximum concentrations (form of the 1-hour SO₂ NAAQS) was also reviewed. As shown in Appendix Figure A-5 and Appendix Table A-8 below, the modeled design value concentrations most nearly matched the monitor design value concentration when the urban modeling option (2,000,000 population) and the A-398 potline stack merging were used in the modeling analysis.

Appendix Figure A-5. Model Performance Design Value Evaluation Graph

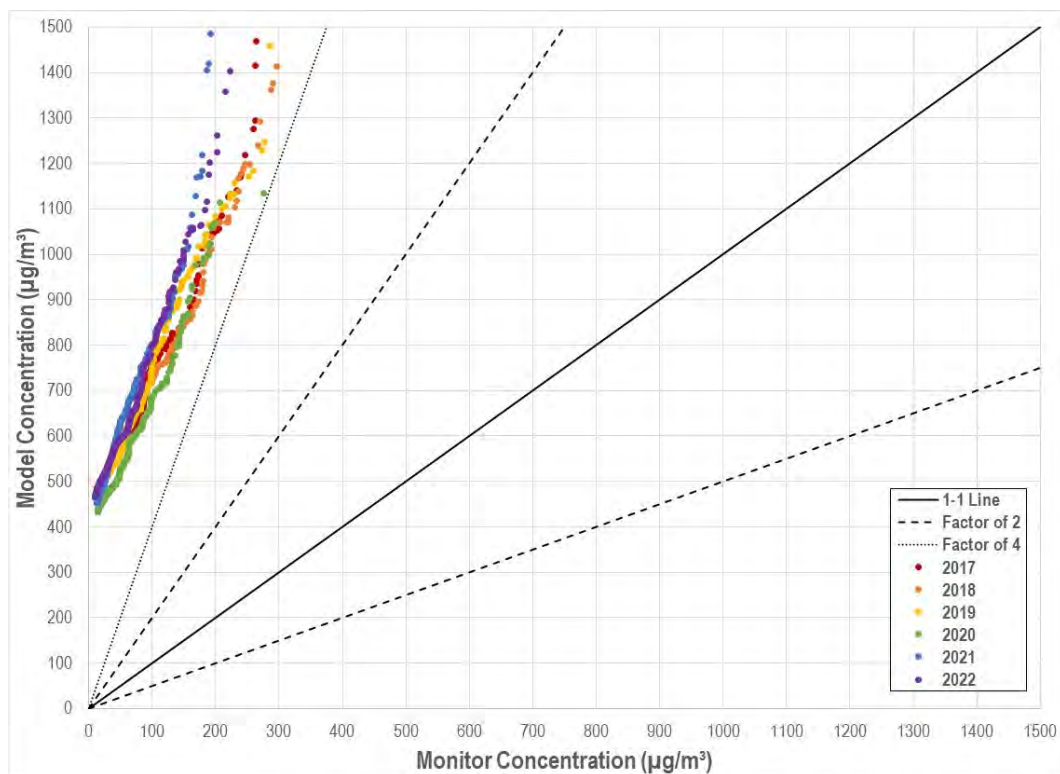


Appendix Table A-8. Design Value Model Performance Monitor to Model Ratios

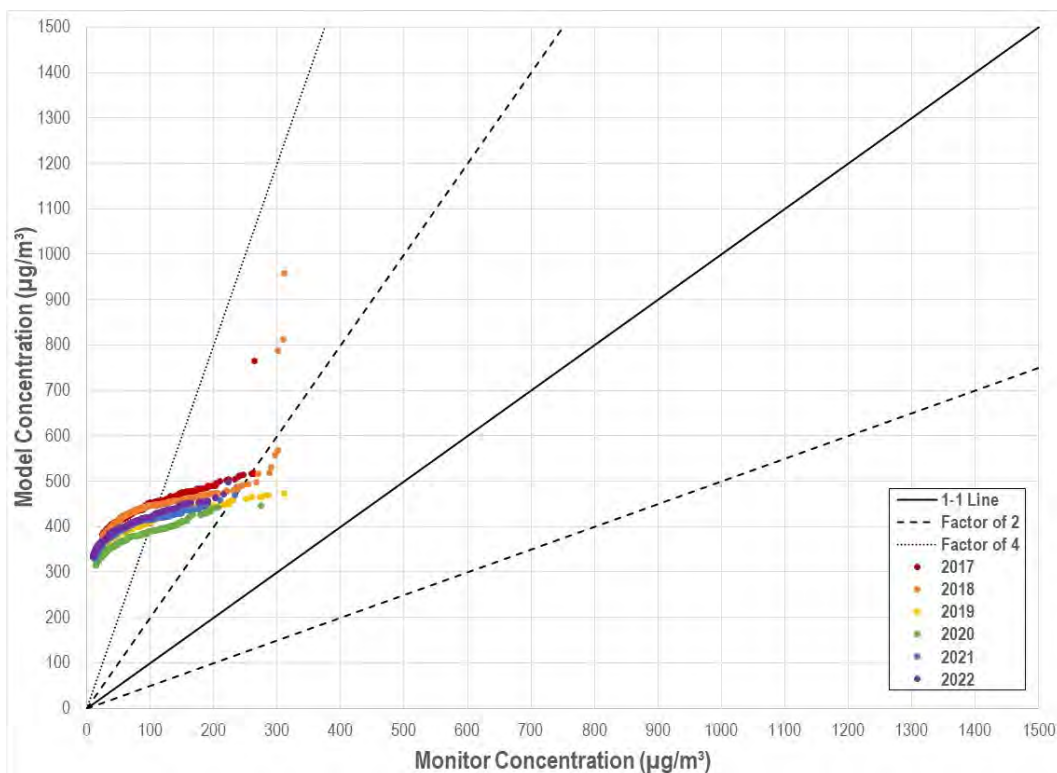
Description	17-19	18-20	19-21	20-22	Average
	3-Year Average H4H Concentration ($\mu\text{g}/\text{m}^3$)				
Monitor	257.0	238.7	209.1	186.1	222.7
Rural	1084.3	1085.5	1033.9	984.5	1047.0
Urban 1M	472.8	445.3	433.2	434.9	446.5
Urban 2M	457.7	429.8	417.0	419.4	431.0
Urban 1M - 10 Scrubber	469.0	442.9	429.6	429.7	442.8
Urban 2M - 10 Scrubber	454.0	425.9	411.4	411.9	425.8
Urban 1M - Merge	278.0	282.3	282.5	268.3	277.8
Urban 2M - Merge	272.4	273.3	272.9	260.0	269.6
Description	Ratio to Actual Monitor				
Monitor	1.0	1.0	1.0	1.0	1.0
Rural	4.2	4.5	4.9	5.3	4.7
Urban 1M	1.8	1.9	2.1	2.3	2.0
Urban 2M	1.8	1.8	2.0	2.3	1.9
Urban 1M - 10 Scrubber	1.8	1.9	2.1	2.3	2.0
Urban 2M - 10 Scrubber	1.8	1.8	2.0	2.2	1.9
Urban 1M - Merge	1.1	1.2	1.4	1.4	1.2
Urban 2M - Merge	1.1	1.1	1.3	1.4	1.2

Quantile-quantile (Q-Q) plots are also useful for evaluating performance of models that predict a peak or near-peak value at an unspecified time, such as AERMOD. The Q-Q plots shown in Appendix Figure A-6 to Appendix Figure A-12 were developed by ranking the top 500 peak modeled (removing duplicate hours) and monitored hourly concentrations for each year and then plotting the resulting pairs that are unpaired in time and space. The Q-Q plots show that use of AERMOD without the urban option for Century Seabee results in model overprediction generally outside the factor of four line across the range of the top 500 peak concentrations. With the use of the urban option, with the exception of a few outliers, peak hourly concentrations are within a factor of 2 of monitored concentrations, but still consistently overpredicted. Adding the stack merging for the Potline 1 and 2 A-398 stacks to the urban option (with 2 million population) results in better agreement of modeled and monitored peak hourly concentrations with a slight underprediction for few peak pairs seen for 2019. All other years continue to show overprediction by the model, resulting in average model overprediction remaining with use of the stack merging technique.

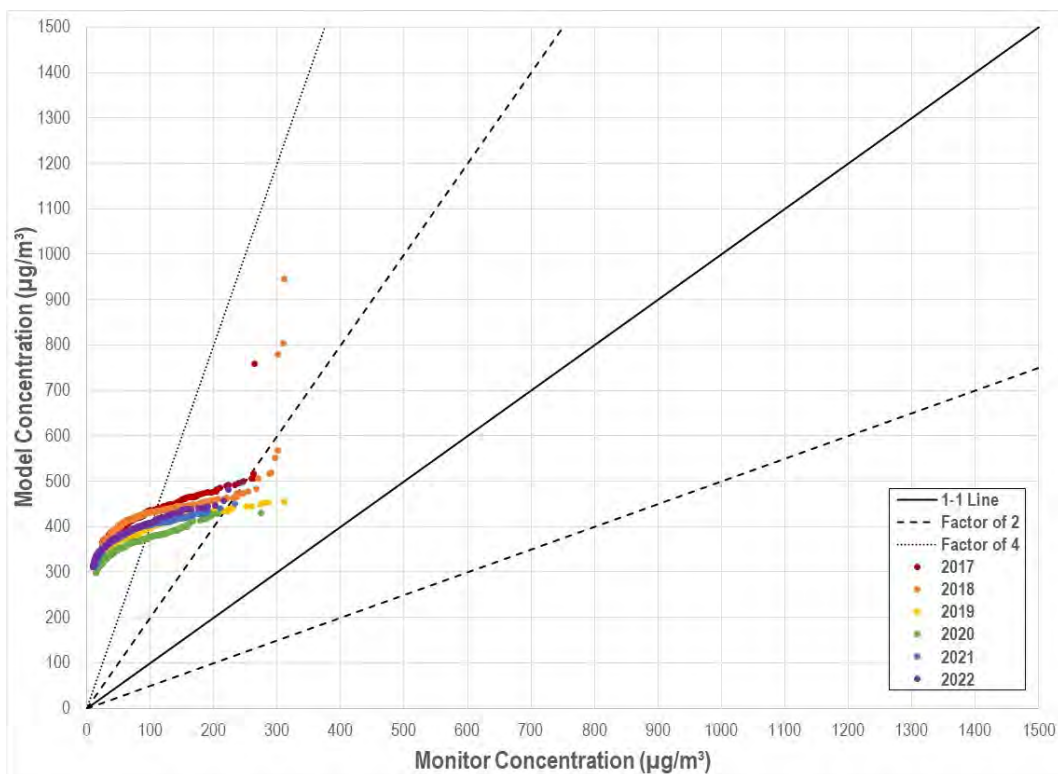
Appendix Figure A-6. 1-Hour SO₂ Q-Q Plot for Rural Scenario



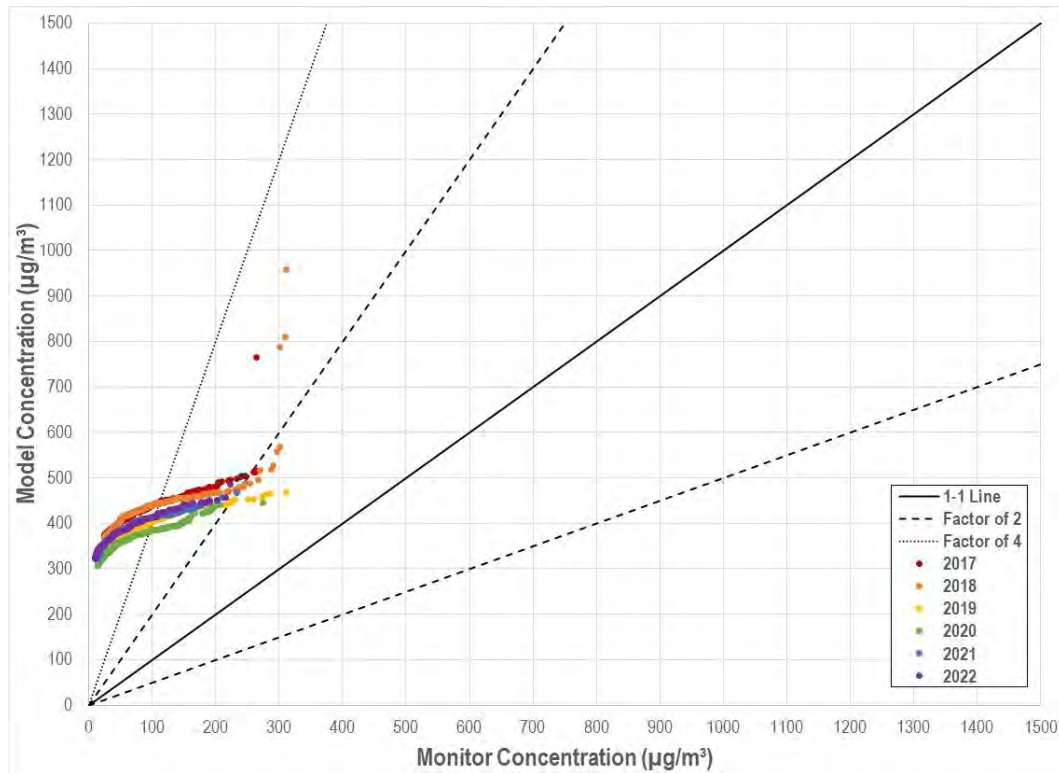
Appendix Figure A-7. 1-Hour SO₂ Q-Q Plot for Urban Scenario (1,000,000 Population)



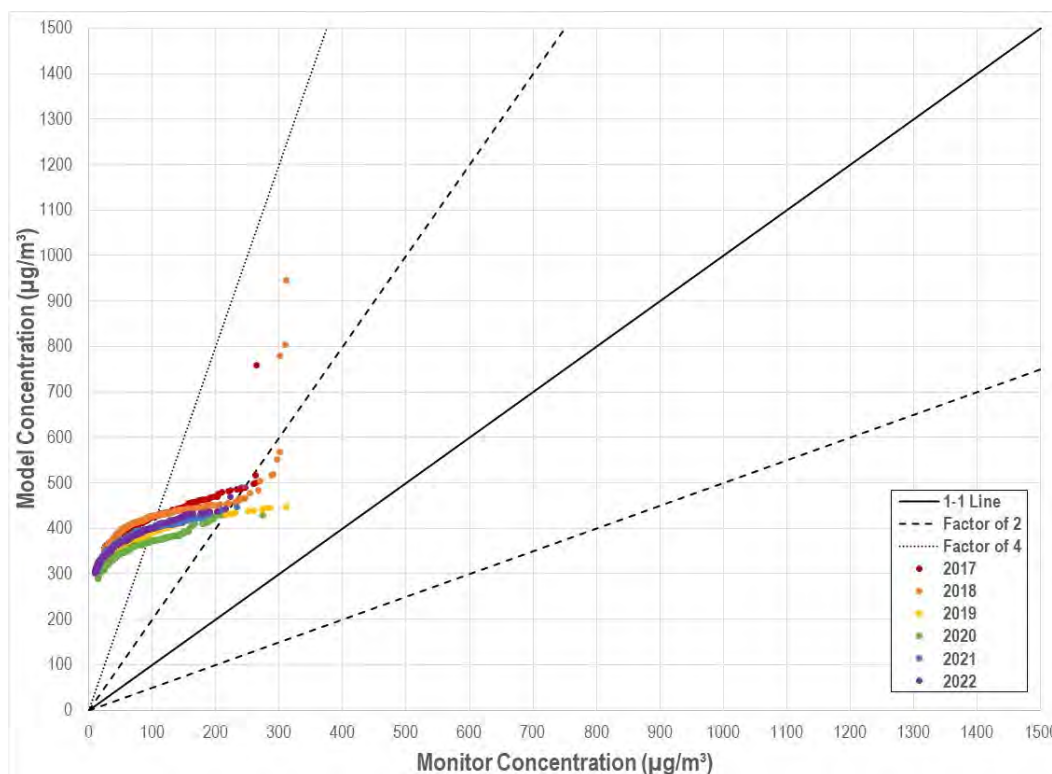
Appendix Figure A-8. 1-Hour SO₂ Q-Q Plot for Urban Scenario (2,000,000 Population)



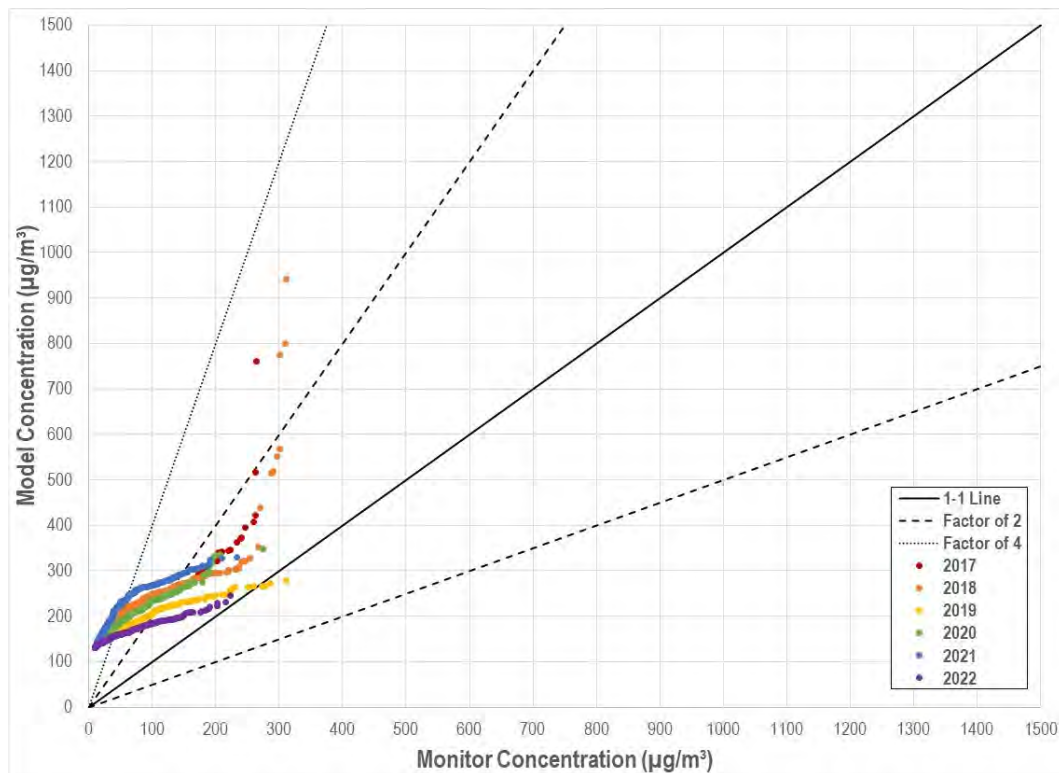
Appendix Figure A-9. 1-Hour SO₂ Q-Q Plot for Urban (1M Population) with A398 10 Stack Configuration



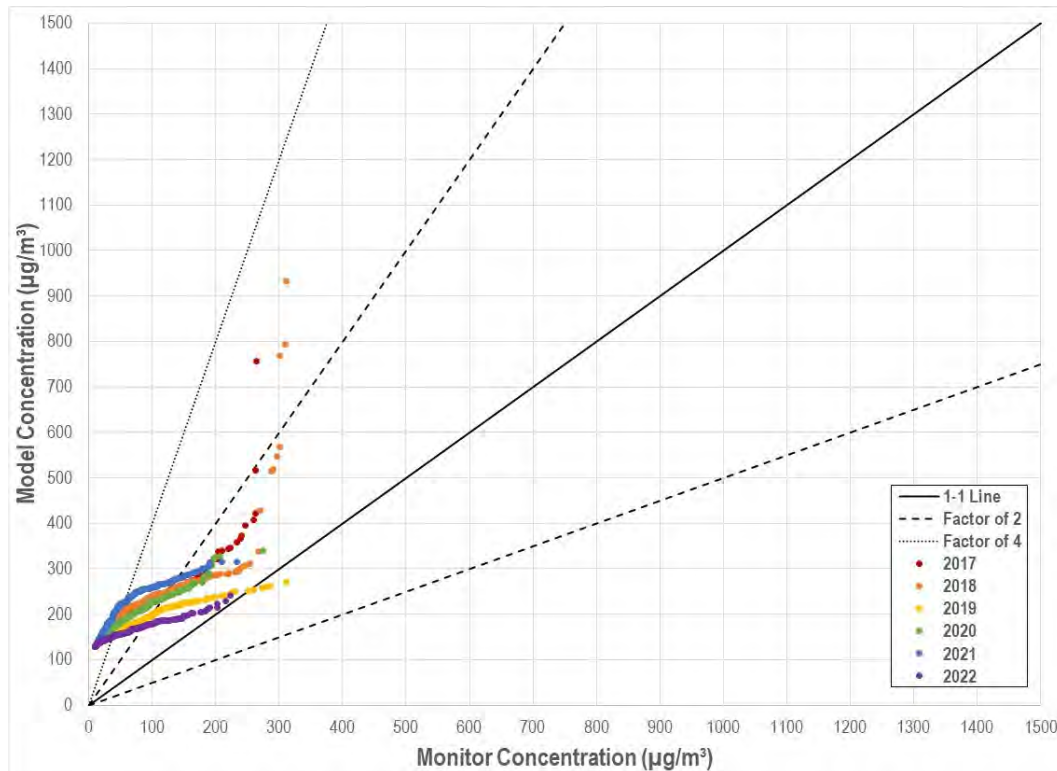
Appendix Figure A-10. 1-Hour SO₂ Q-Q Plot for Urban (2M Population) with A398 10 Stack Configuration



Appendix Figure A-11. 1-Hour SO₂ Q-Q Plot for Urban (1M Population) Including Merged A-398 Stacks



Appendix Figure A-12. 1-Hour SO₂ Q-Q Plot for Urban (2M Population) Including Merged A-398 Stacks



Conclusions

An evaluation of AERMOD performance for 1-hour SO₂ modeled versus monitored concentrations was completed. The base scenario without the use of the urban option yielded considerable overprediction (>4 times for the 99th percentile of daily maximums) by AERMOD compared with monitored concentrations. AERMOD performance was improved considerably through the use of the urban option to represent dispersion for Century Seabree sources, but still yielded conservatively high results (~1.7-2.5 times for the 99th percentile of daily maximums) compared with monitor data. The performance was better with a population of 2,000,000 compared with a population of 1,000,000 used as input to AERMOD. AERMOD performance was further improved, but with continued model overprediction (1.2 times on average for the 99th percentile of daily maximums) with the use of alternative stack diameters to represent interaction between the plumes emitted from the individual stacks located on the Potline 1 and 2 A-398 scrubber systems.

APPENDIX B. QUALITY ASSURANCE PROJECT PLAN (QAPP)

METEOROLOGICAL QUALITY ASSURANCE PROJECT PLAN FOR CENTURY ALUMINUM/BIG RIVERS ELECTRIC CORPORATION MONITORING STATION

Prepared for:

Big Rivers Electric Corporation
201 Third Street
Henderson, Kentucky 42420

Century Aluminum
9404 State Route 2096
Robards, Kentucky 42452

By

Meteorological Solutions Inc.
Project No. 09161685

September 2016

Revision 0



Title: Meteorological QAPP - Century Aluminum/Big Rivers Monitoring Station

Revision Number: 0

Revision Date: September 13, 2016

**METEOROLOGICAL QUALITY ASSURANCE PLAN FOR
CENTURY ALUMINUM/BIG RIVERS ELECTRIC CORPORATION
MONITORING STATION**

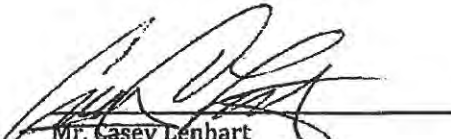
A PROJECT MANAGEMENT ELEMENTS

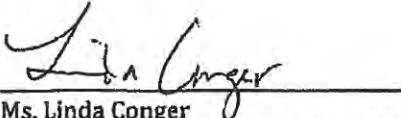
A.1 Approvals Signatures

 Date: 11/10/2016
Mr. John Knight
Environmental Technician, Century Aluminum

 Date: 12/6/2016
Mr. Thomas Shaw
Environmental Director, Big Rivers Electric Corporation

 Date: 10/12/2016
Mr. George Wilkerson
Project Director, MSI Trinity

 Date: 10/12/2016
Mr. Casey Lenhart
Project Manager, MSI Trinity

 Date: 10/12/2016
Ms. Linda Conger
Project Quality Assurance Officer, MSI Trinity

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B	Standard Operating Procedures for Meteorological Sensors
C	Corrective Action Report
D	Site Check Form
E	Standard Operating Procedures for Meteorological Sensor Calibration
F	Data Invalidation Log, Data Validation Site Activity Log, and Data Report Quality Assurance Checklist

A.3 Distribution List

The following individuals have been provided a copy of this Meteorological Quality Assurance Project Plan (QAPP).

Table A-1 Distribution List for QAPP

Personnel	Organization	Email Address	Business Address	Telephone Number
John Knight	Century Aluminum	john.knight@centuryaluminum.com	Century Aluminum 9404 State Route 2096 Robards, KY 42452	270-521-7811
Thomas Shaw	Big Rivers Electric Corp.	Tom.Shaw@Bigrivers.com	P. O. Box 24 Henderson, KY 42419	270-844-6031
George Wilkerson	MSI Trinity	gww@metsolution.com	MSI Trinity 4525 Wasatch Blvd., Suite 200 Salt Lake City, Utah 84124	801-272-3000 Ext. 304
Casey Lenhart	MSI Trinity	ccl@metsolution.com	MSI Trinity 4525 Wasatch Blvd., Suite 200 Salt Lake City, Utah 84124	801-272-3000 Ext. 307
Linda Conger	MSI Trinity	lec@metsolution.com	MSI Trinity 4525 Wasatch Blvd., Suite 200 Salt Lake City, Utah 84124	801-272-3000 Ext. 305

A.4 Project/Task Organization

Mr. John Knight is an environmental technician for Century Aluminum and he, in coordination with Mr. Thomas Shaw the environmental director for Big Rivers Electric Corporation will direct the monitoring activities for Century Aluminum/Big Rivers.

George Wilkerson will be MSI Trinity's Project Director for negotiating and overseeing contractual and financial arrangements.

Mr. Casey Lenhart will serve as MSI Trinity's Project Manager who is responsible for the oversight of all field activities including equipment installation, routine monitoring operations, routine equipment maintenance, equipment calibrations, and will assist with data validation.

Ms. Linda Conger is responsible for MSI Trinity’s quality control/quality assurance activities and will maintain the official approved QA Project Plan. Ms. Conger will be assisted by Mr. Dan Risch who will perform the initial quality control and quality assurance of the data and monitoring activities as well as prepare the data report. Mr. Scott Adamson is in charge of data management for this project.

Mr. Mike Peterson, Mr. Isaac Legare, and/or Mr. Tyler Ward will perform the routine maintenance and instrument calibrations. Mr. Adam Lenkowski, MSI Trinity’s independent auditor will perform the semi-annual quality assurance performance audits. Figure A.1 presents the organizational chart that shows the lines of responsibility and information flow for activities under this project. A list of specific responsibilities for specific positions follows.

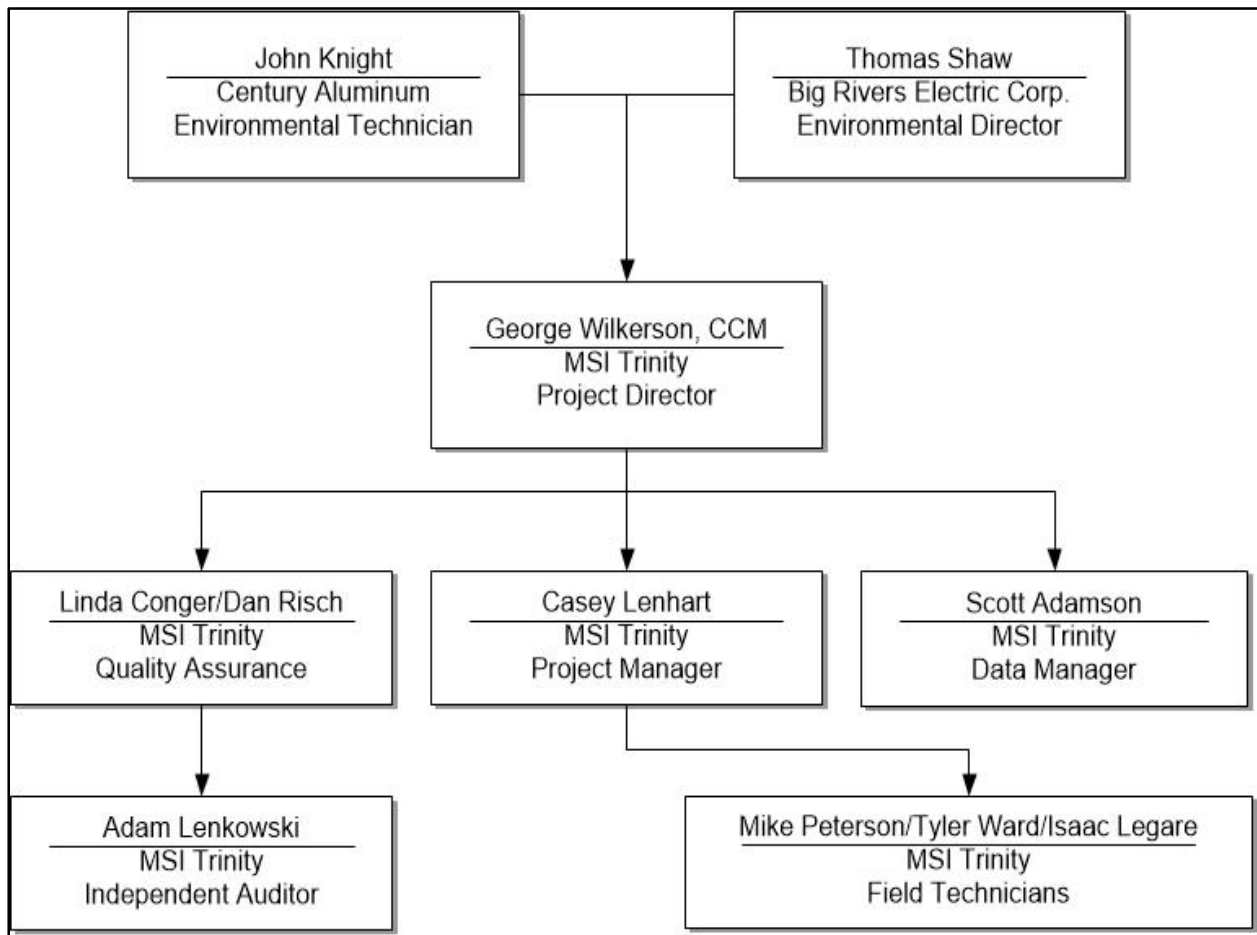


Figure A.1 Organizational Chart

A.4.1 Century Aluminum Environmental Technician

Mr. John Knight will act as the Century Aluminum monitoring project manager and will be responsible for all monitoring activities related to Century Aluminum’s portion of the monitoring program.

A.4.2 Big Rivers Electric Corporation Environmental Director

Mr. Thomas Shaw will act as the Big Rivers Electric Corporation's monitoring project manager and will be responsible for all monitoring activities related to Big Rivers Electric Corporation's portion of the monitoring program.

A.4.3 MSI Trinity Project Director

Mr. George Wilkerson will be MSI Trinity's Project Director who will negotiate contractual arrangements and will provide oversight and consulting expertise to the project.

A.4.4 MSI Trinity Project Manager

Mr. Casey Lenhart will be MSI Trinity's Project Manager and will be responsible for overseeing the station installation, day-to-day operations, routine and preventive maintenance, data collection and data validation activities.

A.4.5 MSI Trinity Field Technicians/Calibration

Mr. Mike Peterson will perform the role as site operator and will perform routine maintenance and instrument calibrations. He will be assisted by Mr. Isaac Legare and Mr. Tyler Ward, as necessary.

A.4.6 MSI Trinity Quality Assurance Manager

Ms. Linda Conger is responsible for oversight of MSI Trinity's quality assurance/quality control activities from field measurements to data validation, data reporting, and implementation of quality assurance policies and procedures. She will be responsible for maintaining the official, approved QA Project Plan for MSI Trinity. Ms. Conger will be assisted by Mr. Dan Risch.

A.4.7 MSI Trinity Data Management

Mr. Scott Adamson will perform data management. MSI Trinity's data manager is responsible for ensuring timely data collection, posting data for review and preparation of data summaries for reports. Final data validation is the responsibility of the MSI Trinity project manager, the reviewing meteorologist, and the quality assurance officer.

A.4.8 Quality Assurance Performance Audits

The quality assurance performance audits for this project will be conducted by MSI Trinity independent auditor, Adam Lenkowski.

A.5 Problem Definition/Background

This quality assurance project plan has been prepared on behalf of the Century Aluminum/Big Rivers Electric Corporation and details the methodologies to establish continuous and accurate meteorological measurements at Century Aluminum and Big Rivers Electric Corporations facilities located near Robards and Sebree Kentucky. Monitoring data will be collected to document meteorological parameters in conformance with US EPA Prevention of Significant Deterioration (PSD) monitoring requirements.

The primary objective of this monitoring station is to obtain meteorological data to characterize the meteorology in the area. Data collected at this station may also be used for AERMOD modeling and comparison with other ambient air monitoring data.

A.5.1 Area Climate and Topography

The following sections describe the climate and topography around Robards and Sebree, Kentucky.

A.5.1.1 Climate

The climate of this area is considered humid subtropical based on the Köppen climate classification and, as such, the climate is mild, generally warm and temperate. Kentucky's inland location contributes to a continental influences which tends to produce a large seasonal temperature range between summer and winter. Kentucky's position north of the Gulf of Mexico contributes a tropical marine influence yields ample precipitation.

Historical weather data for Robards/Sebree area was obtained from the website, Climate-data.org¹. Summer months (June - August) see average maximum temperatures range from approximately 86°F to 88.9°F with July being the hottest month with an average maximum temperature of 88.9°F and an average daily temperature of approximately 78°F. Extreme temperatures can reach into the 100° to 106°F range during the summer months. During the summer months, monthly precipitation averages 3.6 inches in June, 4.1 inches in July, and to 3.4 inches in August.

During the fall months of September – November, the average high temperatures drop from around 82°F in September to near 57°F in November. Average minimum temperatures drop to approximately 37°F by November. November is the wettest fall month averaging 4.1 inches of precipitation; precipitation is lowest in October, with an average of 2.8 inches of rain.

During the winter months (December – February), average maximum temperatures range from approximately 46°F in December to 46.6°F in February with lows temperatures during the winter months in the mid-20's°F. January is typically the coldest month. Precipitation averages between 3.1 to 3.9 inches during the winter months.

The average high temperatures during the spring months (March – May)'s range from 57.4° F in March to 77.7°F in May. Average low temperatures range from approximately 36°F in March to 55°F in May.

¹ <http://en.climate-data.org/location/134692>

Precipitation increases in spring with March as the wettest month of the year averaging 4.8 inches of precipitation.

The average temperature in the area is approximately 57°F. The area averages 45.6 inches of precipitation, annually.

A.5.1.2 Topography

The topography around the Century Aluminum and Big Rivers Electric Corporation facilities is fairly flat with a few nearby hills with abundant vegetation. The Ohio River is located approximately 12 miles north of the two facilities.

A.6 Project/Task Description

All meteorological sensors to be operated at the Century Aluminum/Big Rivers monitoring station will meet PSD monitoring requirements². The operating range of the sensors and monitors will easily bracket the range of environmental conditions expected at the site.

A.6.1 Century Aluminum/Big Rivers Meteorological Monitoring Station

The meteorological tower is equipped to measure wind direction and wind speed at 10 meters, temperature at 2 and 10 meters, relative humidity, solar and net radiation at 2 meters, and barometric pressure at the base of the tower. Atmospheric stability is being calculated using the solar radiation - delta temperature (SRDT) and sigma theta ($\sigma\theta$) methods.

The Century Aluminum facility is located approximately 2.7 miles southeast of Robards and approximately 3.5 miles northeast of Sebree, Kentucky. The Big River Electric Corporation facility is located approximately 0.75 miles south of the Century Aluminum plant and approximately 0.3 miles south of Robards, Kentucky. The meteorological tower is located approximately 0.5 miles west of the Century Aluminum facility, approximately 200 feet northeast of the ambient SO₂ monitoring shelter, approximately 300 feet east of Alcan Aluminum Road. The latitude and longitude coordinates, based on WGS84, for the Century Aluminum/Big Rivers Electric Corporation meteorological monitoring station are:

- 4167572.00 meters North
- 454933.00 meters East

The location of the Century Aluminum/Big Rivers Electric Corporation meteorological monitoring tower is presented by Google Earth in Figure A.2. A summary of the meteorological instrumentation installed at the Century Aluminum/Big Rivers Electric Corporation monitoring site is presented in Table A-2.

² EPA's Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV, Meteorological Measurements, March 2008.



Figure A.2 Location of Century Aluminum/Big Rivers Electric Corporation Meteorological Monitoring Tower

Table A-2 Meteorological Instrumentation at Century Aluminum/Big Rivers Electric Corporation Monitoring Station

Parameter	Equipment Manufacturer	Model Number	Sensor Height (meters)
Wind Direction	RM Young	05305	10
Wind Speed	RM Young	05305	10
Temperature	RM Young	41342	2,10
Motor aspirated radiation shield	RM Young	43502	2,10
Net Radiation	Kipp & Zonen	NR-Lite	2
Solar Radiation	Hukseflux	LP02	2
Barometric Pressure	Vaisala	PTB110	1.5
Relative Humidity	Rotronic	HC253	2
Data Acquisition System	Campbell Scientific	CR1000	NA

A.6.2 Sampling Frequency

Data from the instruments listed in Table A-2 are collected and stored by a Campbell Scientific Inc. Model CR1000 data logger. Meteorological data are sampled every second and recorded as five-minute averages on the data logger.

A.6.3 Project Schedule

Personnel working on this project will be fully qualified, trained, and capable to perform their assigned duties. Work schedules include: daily data review; semi-annual meteorological equipment calibrations; quarterly data summaries within 60 days of quarter completion; semi-annual performance audits; and maintenance and corrective action, as needed. Table A-3 presents the project schedule.

Table A-3 Project Schedule

Task	Time
Monitoring Plan	Start of contract and as needed to reflect changes in equipment or monitoring requirements.
Monitoring Operations	Calibrations – start of contract, semi-annually for meteorological sensors, and whenever an instrument exceeds specified control limits or undergoes major maintenance or repair.
Quality Assurance	Meteorological performance audits and system audits are performed by independent auditor semi-annually for meteorological sensors.

A.6.4 Project Reports

Table A-4 presents the reports that will be produced as part of this project.

Table A-4 Project Reports

Reports	Frequency	Content	Responsible Position	Distribution
Quarterly Meteorological Data Summaries	Quarterly	Summarize data following EPA guidelines	Scott Adamson MSI Trinity Data Manager	See Section A.3 Distribution list
Corrective Action Reports	As Needed	Summarizes corrective actions taken to return the monitoring station to compliant status	Casey Lenhart MSI Trinity Project Manager	See Section A.3 Distribution list
Response to Corrective Action Reports	As Needed	Reports the results of the corrective actions taken	Casey Lenhart MSI Trinity Project Manager	See Section A.3 Distribution list

A.7 Quality Objectives and Criteria for Measurement of Data

Presented in this section are the Measurement Quality Objectives (MQOs) for the meteorological measurements. MQOs are designed to evaluate and control various phases (sampling, preparation, and analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the data quality objectives. MQO's can be defined in terms of the following data quality indicators: precision; accuracy; representativeness; detectability; completeness; and comparability. For the monitoring project, the meteorological MQO's are presented in Tables A-5 and A-6. Calibration and accuracy criteria are presented in Table A-7. Measurements that do not meet the MQO's presented in Table A-5 will be invalidated unless justification can be identified for not doing so. In addition, data will be invalidated if a sensor fails a performance audit and further investigation confirms the audit results. These data will be invalidated back to the last good check or calibration of the equipment.

Precision for the meteorological measurements will be determined based on performance audit results. The accuracy and bias of the sensor measurements is determined through sensor calibrations.

Meteorological measurements recorded are subject to and consistent with the quality assurance requirements as found in the following documents:

- EPA's *Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV, Meteorological Measurements*, EPA March 2008; and
- EPA's *Meteorological Monitoring Guidance for Regulatory Modeling Applications*, EPA-454/R-99-005, February, 2000.

Table A-5 Meteorological Measurement Quality Objectives

Parameter (Manufacturer/ Model)	Specified Accuracy	Required Accuracy	Sensor Resolution in System	Required Resolution	Data Completeness
Wind Speed R.M. Young Model 05305 Wind Monitor AQ	±0.20 m/s or 1% of reading	±0.20	0.01 m/s	0.1 m/s	90%
Wind Direction R.M. Young Model 05305 Wind Monitor AQ	±3 degrees	±5 degrees	0.01	1.0	90%
Temperature RM Young Platinum RTD Model 41342	±0.1°C	±0.5°C	0.01°C	0.1°C	90%
Vertical temperature difference	±0.05°C	±0.1°C	0.01°C	0.01°C	90%
Barometric Pressure Vaisala Model PTB110	±0.3 mb @ +20°C	±3 mb	0.1 mb	0.1	90%
Solar Radiation Hukseflux LP02	±5%	±5%	1.0 W/m ²	1 W/m ²	90%
Net Radiation Kipp & Zonen NR Lite 2	±5%	±5%	1.0 W/m ²	1 W/m ²	90%
Relative Humidity Rotronic Model HC253	±0.8% RH @ 23°C	±7% RH	0.1%	0.5%	90%

Table A-6 Meteorological Measurement Methods and Response Characteristics

Parameter	Measurement Method	Sensor Response Characteristic	EPA-Required Response Characteristics ³
Wind Speed – R.M. Young Model 05305 Wind Monitor AQ	Propeller rotation produces AC signal with frequency output proportional to wind speed	Operating Range: 0-50 m/s (112 mph) Starting Threshold: 0.4m/s Distance Constant:2.1m	Starting Threshold = ≤ 0.5 m/s Distance Const. ≤ 5 m
Wind Direction – R.M. Young Model 05305 Wind Monitor AQ	Precision potentiometer	Operating Range: 0 to 360° Starting Threshold: 0.5 m/s @10° displacement Delay Distance: 1.2 m Damping Ratio: 0.45	Starting Threshold ≤ 0.5 m/s Delay Distance ≤ 5 m Damping Ratio=0.4 to 0.7
Temperature/ Δ Temperature - RM Young 41342	Platinum RTD	Operating Range: $\pm 50^{\circ}\text{C}$ Time Constant: 10 sec	Time Constant ≤ 1 min.
Barometric Pressure Vaisala Model PTB101B	Silicon capacitive sensor	Operating Range: 500 to 1100 hPa Response Time: <100 ms	NA
Solar Radiation – Hukseflux Model LP02	Silicon photovoltaic detector	Operating Range: -40°C to $+80^{\circ}\text{C}$ Spectral Range: 305 to 2800 nm Sensitivity: $15\mu\text{V}/\text{W}/\text{m}^2$	Time Constant = 5 sec Operating Range = -20°C to $+40^{\circ}\text{C}$ Spectral Range = 285 nm to 2800 nm
Net Radiation – Kipp & Zonen Model NR Lite 2	High output thermopile	Operating Range: $\pm 2000 \text{ W}/\text{m}^2$ Response Time: 20 secs Spectral Response: 0-100 μm	NA
Relative Humidity - Rotronic Model HC253	IN1 capacitive sensor	Operating Range: 0 to 100% Response Time: 22 secs	≤ 30 minutes

NA – Not Applicable

³ EPA's Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV, Meteorological Measurements, March 2008, Appendix C.

Table A-7 Meteorological Measurement Calibration and Accuracy Criteria

Parameter	Calibration			Accuracy		
	Type	Acceptance Criteria	Frequency	Type	Acceptance Criteria	Frequency
Wind Speed	NIST-traceable synchronous motor	±0.20 m/s	6 month intervals	NIST-traceable synchronous motor	±0.20 m/s	6 month intervals
Wind Direction	Compass System Orientation plus Linearity	±5°	6 month intervals	Compass System Orientation plus Linearity	±5°	6 month intervals
Temperature	3 pt. water bath with NIST-traceable thermometer	±0.5°C	6 month intervals	3 pt. water bath with NIST-traceable thermometer	0.5°C	6 month intervals
Vertical Temperature Difference	Both sensors simultaneously in 3 pt. water bath with NIST-traceable thermometer	±0.1°C for 2-10 m	6 month intervals	Both sensors simultaneously in 3 pt. water bath with NIST-traceable thermometer	±0.1°C for 2-10 m	6 month intervals
Relative Humidity	Collocated NIST-certified RH sensor	±7%RH	6 month intervals	NIST- certified RH sensor	±7% RH	6 month intervals
Solar Radiation	Collocated NIST-traceable reference pyranometer	±5%	6 month intervals	NIST-traceable pyranometer	±5%	6 month intervals
Net Radiation	Collocated NIST-traceable reference net radiometer	±5%	6 month intervals	NIST-traceable net radiometer	±5%	6 month intervals
Barometric Pressure	NIST-traceable reference barometer	±3 mbar	6 month intervals	NIST-traceable reference barometer	±3 mbar	6 month intervals

A.7.1 Representativeness of the Meteorological Measurements

Site selection followed guidelines presented in the following US EPA documents to assure that measurements are representative of meteorological monitoring conditions at Century Aluminum/Big Rivers monitoring site:

- *Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements* March 2008;
- *40 CFR Part 58, Appendix A Quality Assurance Requirements for State and Local Air Monitoring Stations (SLAMS)*; and
- *Meteorological Monitoring Guidance for Regulatory Modeling Applications* EPA-454/R-99-005.

A.8 Special Training/Certifications

Personnel assigned to meteorological monitoring activities will be thoroughly trained in the proper operation, calibration, and maintenance of the equipment to ensure continued collection of valid, representative data. The MSI Trinity Project Manager will document the type of training conducted and when the training was performed. This documentation is kept in MSI Trinity's personnel file by employee. These personnel have met the educational, work experience, responsibility, and training requirements for their position. Meteorological monitoring professionals with several years of experience will have responsibility for conducting the significant quality control and quality assurance activities on site.

MSI Trinity personnel will be the site operators for the Century Aluminum/Big Rivers monitoring site. These operators have been trained by MSI Trinity monitoring management in the proper operation, calibration, and maintenance of the equipment. Per MSI Trinity's Standard Operation Procedure 109, hands-on training is conducted in MSI Trinity's ambient monitoring laboratory and in the field by the Monitoring Manager or his designated experienced instrumentation specialists.

A.9 Documents and Records

The meteorological monitoring program is committed to fully documenting all activities related to data collection, analysis, validation, and reporting. Table A-8 contains a list of the records maintained by the air monitoring program. These records can be electronic, bound in notebooks, logbooks, e-logbooks, and/or forms that are used for specific applications. Copies of the field and e-logbook are kept by MSI Trinity QA personnel and are included as part of MSI Trinity's project specific file.

Table A-8 Documentation and Reports

Documentation Type	Frequency	Report Submission	Archive	Retention Period
Monitoring Data	Daily Downloads	MSI Trinity Data Manager	MSI Trinity Server (with backup)	> 5 years
QAPP	Updated as needed	MSI Trinity QA Manager (See Distribution List in A-1)	MSI Trinity	> 5 years
Copies of Field and e-Logbook	After each site visit	MSI Trinity QA personnel	MSI Trinity	> 5 years
Quarterly Reports	Quarterly	Century Aluminum/Big Rivers Corporation	MSI	> 5 years

Primary data collection at the meteorological monitoring site will be accomplished through the use of Campbell Scientific CR1000 data logger. Meteorological data will be stored in the data logger memory as 5-minute and hourly averages computed from secondly values. Remote data management will be accomplished by remotely interrogating the monitoring site from MSI Trinity's Salt Lake City office daily to maximize data recovery and identify problems in a timely manner.

MSI Trinity will host a password-protected project web-site which would be updated after every successful download. The site will contain current meteorological chart graphics, daily minimum, maximums, and averages, quality assurance station notes, and wind roses. Historical data will also be available for review from the web site.

Stacked parameter plots will be generated which consist of every data point downloaded since the last site interrogation and reviewed by a qualified meteorologist for consistency and possible problems. These data will be reviewed on a daily basis to determine if the measurements appear normal as well as identify instrumentation problems in a timely manner.

Quarterly meteorological data reports will be compiled by MSI Trinity and submitted to the Century Aluminum/Big Rivers Corporation no later than forty five (45) days of the end of each calendar quarter. The following data and quality assurance results will be contained in the quarterly summary reports:

- Monthly printouts with valid hourly and daily averages.
- Monthly, quarterly, and annual wind roses.
- Monthly and quarterly percent data recovery by parameter.
- Results of calibration (by make, model, and serial number for each sensor and reference calibration equipment) and quality control checks.
- Problems and corrective actions/resolved.
- QAPP revisions, if necessary.

QAPP revisions will be forwarded to the individuals on the distribution list in electronic or hard-copy format. MSI Trinity's QA officer will be responsible for QAPP distribution. All monitoring data, reports and project documentation will be retained by MSI Trinity for a minimum of five (5) years.

B. MEASUREMENT AND DATA ACQUISITION

This section describes the project design and implementation of the Century Aluminum/Big Rivers monitoring project, including sampling methods, sample collection, data handling and analysis, quality control requirements, equipment testing, inspection, calibration and maintenance, and managing and validating data.

B.1 Sampling Process Design

The purpose for the meteorological measurements is to provide a continuous data record of meteorological conditions in the vicinity of the Century Aluminum/Big Rivers Power Plant to characterize the meteorology of the area. Data collected at this station may also be used for dispersion modeling. The monitoring methods and equipment implemented will provide PSD quality meteorological data. All of the sensors in the system meet or exceed PSD requirements (see Table B-2). Each instrument produces a signal transmitted to the data acquisition system where it is digitized and converted to engineering units and stored in electronic memory.

The site selection criteria, as found in EPA's *Quality Assurance Handbook for Air Pollution Measurement Systems Volume IV: Meteorological Measurements Version 2.0* and *Meteorological Monitoring Guidance for Regulatory Modeling Applications* was followed in considering placement of the tower. The tower was installed at a distance beyond the influence of obstructions, such as buildings and trees. Accessibility and site security were also considered in the placement of the tower. The meteorological measurements at this location will be representative of the meteorological conditions in this area of interest. More detailed site information with a map and a photograph of the monitoring site is presented in Section A.6.

To access the Century Aluminum/Big Rivers meteorological monitoring station from Sebree, travel north on US-41 for approximately three miles then head east on KY-2097 for 0.8 miles. Head north on KY-2096 for 0.5 miles and the tower is located 300 feet to the east. Access to the tower and equipment is made via foot. MSI Trinity technicians can drive to the site in the winter months.

B.2 Sampling Monitoring Equipment and Methods Description

This section summarizes the meteorological instrumentation being used for the Century Aluminum/Big Rivers monitoring program. The operating range of the sensors easily brackets the range of environmental conditions expected at the site. The equipment manufacturer, model, and sampling height for each piece of equipment installed on the meteorological tower is presented in Table A-2. The standard operating procedures followed to calibrate and operate the equipment in Table A-2 are presented in Table B-2.

B.2.1 Meteorological Equipment Description

A brief description of each meteorological sensor installed at the Century Aluminum/Big Rivers monitoring station is discussed in this section. Full specifications for each piece of equipment can be found in Appendix A.

B.2.1.1 Wind Direction and Wind Speed

The R.M. Young Model 05305 Wind Monitor AQ is a high resolution wind sensor designed specifically for air quality applications and made of UV-stabilized plastic with stainless steel and anodized aluminum fittings. Precision grade, stainless steel ball bearings are used. Transient protection and cable terminations are in a convenient junction box.

The wind speed sensor is a four blade helicoid propeller. Propeller rotation produces an AC sine wave voltage signal with frequency directly proportional to wind speed. The starting threshold is 0.4 m/s.

The wind direction sensor is a rugged yet lightweight vane with a sufficiently low aspect ratio to assure good fidelity in fluctuating wind conditions. Vane angle is sensed by a precision potentiometer housed in a sealed chamber. With a known excitation voltage applied to the potentiometer, the output voltage is directly proportional to vane angle. A mounting orientation ring assures correct alignment of the wind direction reference when the instrument is removed for maintenance. The vane starting threshold is 0.5 m/s at 10 degrees displacement.

B.2.1.2 Temperature and Delta-Temperature

RM Young Platinum RTD Model 41342 ambient temperature sensors, to be used at the 2- and 10-meter levels, utilize a precision, extended range thermistor to measure ambient air temperature. The temperature sensor will be operated in a motor-aspirated radiation shield with flow interrupt indicators. With an NIST-traceable factory calibration, the sensor has an absolute accuracy of $\pm 0.1^{\circ}\text{C}$. The sensor accuracy for delta-T is $\pm 0.1^{\circ}\text{C}$.

Each temperature sensor will be mounted in a R.M. Young Model 43502 aspirated radiation shield. The aspirated radiation shield provides maximum sensor protection from incoming short wave and outgoing long wave radiation. The shield employs a triple walled intake tube and multiple canopy shades to effectively isolate the sensor from precipitation and solar radiation. A continuous duty DC blower provides constant flow of ambient air over the sensor.

B.2.1.3 Relative Humidity

The Rotronics HC2S3 is a rugged, accurate temperature/RH probe that is ideal for long-term, unattended applications. The HC253 uses an advanced capacitive sensor for the relative humidity measurement. The relative humidity sensor has an accuracy of $\pm 0.8\%$.

B.2.1.4 Solar Radiation

The Hukseflux LP02 is an ISO second-class pyranometer that measures solar radiation with a high quality blackened thermopile protected by a dome. The blackened thermopile provides a flat spectral response for the full scale spectrum range (305 to 2800 nm).

B.2.1.5 Net Radiation

The Kipp & Zonen NR-LITE 2 net radiometer measures the energy balance between incoming short-wave and long-wave IR radiation relative to surface reflected short-wave and outgoing long-wave IR radiation. This net radiometer includes two black conical absorbers, one facing upward and the other facing downward. Both absorbers are calibrated to an identical sensitivity coefficient. The net radiometer outputs a millivolt signal that is measured directly by the datalogger.

B.2.1.6 Barometric Pressure

The Vaisala PTB110 uses a BAROCAP sensor, a silicon capacitive absolute pressure sensor to measure barometric pressure over a 500 to 1100 millibar range.

B.2.1.7 Data Acquisition System

A Campbell Scientific CR1000 data acquisition system (DAS) is used to store data from the sensors. The DAS uses one-second data values to compute and stores 5-minute averages of temperature, delta temperature, scalar wind speed, unit vector wind direction, sigma theta of wind direction, solar and net radiation, and barometric pressure. The DAS is capable of being polled locally through a RS232 connector or remotely via modem. An on-site display allows users to view current values of the parameters being measured.

B.2.1.8 10-Meter Aluminum Tower

The meteorological sensors will be secured to a Model UT30 10-meter guyed aluminum tower. The UT30 includes a mounting base secured in concrete. Lightning protection will be mounted to the tower. The tower tilts down to ground level which eliminates the need to climb the tower for servicing.

B.2.1.9 Telecommunications

Telecommunications to the station are accomplished with a Sierra Wireless Raven modem with a Verizon wireless connection will be utilized for remote access to site datalogger to download data and check the status of on-site equipment. The site will be securely available via a password protected static IP address and be available for data collection and interrogation 24/7/365.

Table B-1 presents the equipment specifications and the PSD criteria for meteorological sensors.

Table B-1 Meteorological Equipment Specifications

Parameter	Specifications	EPA PSD Criteria	Selected Site Sensor Specifications
Wind Speed	Starting Threshold	WS $\leq$ 0.5 m/s	WS = 0.22 m/s
	Accuracy	$\pm$ 0.2 m/s	$\pm$ 0.07 m/s (0.15 mph)
	Distance Constant	$\leq$ 0.5 m @ 1.2 kg/m ³	1.5m
Wind Direction	Starting Threshold	$\leq$ 0.5 m/s @ 10 degrees	0.22 m/s
	Damping Ratio	0.4 to 0.70 @1.2 kg/m ³	0.6
	Accuracy	$\pm$ 5 degrees	$\pm$ 3 degrees
Temperature	Accuracy	$\pm$ 0.5°C	$\pm$ 0.1 °C
Vertical Temperature Difference	Accuracy	$\pm$ 0.1 °C	0.05 °C
Shield (Motor Aspirated)	Aspiration rate	>3.0 m/s	3.4 to 7.6 m/s
Relative Humidity	Accuracy	$\pm$ 7%RH	$\pm$ 2% (0 to 90% RH) $\pm$ 3% (90-100% RH)
Solar Radiation	Accuracy	$\pm$ 5%	$\pm$ 3% typical $\pm$ 5% maximum
Net Radiation	Accuracy	$\pm$ 5%	$\pm$ 5%
Barometric Pressure	Accuracy	$\pm$ 3.0 mb (0.3 kPa)	$\pm$ 0.5 mb @ +20°C $\pm$ 1.5 mb @ 0° to 40°C $\pm$ 2.0 mb @ -20° to +45°C $\pm$ 3.0 mb @ -40° to +60°C

B.2.2 Standard Operating Procedures

Standard operating procedures have been developed to provide instructions to the site operators regarding routine operation of the meteorological equipment. These SOP's range from inventory of equipment, equipment inspection and acceptance testing, visual inspections, preventive maintenance, and calibrations. Table B-2 presents the SOPs used for this program. Copies of these SOP's can be found in Appendix B.

Table B-2 Standard Operating Procedures

MSI SOP No.	Revision No. and Date	SOP Title	Regulatory Citation
SOP 69	Rev. 4 09/18/2014	Calibration and Audit Equipment Certification	1
SOP 106	Rev. 2 09/18/2014	In-House Calibration of Test Equipment	1
SOP 107	Rev. 2 09/18/2014	Equipment Inventory Procedure	NA
SOP 113	Rev 2. 09/18/2014	Visual Inspection of Meteorological Equipment	1
SOP 114	Rev. 1 10/15/2014	Data Collection and Initial Processing	1
SOP 115	Rev. 1 10/15/2014	Level 1 Data Validation	1
SOP M11	Rev 6. 09/18/2014	Wind Direction Calibration	1
SOP M12	Rev 4. 09/18/2014	Wind Speed Calibration	1
SOP M13	Rev 4. 09/18/2014	Temperature	1
SOP M15	Rev 4. 09/18/2014	Relative Humidity Calibration Procedures	1
SOP M16	Rev 4. 09/30/2014	Solar Radiation Calibration	1
SOP M17	Rev 3. 09/30/2014	Barometric Pressure Calibration	1
SOP M18	Rev. 4 10/14/2014	Net Radiation Calibration	1

¹ Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements Version 2.0 (Final).

Conditions adverse to quality will be identified promptly by the Data Manager or site technician and the Project Manager will be notified. Once an issue that is adverse to quality has been identified by the Data manager, the Project manager or his designate will troubleshoot the issue to identify the cause and the issue will be corrected as soon as possible. The Project Manager will initiate a Corrective Action Report (Appendix C) which includes the date and time when the problem was identified, the proposed corrective action to resolve the issue, and the date and time of the results of the proposed action.

B.3 Sample Handling and Custody

Not applicable.

B.4 Analytical Methods

Not applicable.

B.5 Quality Control Requirements

This section describes the routine quality control procedures used for the Century Aluminum/Big Rivers meteorological monitoring program. All procedures have been specifically designed to provide the appropriate quality control and ensure that valid data recovery meets or exceeds the data recovery requirements of 90 percent per quarter for meteorological parameters.

The meteorological monitoring program will follow the quality control guidelines as stated in the following documents:

- *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements*, March 2008; and
- *Meteorological Monitoring Guidance for Regulatory Modeling Applications*, 2000.

Table B-3 presents quality control procedures and frequency.

Table B-3 Quality Control Procedures

Procedure	Frequency	Requirement
1. Visual Inspection of Equipment	Routine or Emergency Site Visits	Meets MQO (Table A-5)
2. Remote interrogation of monitoring station and inspection of data	Daily	QC Checks for data screening (Section B.10)
3. Routine calibration	Semi-annually	Meets MQO (Table A-5)
4. Calibration reference standard certification	Annually	NIST-traceable or A2LA, if applicable
5. Equipment Maintenance	Annually or as needed	Section B.5.8
6. Personnel Training	On-going	MSI SOP 109
7. Data validation	Daily and monthly	Electronic data screening Time/Parameter Plot visual check
	Quarterly	Data processing calculation check Missing data confirmed Off-line periods confirmed Data validation checklist

B.5.1 Visual Inspection of Equipment

The meteorological equipment is mounted on a 10-meter tower. Visual inspections of the tower will be performed semi-annually by the site technician. Maintenance will be performed as needed. A site check form will be completed during each visit. A sample Site Check Form is found in Appendix D.

B.5.2 Remote Interrogation of Monitoring Station and Inspection of Data

The DAS at the Century Aluminum/Big Rivers site will be interrogated daily via modem to download and process the data. Computerized inspection and visual inspection of these data will be performed daily using an outlier program. Values that fall outside of prescribed limits will be evaluated by a qualified air quality specialist or meteorologist and corrections to data will be documented. Abnormal data values or problems will be reported as soon as possible to the Project Manager and Project Quality Assurance Manager who will initiate corrective action and determine if a special site visit is required.

Should corrective action be necessary, the Project Manager will initiate the process by preparing a Corrective Action Form to document the issue, time of discovery, the affected measured parameters, and the recommended course of action. The Project Manager will notify project participants via email or telecommunications of any planned corrective action that cannot be immediately resolved and may result in data loss. A copy of the Correction Action Form is presented in Appendix C.

The Project Manager will be responsible for verifying that corrective actions are appropriate and were performed correctly and in a timely manner. The Project Manager is responsible for maintaining and tracking the Corrective Action Form to document completion of work. All final Corrective Actions Forms will be signed by the Project manager once all work is completed. Copies of the completed Corrective Action Forms will be included in the quarterly data summaries.

B.5.3 Equipment Calibration

Meteorological equipment calibrations will be performed when problems are noted and semi-annually. Sensors which do not meet calibration specifications or fail performance audits will be repaired and recalibrated.

B.5.4 Calibration Reference Standard Certification

Reference standards used for calibration of meteorological sensors will be certified annually and will be traceable to National Institute of Standards and Technology (NIST) standards. Calibration certificates are on file at MSI Trinity's office and are included with each calibration report. Reference standards will be certified over the ambient measurement range expected at the Century Aluminum/Big Rivers monitoring station.

B.5.5 Equipment Maintenance

Manufacturer's recommendations for maintenance of the meteorological sensors will be followed. Instrument instruction manuals are available for reference of preventive and remedial maintenance procedures. Preventive and corrective maintenance will be documented on the calibration forms completed immediately after any maintenance.

B.5.6 Personnel Training

Personnel operating the meteorological equipment will be thoroughly trained in the proper operation, calibration, and maintenance of the equipment to ensure continued collection of valid, representative data.

B.5.7 Data Validation Criteria

The criteria presented in Table A-7 are deemed critical to maintaining the integrity of the data. Data that do not meet the verification/calibration and accuracy criteria will be invalidated unless compelling reason or justifications exist for not doing so. The cause for not operating within the acceptable range will be investigated and corrective action taken to remedy the problem such that additional data will be invalidated. The Project Manager will be alerted by the Data Manager or site technician when critical criteria are exceeded. Project Manager will notify Century Aluminum/Big Rivers when critical criteria are exceeded causing data to be invalidated.

B.6 Instrument/Equipment Testing, Inspection and Maintenance

The procedures to be followed for equipment testing, inspection, and maintenance are discussed below.

B.6.1 Acceptance Testing of Instrumentation and Equipment Integration

Prior to installation, acceptance testing of instrumentation will be performed to verify that the instruments meet the required US EPA performance specifications. Sensors that fail to meet specifications will be returned to the manufacturer. After installation, the meteorological sensors are calibrated according to the procedures presented in each respective operating manual. To ensure that the meteorological equipment continue to operate properly during monitoring, checks of the instruments will be conducted during each site visit or at least semi-annually. Preventive maintenance and quality assurance procedures will be conducted on a routine basis.

B.6.2 Site Surveillance and System Check Procedures

At least semi-annually or as needed, a site technician will visit the monitoring station to inspect the meteorological tower and sensors. During each site visit, entries will be made in the site logbook or in an e-logbook documenting all site activities conducted. These entries will include the date of the visit, reason for the visit, and the maintenance or calibration activities performed. If changes are made to the equipment or configuration of the system, these changes will also be entered in the site logbook. Entries will be made when: (1) sensors are replaced, or (2) any change is made to the station's configuration.

Personnel operating the meteorological equipment are thoroughly trained in the proper operation, calibration, and maintenance of the equipment to ensure continued collection of valid, representative data.

B.6.3 Site and Equipment Maintenance

Manufacturer's recommendations for maintenance of the sensors will be followed, as required. Preventative and corrective maintenance will be documented on the calibration forms completed immediately after any maintenance. The routine maintenance to be performed at the Century Aluminum/Big Rivers monitoring site is presented in Table B-4.

Table B-4 Routine Maintenance

Item	Schedule
Wind Monitor AQ	
Wind Speed Bearings Replacement	Biannually or As needed
Wind Direction Bearings Replacement	Biannually or As needed
Wind Direction Potentiometer Replacement	As Needed
Carbon Fiber Propeller Replacement	As Needed
Motor Aspirated Temperature	
Blower Motor Replacement	As needed
Solar Radiation Sensor	
Dome Cleaning	Biannually or As Needed
Relative Humidity	
Particulate Filter & Cap Cleaning or Replacement	As Needed

Additional maintenance to be performed on the relative humidity sensor semi-annually or more frequently, as needed, includes: (1) checking to see if the radiation shield is free of debris; (2) the black screen at the end of the sensor is checked for contaminants; and (3) the Teflon membrane filter checked and cleaned, if necessary, for contaminant buildup. Preventive and corrective maintenance will be documented. The guy wires will be inspected during each site visit. Guy anchors will be checked at least annually.

B.6.4 Spare Parts

Spare parts, such as bearings, cups, and propellers, will be retained and stored at MSI Trinity in a secure area in case they are needed.

B.7 Instrument/Equipment Calibration and Frequency

B.7.1 Meteorological Calibration Procedures

Meteorological equipment calibrations will be performed semi-annually with equipment that is in current calibration and is traceable to NIST or A2LA standards. Sensors which do not meet calibration specifications or fail performance audits will be repaired and re-calibrated. Calibration certifications and records remain on file at MSI Trinity's Salt Lake City office. Calibration procedures for the meteorological sensors are presented below. Standard Operating Procedures for meteorological sensor calibration are provided in Appendix E.

B.7.1.1 Wind Direction

The cross arm orientation will be checked using a professional compass. The wind vane will be aligned with the cross arm and set to true north. True north is distinguished from magnetic north by reading a magnetic compass and applying a correction factor for the magnetic declination. The declination will be determined from a declination calculation computer program. If the overall wind direction error (orientation plus linearity) exceeds ± 5 degrees from true North, the sensor will be re-calibrated.

The wind direction sensor starting threshold will be checked using a torque gauge. The torque gauge is placed on the sensor shaft and the torque is measured. If the sensor starting threshold is greater than 0.5 meters per second (m/s), the bearings will be replaced and the sensor will be re-calibrated.

The wind direction linearity will be checked using a direction template. The sensor response will be checked at a minimum at 30 degree increments in both clockwise and counterclockwise rotations and compared with the DAS readings. If the indicated wind direction linearity plus orientation error exceeds ± 5 degrees, the sensor will be repaired and re-calibrated.

B.7.1.2 Horizontal Wind Speed

Horizontal wind speed response checks will be performed using a synchronous motor. Sensor readings taken from the DAS will be compared to calibration values obtained from transfer functions provided in the sensor manufacturer's specifications. If the horizontal wind speed error exceeds ± 0.20 m/s, then the instrument will be recalibrated.

The horizontal wind speed sensor starting threshold will be checked using a torque gauge or a torque disc. The torque device is placed on the sensor shaft and the torque is measured. If the measured torque exceeds manufacturer's tolerance specifications for wind speed sensor starting threshold of 0.5 m/s, then the bearings will be replaced and the instrument will be recalibrated.

B.7.1.3 Temperature

Temperature sensor calibration will be verified by direct comparison of sensor outputs to a collocated calibrated reference standard thermometer encompassing the measurement range expected at that particular site. If the sensor output is more than 0.5 degrees Centigrade (°C) different from the reference, the sensor will be repaired and re-calibrated. Sensors at different levels will be checked simultaneously in the same medium so that the delta temperature (ΔT) function can be verified.

If the vertical temperature difference differs by more than 0.1°C for 2-10 meters, the sensors will be repaired/replaced and re-calibrated.

B.7.1.4 Relative Humidity

The relative humidity sensor calibration will be verified by comparison of station sensor outputs with a relative humidity reference sensor collocated at ambient conditions. If the site sensor output differs by more than ± 7 percent relative humidity from the reference, the sensor will be recalibrated.

B.7.1.5 Solar Radiation

The solar radiation pyranometer outputs will be verified by collocation of a calibrated pyranometer adjacent to the system sensor. Readings from the reference pyranometer will be compared directly to the site's pyranometer readings recorded on the DAS. If the sensor output differs by more than $\pm 5\%$ from the reference, the sensor will be recalibrated.

B.7.1.6 Net Radiation

Net radiation outputs will be verified by collocation of a calibrated net radiometer adjacent to the system sensor. Readings from the reference pyranometer will be compared directly to the site's net radiometer's readings recorded on the DAS. If the sensor output differs by more than $\pm 5\%$ from the reference, the sensor will be recalibrated.

B.7.1.7 Barometric Pressure

The barometric pressure sensor calibration will be verified by collocation of a certified reference barometer and comparing the reference output with sensor outputs recorded on the data acquisition system. If the site sensor output differs from the reference by more than ± 3 mb, the sensor will be recalibrated.

The equipment used to perform meteorological sensor calibrations is listed in Table B-5.

Table B-5 Meteorological Calibration Equipment

Parameter	Equipment	Serial Number
Wind Direction	Brunton Model 5008 Pocket Transit RM Young Model 18331 Vane Torque Gauge Met One Model 040 Direction Template	5081005174 NA DIR 06
Wind Speed	RM Young Model 18802 Anemometer Drive RM Young Torque Disc Model 18310	CA02014 NA
Temperature (2 and 10 meter)	Brooklyn Digital Model 6661S Thermometer	C466800
Barometric Pressure	Vaisala Model PTB110	G0770046
Solar Radiation	LiCor Model 200X	PY56373
Net Radiation	REBS Q-7.1	Q01013
Relative Humidity	Vaisala HMP45AC	W1630084

B.7.2 Calibration Forms

Meteorological sensor calibration forms are included in Appendices D.

B.7.3 Calibration Frequency

Meteorological instrument calibrations will be performed semi-annually and whenever an instrument exceeds specified control limits or undergoes major maintenance or repair. If a sensor fails a performance audit, calibration verification will be documented and then it will be replaced or repaired and re-calibrated. If possible, an as found calibration checks will be documented and then an after maintenance calibration check will follow.

B.8 Inspection/Acceptance of Supplies and Consumables

Spare parts will be purchased only from the instrumentation manufacturer. They will be inspected by MSI Trinity's Project Manager for shipping damage upon receipt. The use of spare parts will be documented on calibration forms.

B.9 Non-direct Measurements

To insure accuracy of the measurements, measuring and test equipment will be calibrated against verified instruments having known relationships to nationally recognized standards. For example, reference standards used for calibration of meteorological instrumentation will be traceable to NIST standards. Barometric pressure sensors may be verified against location National Weather Service reference aneroid barometers.

Sigma theta will be calculated by the data logger using the Yamartino Method. The site location will be verified with a GPS.

B.10 Data Management

The proper management of all data is critical to assuring the quality and usability of the monitoring results. As such, procedures have been implemented to ensure robust data acquisition, validation, reduction, reporting, and storage of electronic data. Meteorological monitoring data will be recorded and stored on site using a Campbell Scientific CR1000 data logger. Meteorological data will be retrieved from the monitoring site daily via cellular modem. The modem can be called from any computer having the correct software and the IP address.

All electronic calculations and statistical analyses will be performed using standard software (Microsoft Excel) that can be easily verified. All project documentation, records, data, and reports will be stored for at least five years following project completion. The data are stored on a personal computer at MSI Trinity which is backed up to a network storage unit nightly and will be archived at two separate locations.

Meteorological data will be reviewed routinely by the MSI Trinity Data Manager and by the project meteorologist assigned to this project. These data will be subjected to several levels of quality control, validation and quality assurance as discussed in Section D. Validated data are compiled into the final database for further analysis and report preparation. The final database is processed and stored on a personal computer and then archived on various storage media and maintained in duplicate in more than one location for protection.

The Data Manager will archive data on MSI Trinity's network and on storage hard drives which are stored off-site. The overall flow of data management is illustrated in Figure B.1.

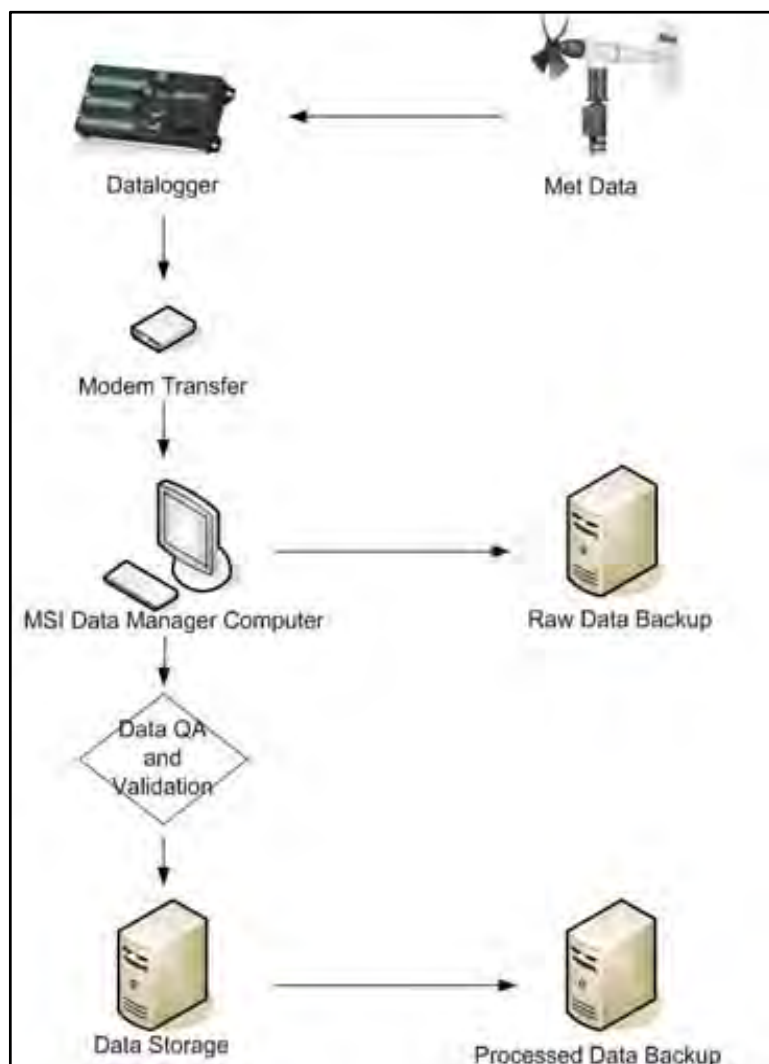


Figure B.1 Data Management Flow Chart

The meteorological data will be summarized in monthly tables and reported quarterly. The quarterly report will conform to EPA guidance.

B.10.1 Data Retrieval

Data is retrieved from the site by connecting to the DAS via remote telemetry.

B.10.2 Raw Data

Raw data are records, notes, memoranda, worksheets or exact copies and are the result of original observations and activities of the monitoring project. Raw data include data from the DAS and data entered directly into a system.

B.10.3 Data Transfer

The sensors produce an analog voltage that is collected by a DAS and averaged for a particular time period. The data are stored on a network and are validated quarterly.

B.10.4 DAS Data Review

Data review is performed by a meteorologist. The review of the data includes reviewing the calibration information, hourly data, and recording any information that might be vital to proper review of the data. Information used in the review and which may be used to invalidate data are input to Excel spreadsheets. This spreadsheet contains data and time of suspect data by parameter, potential reason for data being suspect, and any pertinent comments that relate to this data value.

The data report QA checklist is also used which is presented in Appendix F. This list provides a reminder for the reviewing meteorologist to verify missing data periods, percent data recovery, data table calculations, to name a few. Data review also includes documentation of suspect data or invalidations that occurred.

B.10.5 Data Validation

Data validation ensures that data processing operations have been carried out correctly and that the quality of field operations has been performed properly and in accordance with written procedures. Once data validation has identified problems, the data can be corrected, flagged or invalidated and correction actions can be taken when necessary. In the event of a failed audit or out of range calibration, the meteorologist will be responsible for checking or invalidating data. Data validation procedures are described in detail in Section D.

B.10.6 Data Transmittal

Data transmittal occurs when data are transferred from one location to another or from one person or group to another. An example of data transfer is the electronic transfer of data over a telephone or computer network.

B.10.7 Data Processing

Data processing includes the aggregating and summarizing of results so they can be easily understood and interpreted in various ways. EPA requires that meteorological data be reported on a regular basis.

B.10.8 Data Flagging

Data will be flagged if a numeric result was available but it has been qualified in some respect related to the validity of the result. Null data codes will be generated for invalid data. See Section D.2.3 for details on data flagging.

B.10.9 Data Storage and Retrieval

Electronic copies of the data will be stored at MSI Trinity's office in Salt Lake City.

C. ASSESSMENTS AND OVERSIGHT

C.1 Assessments and Response Actions

Performance audits of the meteorological sensors will be conducted semi-annually by MSI Trinity's independent auditor. Performance audits for the meteorological sensors will be conducted by challenging the sensors with known inputs or collocating audit meteorological sensors with those being used for the monitoring program. Performance audits will serve the monitoring program with a measure of quality assurance for meteorological sensors and a means to produce a defensible data set. Audit procedures and techniques will follow established EPA audit guidelines.

C.1.1 Data Quality Audits

Data review is conducted daily utilizing electronic and visual scanning to identify outliers and determine whether data are reasonable and representative. The systems audit includes a confirmation of the integrity of transmitted data from sensor outputs to data reporting.

C.1.2 Corrective Actions

All deficiencies identified during routine data surveillance, performance audits and/or site surveillances will be documented and reported to the Project Manager no later than one working day of discovery and, depending on the nature of the deficiency, corrective action will be made no later than seven working days of the notification. The corrective action report will be initiated by MSI Trinity's Data Manager or MSI Trinity's Project Manager. The Data Manager will report to MSI Trinity's Project Manager when corrective action has been completed and the issue resolved.

Corrective actions to deficiencies will be addressed and documented in the station logbook and on a Corrective Action Report. Follow-up action shall be taken to verify implementation of the corrective action. A corrective action report form will be filled out that identified the problem or deficiency, the proposed corrective action, and the results of the corrective action. MSI Trinity's Project Manager will verify corrective actions and sign off on the completion of the work. MSI Trinity's Project Manager will notify the Century Aluminum/Big Rivers environmental managers when the work has been completed to resolve the issue that needed to be corrected. An example copy of a Corrective Action Report is presented in Appendix C.

C.1.3 QAPP Revisions

The QAPP will be revised any time there are significant changes to the program and will be submitted to the Century Aluminum/Big Rivers for review and approval. If the QAPP spans more than one year, the QAPP will be reviewed annually, with new signatures acquired. If there are no significant changes, an annual review will be conducted and will be documented by Century Aluminum/Big Rivers.

QAPP revisions will be forwarded to the individuals on the distribution list in electronic or hard-copy format. New signatures will be obtained for each revision. MSI Trinity's Project Manager will alert MSI Trinity's QA officer when significant changes are made to the program. MSI Trinity's QA officer will be responsible for revising and distributing the QAPP.

C.2 Reports to Management

MSI Trinity Project Manager is responsible for overseeing the completion of any reports and distribution of the reports and data to Century Aluminum/Big Rivers. A summary of the reports to be generated is presented in Table C-1.

Table C-1 Reports to Management

Reports	Frequency	Content	Responsible Position/ Individual	Distribution
Quarterly Summaries	Quarterly	Summarize Data for Quarterly Summaries	MSI Trinity Data Manager Scott Adamson	See Section A.3 Distribution List
Corrective Action Reports	As Needed	Summarizes Corrective Actions Taken to Return the Meteorological Monitoring Station into Compliant Status	MSI Trinity Project Manager Casey Lenhart	See Section A.3 Distribution List
Response to Corrective Action Reports	As Needed	Reports the results of the Corrective Actions Taken	MSI Trinity Program Manager George Wilkerson	See Section A.3 Distribution List
Performance Audit Reports	Quarterly	Reports the results of the Quality Assurance Performance Audits	Independent auditor	See Section A.3 Distribution List

Quarterly summaries will be submitted to Century Aluminum/Big Rivers by MSI's Project Manager within 60 days of the end of the monitoring quarter. The quarterly reports will detail the operation of the meteorological monitoring activities as well as any maintenance and service work performed. These reports will contain: (1) detailed data summaries for each monitoring parameter; (2) a summary of any problems encountered, the status of any current problems, and the corrective action taken; (3) a summary of any meetings or correspondence; (4) a synopsis of percent recovery including brief explanations of missing data; (5) overall data recovery; (6) quality control; and (7) all quality assurance documentation.

D. DATA VALIDATION AND USABILITY

D.1 Data Review, Validation, and Verification Requirements

The criteria and process for determining the validity of meteorological data will be based on the US EPA *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV (March 2008)*, and US EPA's *Meteorological Monitoring Guidance for Regulatory Modeling Applications (February 2000)*, including recommended system accuracies and response characteristics for meteorological sensors and other applicable US EPA guidance.

The MSI Trinity Project Manager and site technicians are responsible for verifying proper operation of the meteorological monitoring equipment. During each quarter, the data will be reviewed again by a qualified meteorologist appointed by the QA Manager to ensure that the data are complete, accurate, and representative and that erroneous data have been removed in preparation for the final data report.

MSI Trinity has developed and implemented software which conducts live inspection of monitoring site data. The program is called MSI Trinity Data Scanning and Alert System (DSAS) and is used as a tool to assist MSI Trinity staff identify data outliers, problems with site equipment, or site communication issues. Once every minute, MSI Trinity DSAS scans all raw data files downloaded from the monitoring site to see if new data have arrived for interrogation. Data downloaded from the samplers are one-hour averages.

After the data collection, MSI Trinity DSAS conducts a computerized inspection of the data using pre-defined quality control checks. The quality control checks include data outliers, spikes in data, and data constancy. If parameters fail these tests, the parameter is flagged in the software and MSI Trinity staff is alerted.

A user interface for the MSI Trinity DSAS software was developed for visual and audio cues to alert MSI Trinity staff when a parameter fails a quality control check. The user interface is displayed on a touchscreen monitor near MSI Trinity's data management section. The user interface displays a matrix listing all the meteorological and air quality stations in rows as well as associated parameters listed in columns. Each cell represents a parameter being measured at a monitoring site and will be colored with green, yellow, orange, or red depending on the severity of the failure. For example, a green cell indicates no problems were detected. To analyze the failure indicated by the visual cue (red for example), MSI Trinity staff are able to click on the indicated cell to get specific details of the error or double click the cell to look at plots of the data.

The Data Manager will routinely check for irregularities during the daily data review. Data review includes evaluation of the raw data, maintenance records, calibration and audit data. Any abnormalities in the data will be flagged and noted on the appropriate checklists. Any suspect data will be brought to the attention of the Project Manager as soon as possible. All other documentation pertaining to the project (i.e. station logs, field notes, calibration and audit sheets) will be reviewed to insure that erroneous data are identified and removed, as necessary from the final data set.

Calibration procedures for the meteorological equipment are presented in Section B.7 of this QAPP. For the meteorological data, data will be considered valid when the system response indicated precision, bias and accuracy goals are being achieved.

D.1.1 Data Acceptance Limits for Meteorological Parameters Based on Audits

In accordance with data acceptance criteria established by the EPA, data will be acceptable if quality assurance performance audits show the following results for accuracy:

- > The wind direction error (orientation plus linearity) does not exceed ± 5 degrees from true north, and the sensor starting threshold is less than 0.50 m/s wind speed;
- > The horizontal wind speed average absolute error does not exceed ± 0.20 m/s. The sensor starting threshold must be less than 0.50 m/s wind speed for horizontal wind speed;
- > The ambient absolute temperature sensor average absolute error does not exceed $\pm 1.0^\circ\text{C}$;
- > Vertical temperature difference cannot exceed the required $\pm 0.1^\circ\text{C}$ for 2-10 meter when the sensors are placed in the same medium;
- > The barometric pressure sensor average absolute error does not exceed the acceptable tolerance of ± 3 mb;
- > Solar radiation sensor average percent difference does not exceed the acceptable tolerance of the greater $\pm 5\%$;
- > Relative humidity sensor absolute average percent difference does not exceed the acceptable tolerance of $\pm 7\%$ relative humidity; and,
- > Net radiation sensor average percent difference does not exceed the acceptable tolerance of the greater $\pm 5\%$.

The sampling frequency will be one second for all meteorological parameters.

D.2 Data Validation and Verification Methods

Meteorological data will be stored by a CSI CR1000 data logger. Data will be stored in the data logger memory as five-minute and hourly averages computed from secondly values. Data validation will be performed on the hourly average data. An hourly average will be computed when at least nine five-minute averages are available for the hour.

The MSI Trinity Project Manager, Data Manager and QA Manager are responsible for verifying the proper operation of the meteorological equipment by reviewing calibration records, audit results, and field notes from the site technicians prior to formal acceptance of these data. The Project and Data Managers will use the validation templates (Section B.5) to ensure that the reported data meets the appropriate data quality objectives.

D.2.1 Level 0 Data Validation

Level 0 data validation is essentially raw data obtained directly from the data acquisition systems in the field. These data have not received any adjustments for known biases or problems that may have been identified during preventive maintenance checks or audits. Level 0 data validation is accomplished by:

- > Collecting data via modem, and
- > Initially screening the daily data for anomalies using MSI Trinity's QC software (Section D.2.2).

Stacked parameter plots will be generated which consist of every data point downloaded since the last site interrogation and reviewed by a qualified meteorologist or air monitoring specialist for consistency and possible problems. This redundancy assures that problems that might go unnoticed by the software will always be caught by the reviewer.

To aid in data validation, a password-protected project web-site will be hosted which will be updated daily. The site contains 24-hour meteorological chart graphics, daily minimum, maximums, and averages, quality assurance reports and wind roses. Historical data can also be reviewed at this web-site. Figures D.1 and D.2 present examples of these graphics. By using this approach, data collection percentages are greatly enhanced and data management personnel can quickly note and resolve any potential instrumentation problems.

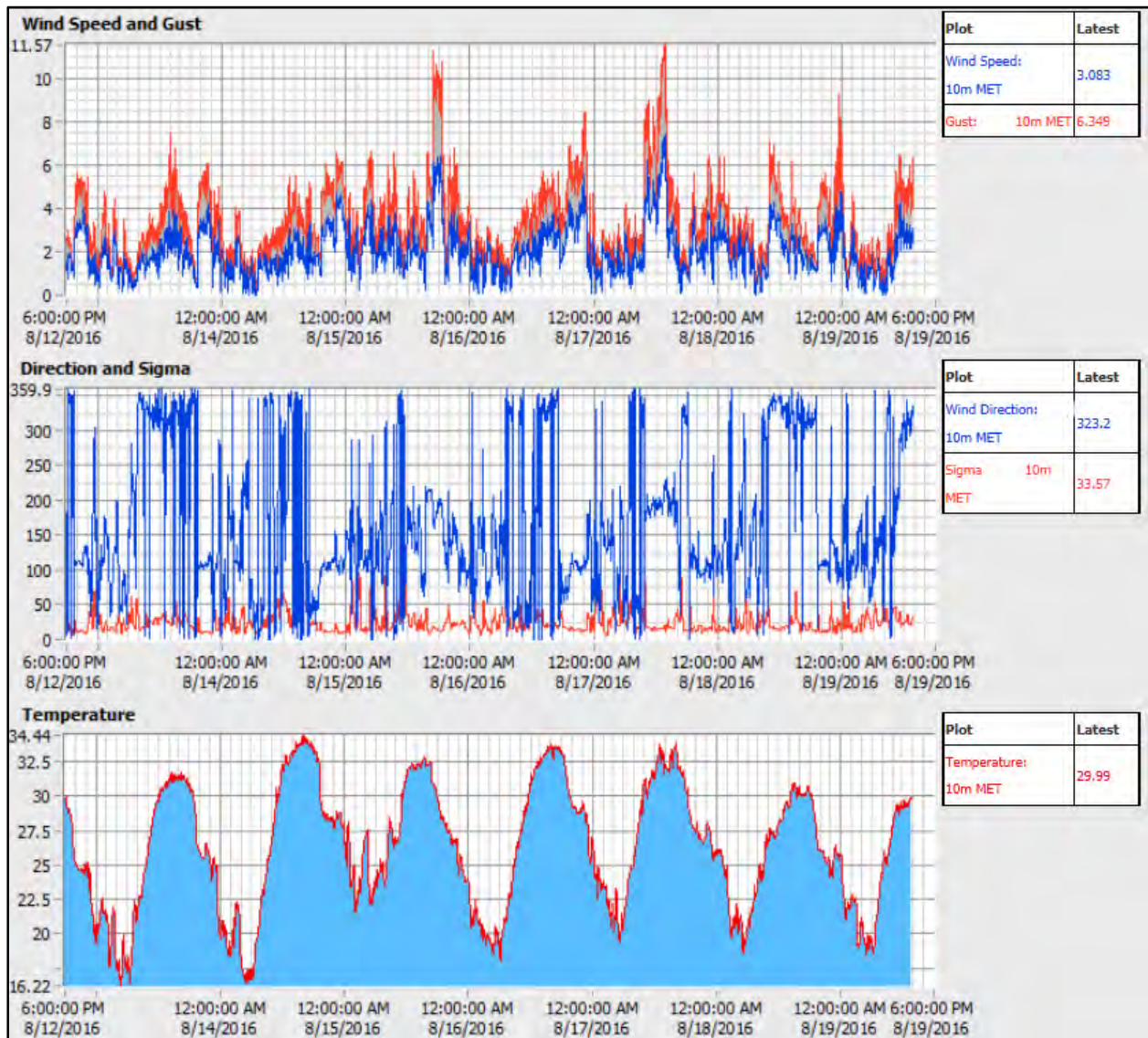


Figure D.1 Example Real-Time Wind and Temperature Display

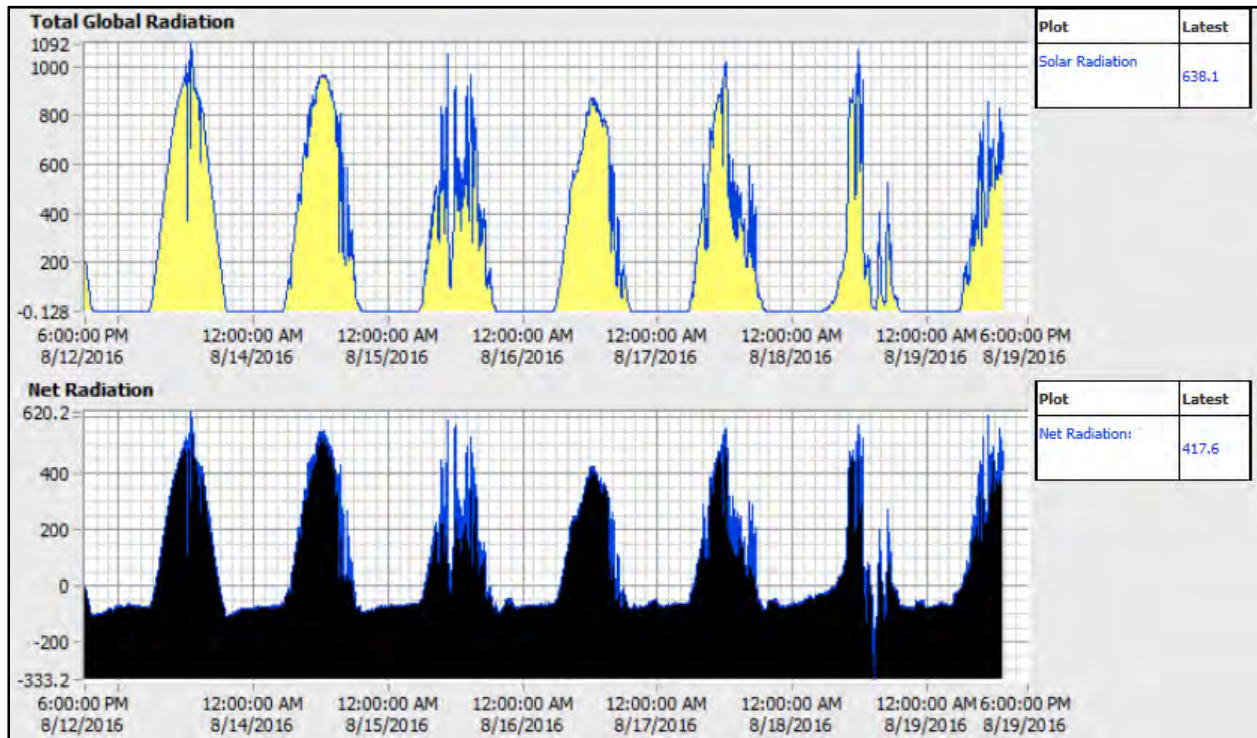


Figure D.2 Example Real-Time Solar and Net Radiation Display

D.2.2 Quality Control Checks for Data Validation

Once data are downloaded via modem, they will be subjected to a series of quality control checks by a software package. The software package performs extensive quality control checks of the data, generates a data summary report which lists means, maximums, minimums, time of occurrence, data values which fall outside of prescribed ranges, periods of constant values, and periods of rapid value changes. This software uses selected data flagging criteria. Example criteria that will cause a data flag in the meteorological data include:

- > Wind speed >25 m/s for a 5-minute average;
- > Temperature change exceeds 4°C in a 5-minute period;
- > Time increments greater than 5 minutes between data records;
- > Ambient temperature exceeds 35°C;
- > Ambient temperature falls below -30°C;
- > Delta temperature <-2°C or > 4°C;
- > Wind direction unchanged for 1 or more hours;
- > Horizontal wind speed unchanged for 1 or more hours;
- > Temperature unchanged for 1 or more hours;
- > Temperature difference >7°C or <-1.5°C;
- > Battery voltage <11 volts;
- > Change in pressure more than 1 mb in 5 minutes;
- > Solar radiation <-5 watts/m²;
- > Solar radiation >1600 watts/m²;
- > Relative humidity >100%;
- > Relative humidity <5%;

- > Pressure is >795 mb; and,
- > Pressure is <765 mb.

These criteria may be adjusted as data are collected to more accurately encompass site-specific conditions.

The QA Manager or her designates will be responsible for performing the verification/validation actions. The quality assurance software is used to generate flags or warnings that the parameter value is outside of a normally acceptable range. The outlier program does not invalidate data or erase file records on the basis of these outlier tests. Raw data files are never modified and are archived. It will be left to a qualified meteorologist to review the results of the outlier program in conjunction with the data parameter plots and initiate corrective actions if warranted (site visit or data invalidation).

D.2.3 Level 1 Data Validation

After the QC software is run, visual inspection of the data are performed to identify suspect data values that warrant further investigation. These values will be flagged by the Data Manager. Final data validation will be performed by the QA Manager or her designates who have the necessary skills and training to perform this task.

Per EPA's Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, EPA recommends the use of flags or result qualifiers to identify potential problems with data (or a sample). According to EPA, a flag is an indicator of the fact and the reason that a data value (a) did not produce a numeric result, (b) produced a numeric result but it is qualified in some respect relating to the type or validity of the result, or (c) produced a numeric result but for administrative reasons is not to be reported outside the organization.

Thus, quality control flags and codes, consisting of a letter and value will be assigned to each datum to indicate its quality. Multiple flags will be applied to each invalid data point such as data invalid due to calibration. Table D-1 presents the data flags and codes that will be applied to the data.

Table D-1 Data Flags

Flag	Code	Description
V	0	Valid
C	1	Corrected or Estimated
S	7	Suspect: data appears to be a data spike or outside normal data range
I	8	Invalid data
M	9999	Missing data: measurement not taken
BJ	9963	Operator Error
AC	9969	Construction in Area
AL	9978	Voided by Operator
AM	9979	Miscellaneous Void
AN	9980	Instrument Malfunction
AP	9982	Vandalism
AQ	9983	Collection Failure
AS	9985	Poor QA Results
AT	9986	Calibration
AV	9988	Power Failure
AW	9989	Wildlife Damage
AZ	9992	QC Audit
BA	9993	Maintenance
BB	9994	Unable to Reach Site
BC	9995	Multi-Point Calibration

To assist in data validation, a copy of the site logbook will be examined to confirm periods when instrumentation may have been off-line due to power outages, maintenance or repair, audits, or other quality assurance activities. Significant events will be checked against the graphs for consistency.

Especially high values will be checked to be sure that audit or calibration data were not inadvertently included. Suspect data will be reported but flagged as suspect. Missing data will be left missing.

It is important to maintain detailed, accurate records of changes to the data. The justification for all data invalidations will be permanently documented in a data validation summary spreadsheet. Suspect data will also be documented on a Quality Assurance/Data Validation Log (Appendix F).

D.2.4 Minimum Acceptable Data Recovery Percentage

To be considered valid, each hour of meteorological data must consist of at least 45 minutes of valid data. Data recovery for meteorological parameters will be 90 percent per quarter⁴.

⁴ EPA, Meteorological Monitoring Guidance for Regulatory Modeling Applications, EPA-454/R-99-005, Feb. 2000.

D.2.5 Data Report QA Checklist

As part of the data validation process to prepare data for reports, report table content versus data files, missing data, off-line periods, percent data recovery and mathematical calculations are routinely verified. Cross-checks are documented on the Data Report QA Checklist presented in Appendix F.

D. 3 Reconciliation with User Requirements

The primary objective of the Century Aluminum/Big Rivers meteorological monitoring station will be used to gather meteorological data to provide accurate and representative meteorological conditions around the Century Aluminum/Big Rivers facilities. Following the procedures described in this QAPP will ensure that the data quality objectives are met and the data will be representative of local meteorological conditions and be of acceptable PSD quality accuracy, precision and completeness.

APPENDIX A

Meteorological Equipment Specifications

wind

High Performance Wind Sensor



Model 05103
Wind Monitor

The Wind Monitor is a high performance, rugged wind sensor. Its simplicity and corrosion-resistant construction make it ideal for a wide range of wind measuring applications.

The wind speed sensor is a four blade helicoid propeller. Propeller rotation produces an AC sine wave voltage signal with frequency directly proportional to wind speed. Slip rings and brushes are eliminated for increased reliability.

The wind direction sensor is a rugged yet lightweight vane with a sufficiently low aspect ratio to assure good fidelity in fluctuating wind conditions. Vane angle is sensed by a precision potentiometer housed in a sealed chamber. With a known excitation voltage applied to the potentiometer, the output voltage is directly proportional to vane angle. A mounting orientation ring assures correct realignment of the wind direction reference when the instrument is removed for maintenance.

The instrument is made of UV stabilized plastic with stainless steel and anodized aluminum fittings. Precision grade, stainless steel ball bearings are used. Transient protection and cable terminations are in a convenient junction box. The instrument mounts on standard 1 inch pipe.



For offshore and marine use, **Model 05106, Wind Monitor-MA** features special waterproof bearing lubricant and a sealed, heavy duty cable pigtail in place of the standard junction box. Separate signal conditioning for voltage or current outputs is available.

The Wind Monitor is available with two additional output signal options. **Model 05103V** offers calibrated 0-5 VDC outputs, convenient for use with many dataloggers. **Model 05103L** provides a calibrated 4-20 mA current signal for each channel, useful in high noise areas or for long cables (up to several kilometers). Signal conditioning electronics are integrated into the sensor junction box.



Specifications

Range:

Wind speed: 0-100 m/s (224 mph)
Azimuth: 360° mechanical, 355° electrical (5° open)

Accuracy:

Wind speed: ± 0.3 m/s (0.6 mph) or 1% of reading
Wind direction: ± 3 degrees

Threshold:*

Propeller: 1.0 m/s (2.2 mph)
1.1 m/s (2.4 mph) 05106
Vane: 1.1 m/s (2.4 mph) 05103

Dynamic Response:*

Propeller distance constant (63% recovery) 2.7 m (8.9 ft)
Vane delay distance (50% recovery) 1.3 m (4.3 ft)
Damping ratio: 0.3
Damped natural wavelength: 7.4 m (24.3 ft)
Undamped natural wavelength: 7.2 m (23.6 ft)

Signal Output:

Wind speed: magnetically induced AC voltage, 3 pulses per revolution. 1800 rpm (90 Hz) = 8.8 m/s (19.7 mph)
Azimuth: analog DC voltage from conductive plastic potentiometer – resistance 10K Ω , linearity 0.25%, life expectancy – 50 million revolutions

Power Requirement:

Potentiometer excitation: 15 VDC maximum

Dimensions:

Overall height: 37 cm (14.6 in)
Overall length: 55 cm (21.7 in)
Propeller: 18 cm (7 in) diameter
Mounting: 34 mm (1.34 in) diameter (standard 1 inch pipe)

Weight:

Sensor weight: 1.0 kg (2.2 lbs)
Shipping weight: 2.3 kg (5 lbs)

**Nominal values, determined in accordance with ASTM standard procedures.*

MODEL 05103V 0-5 VDC outputs

Power Requirement:

8-24 VDC (5 mA @ 12 VDC)

Operating Temperature:

-50 to 50° C

Output Signals:

0-5.00 VDC full scale

MODEL 05103L 4-20 mA outputs

Power Requirement:

8-30 VDC (40 mA max.)

Operating Temperature:

-50 to 50° C

Output Signals:

4-20 mA full scale

CE Complies with applicable CE directives.
Specifications subject to change without notice.

Ordering Information

MODEL

WIND MONITOR	05103
WIND MONITOR 0-5 VDC OUTPUTS	05103V
WIND MONITOR 4-20 mA OUTPUTS	05103L
WIND MONITOR-MA (MARINE MODEL)	05106
WIND SENSOR INTERFACE (FOR USE WITH 05106) 0-5 VDC	05603C
WIND LINE DRIVER (FOR USE WITH 05106) 4-20 mA	05631C



R.M. YOUNG COMPANY

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Traverse City, Michigan 49686 USA
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E-mail: met.sales@youngusa.com
Web Site: www.youngusa.com



MODEL 41342 PLATINUM TEMPERATURE PROBE

INSTRUCTION SHEET 41342-90
REV B062309

INTRODUCTION

The Model 41342 Platinum Temperature Probe is an accurate 1000 ohm Platinum RTD temperature sensor mounted in a weatherproof junction box. The probe is designed for easy installation in YOUNG Multi-plate and Aspirated Radiation Shields.

INSTALLATION

For accurate measurements, the temperature probe should be installed in a protective radiation shield. Use of the probe without a radiation shield may result in large errors due to solar heating. The probe installs easily in YOUNG naturally ventilated or aspirated shields. For best performance, the probe and shield should be placed in a location with good air circulation clear of large masses (buildings, pavement, solar panels...), exhaust vents, electrical machinery, motors, water fountains and sprinklers

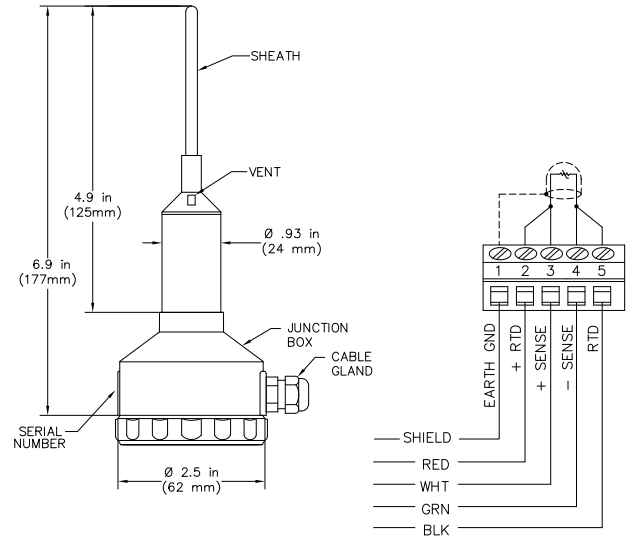
MAINTENANCE

The temperature probe is designed to offer years of service with minimal maintenance. If necessary, the probe may be periodically checked or recalibrated using normal bath calibration methods. NIST traceable calibration is available from YOUNG at additional cost.

NOTE: The terminal marked "EARTH GND" should be connected to properly grounded tower or grounding conductor as close to the sensor as possible. Failure to do so may result in damage due to static discharge.

CE COMPLIANCE

This product has been tested and shown to comply with European CE requirements for the EMC Directive. Please note that shielded cable must be used.



WARRANTY

This product is warranted to be free of defects in materials and construction for a period of 12 months from date of initial purchase. Liability is limited to repair or replacement of defective item. A copy of the warranty policy may be obtained from R. M. Young Company.

SPECIFICATIONS

- Measuring range: -50 to +50°C
-50 to +150°F
- Accuracy at 0°C: ±0.3°C
±0.1°C (optional)
- Time Constant: 42 seconds in 43408 shield.
- Sensor type: 1000Ω Platinum RTD
- Output signal: 4 wire RTD
- Recommended Cable: 2 pair shielded, 22 AWG (#18723)
- Recommended Radiation Shields:

Model 41502 Compact Aspirated Radiation Shield
Model 41003P Multi-Plate Radiation Shield

Resistance vs. Temperature for 1000Ω nominal probe
Temperature Coefficient = 0.00375 Ω/Ω°C

Resistance Ω	°F	°C	Resistance Ω
1226.445	140	60	1226.445
1205.659	130		
1184.837	120		1189.005
1163.978	110	40	1151.445
1143.081	100		
1122.148	90		1113.764
1101.177	80	20	1075.963
1080.169	70		
1059.124	60		1038.042
1038.042	50	0	1000.000
1016.922	40		
995.766	30		961.837
974.572	20	-10	923.550
953.340	10		
932.069	0		885.132
910.759	-10	-30	846.576
889.407	-20		
868.013	-30		807.873
846.576	-40	-50	
825.093	-50		

Transfer function calculated from manufacturer's data:
 $C^{\circ} = (1.1279 \times 10^{-5}, R^2) + (2.3985 \times 10^{-1}, R) - 251.1326$
 $F^{\circ} = (2.0302 \times 10^{-5}, R^2) + (4.3174 \times 10^{-1}, R) - 420.0387$

Declaration of Conformity

R. M. Young Company
2801 Aero Park Drive
Traverse City, MI 49686 USA

Model 41342 PLATINUM TEMPERATURE PROBE

The undersigned hereby declares on behalf of R. M. Young Company that the above-referenced product, to which this declaration relates, is in conformity with the provisions of:

Council Directive 2004/108/EC (December 15, 2004)
on Electromagnetic Compatibility

David Poinsett
R&D Manager



HC2S3

Temperature and RH Sensor



The HC2S3 is a rugged, accurate temperature/RH probe that is ideal for long-term, unattended applications. The probe uses a Rotronic's IN1 capacitive sensor to measure RH and a 100 ohm PRT to measure temperature. For optimum results, the HC2S3 should be recalibrated annually.

The HC2S3 comes with a polyethylene filter that protects its sensor from fine dust and particles and minimizes water absorption and retention. Alternatively, a teflon filter is available for marine environments. The response time is slower when using the teflon filter.

Sensor Mounts

The 41003-5 radiation shield should be used when the HC2S3 is exposed to sunlight. The 41003-5 can attach directly to a mast or tower leg or to a CM202, CM204, or CM206 crossarm.

Ordering Information

Air Temperature and Relative Humidity Probe

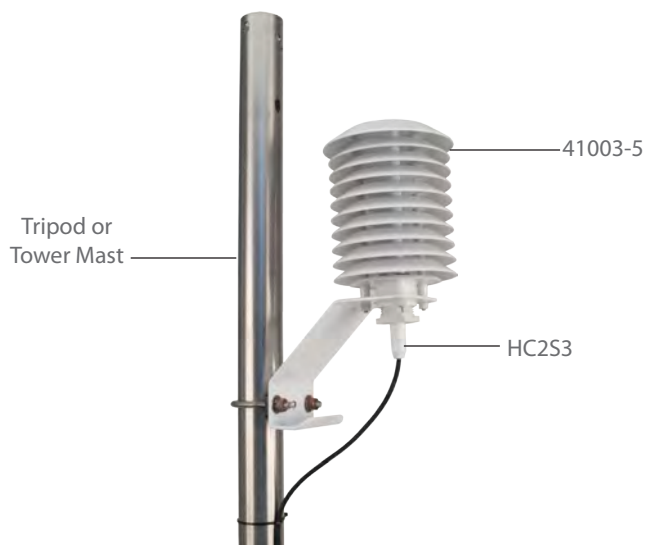
HC2S3-L Rotronics Temperature/RH Probe with user-specified cable length. Enter cable length, in feet, after the -L. Maximum cable length is 1000 ft (300 m) with 12 V power, or 10 ft (3 m) with 5 V power. Must choose a cable termination option (see below).

Cable Termination Options (choose one)

- PT** Cable terminates in stripped and tinned leads for direct connection to a datalogger's terminals.
- PW** Cable terminates in connector for attachment to a prewired enclosure.
- CWS** Cable terminates in a connector for attachment to a CWS900-series interface. Connection to a CWS900-series interface allows this sensor to be used in a wireless sensor network.
- C** Cable terminates in a connector for attachment to a CS110 Electric Field Meter or ET107 weather station.
- RQ** Cable terminates in a connector for attachment to a RAWS-P Permanent Remote Automated Weather Station.

Common Accessories

- 41003-5** 10-Plate Gill Radiation Shield to house the HC2S3
- 27755** Teflon Filter for marine environments.



Recommended Cable Lengths

2-m Height		Atop a tripod or tower via a 2-ft crossarm such as the CM202								
Mast/Leg	CM202	CM6	CM106	CM10	CM110	CM115	CM120	UT10	UT20	UT30
9 ft	11 ft	11 ft	14 ft	14 ft	14 ft	19 ft	24 ft	14 ft	24 ft	37 ft

Note: Add two feet to the cable length if mounting the enclosure to the leg base of a CM106, CM110, CM115, or CM120 tripod.

Specifications

Electronics

Operating Limits: -40° to +100°C

Storage Temperature: -50° to +100°C

Dimensions

Diameter: 15 mm (0.6 in.)
Length w/o connector: 85 mm (3.3 in.)
Length w/connector: 183 mm (7.25 in.)

Weight: 10 g (0.35 oz)

Filter

Standard: Polyethylene
Optional: Teflon (ordered separately;
 see Ordering Information)

Current Consumption: <4.3 mA @ 5 Vdc
 <2.0 mA @ 12 Vdc

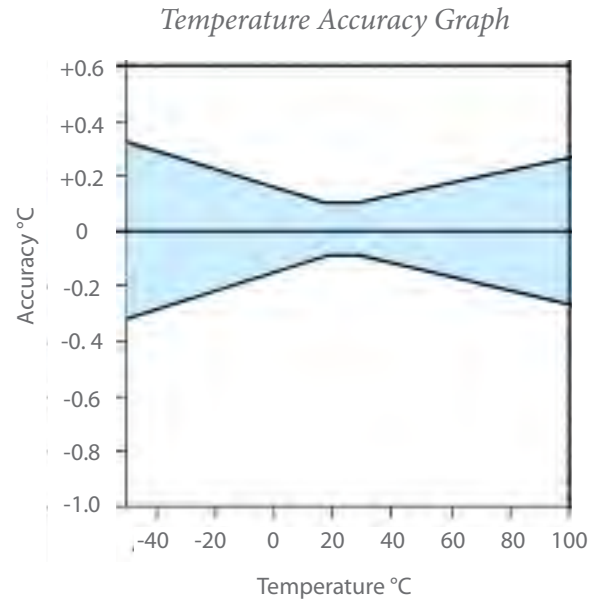
Supply Voltage: 5 to 24 Vdc

Startup Time: 1.5 s typical¹

Maximum Startup Current: <50 mA for 2 μs

Analog Outputs

Offset at 0 V: ±3 mV (maximum)
Deviation for Digital Signal: < ±1 mV (0.1°C, 0.1% R. H.)



Temperature

Temperature Sensor: PT100 RTD, IEC 751 1/3 Class B

Measurement Range: -50° to +100°C
 (default to -40° to +60°C)

Output Signal Range: 0 to 1 V

Accuracy at 23°C: ±0.1°C with standard
 configuration settings

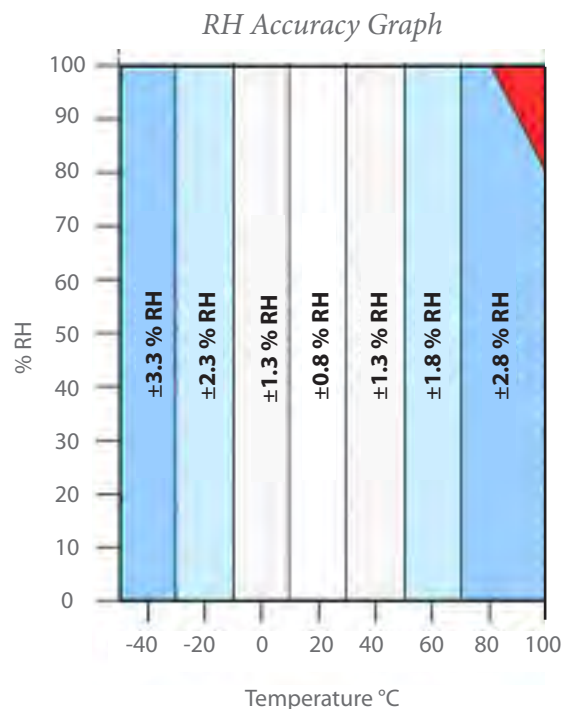
Long Term Stability: <0.1°C/year

Sensor Time Constant [63% step change (1 m/s air flow at sensor)]

Standard PE Filter: ≤ 22 s

Optional Teflon Filter: ≤ 30 s

Temperature Accuracy: see graph at top right



Relative Humidity (RH)

Sensor: ROTRONIC Hygromer® IN-1

Measurement Range: 0 to 100% RH,
 non-condensing

Output Signal Range: 0 to 1 Vdc

Accuracy at 23°C: ±0.8% RH with standard
 configuration settings

Long-Term Stability: <1% RH per year

**Sensor Time Constant [63% of a 35 to 80% RH step change
 (1 m/s air flow at sensor)]**

Standard PE Filter: ≤ 22 s

Optional Teflon Filter: ≤ 30 s

RH Accuracy over

Temperature: see graph at bottom right

Notes:

¹The startup time is Rotronics specification. Campbell Scientific recommends 2 s at 60°C, 3 s at 0°C, and 4 s at -40°C.

¹The black outer jacket of the cable is Santoprene® rubber. This compound was chosen for its resistance to temperature extremes, moisture, and UV degradation. However, this jacket will support combustion in air. It is rated as slow burning when tested according to U.L. 94 H.B. and will pass FM-VSS302. Local fire codes may preclude its use inside buildings.



LP02

Second class pyranometer

LP02 is a solar radiation sensor that is applied in most common solar radiation observations. It complies with the second class specifications of the ISO 9060 standard and the WMO Guide. LP02 pyranometer is widely used in (agro-) meteorological applications and for PV system performance monitoring.



Figure 1 LP02 second class pyranometer



Figure 2 pyranometer in use with LI19 read-out unit

Introduction

LP02 is a solar radiation sensor that is applied in general observations. It measures the solar radiation received by a plane surface from a 180° field of view angle. This quantity, expressed in W/m^2 , is called “hemispherical” solar radiation. LP02 pyranometer can be employed outdoors under the sun, as well as indoors with lamp-based solar simulators. Its orientation depends on the application and may be horizontal, tilted (for plane of array radiation) or inverted (for reflected radiation).

LP02 pyranometer is a very good alternative to silicon cell (photodiode-based) pyranometers, which do not comply to the ISO 9060 standard.

Operation

Using LP02 is easy. The pyranometer can be connected directly to commonly used data logging systems.

The irradiance in W/m^2 is calculated by dividing the LP02 output, a small voltage, by the sensitivity. This sensitivity is provided with LP02 on its calibration certificate.

Uncertainty evaluation

The uncertainty of a measurement under outdoor conditions depends on many factors. Guidelines for uncertainty evaluation according to the “Guide to Expression of Uncertainty in Measurement” (GUM) can be found in our manuals. We provide spreadsheets to assist in the process of uncertainty evaluation of your measurement.

Suggested use

- general meteorological observations
- agricultural networks
- PV system performance monitoring

LP02 design

LP02 pyranometer employs a thermal sensor with black coating, a single glass dome and an anodised aluminium body.

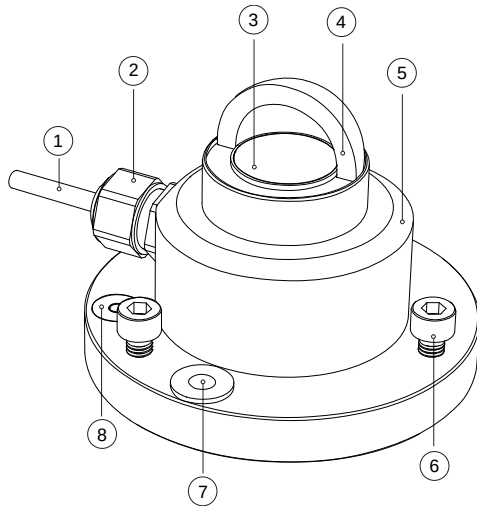


Figure 3 overview of LP02:

(1) cable, (2) cable gland, (3) thermal sensor with black coating, (4) glass dome, (5) sensor body, (6) levelling feet, (7) mounting hole, (8) bubble level

Use as sunshine duration sensor

WMO has approved the “pyranometric method” to calculate sunshine duration from pyranometer measurements in WMO-No. 8, Guide to Meteorological Instruments and Methods of Observation. This implies that LP02 may be used, in combination with appropriate software, to estimate sunshine duration. This is much more cost-effective than using a dedicated sunshine duration sensor. Ask for our application note.

Choosing the right instrument

Pyranometers are subject to classification in three classes according to ISO 9060. From second class to first class and from first class to secondary standard, the achievable accuracy improves by a factor 2. Measurement accuracy does not only depend on instrument properties, but also on measurement conditions. A very accurate instrument will quickly underperform without a regular schedule of maintenance. Our pyranometer [selection guide](#) assists you in choosing the right instrument. Whatever your application is: Hukseflux offers the highest accuracy in every class at the most attractive price level.

LP02 specifications

Measurand	hemispherical solar radiation
ISO classification	second class pyranometer
Calibration uncertainty	< 1.8 % (k = 2)
Calibration traceability	to WRR
Spectral range	285 to 3000 x 10 ⁻⁹ m
Sensitivity (nominal)	15 x 10 ⁻⁶ V/(W/m ²)
Rated operating temperature range	-40 to +80 °C
Temperature response	< ± 3 % (-10 to +40 °C)
Standard cable length	5 m

Options

- longer cable, in multiples of 5 metres
- sun screen
- [LP02-LI19](#), including read-out unit / datalogger [LI19](#)

See also

- [LP02-TR](#) with 4-20 mA transmitter
- [SR03](#) fast response pyranometer
- [SR11](#), [SR12](#) and [SR20](#) pyranometers for higher accuracy measurements
- [SRA01](#) for albedo measurements
- view our complete [product range of solar sensors](#)

Standards

Applicable instrument classification standards are ISO 9060 and WMO-No. 8. Calibration is according to ISO 9847. PV related standards are ASTM E2848 and IEC 61724.

About Hukseflux

Hukseflux Thermal Sensors, founded in 1993, aims to advance thermal measurement. We offer a complete range of sensors and systems for measuring heat flux, solar radiation and thermal conductivity. We also provide consultancy and services such as performing measurements and designing instrumentation according to customer requirements. Customers are served through the main office in Delft in the Netherlands, and locally owned representations in the USA, China and Japan.

Interested in this product?
E-mail us at: info@hukseflux.com



Net Radiometers

FOR MEASUREMENT OF THE ENERGY BALANCE

One-component and four-component instruments

Reliable all-weather performance

Light weight and robust

Unique ventilation system

INTRODUCTION

Net radiation is the balance between incoming radiation from the sun and sky and outgoing radiation from the ground. Short-wave radiation of 0.3 to 3 μm wavelength reaches the Earth's surface, where some is reflected and the rest of the energy is absorbed by the surface. Incoming long-wave Far Infrared (FIR) radiation from 4.5 to more than 40 μm is also absorbed by the surface, which heats up and emits FIR back to the sky.

The four components of net radiation are the incoming and reflected solar radiation, from which the Albedo can be calculated; and the downward and upward infrared radiation. These parameters can be measured using a pair of pyranometers and a pair of pyrgeometers, but more commonly a net radiometer is used that conveniently combines four sensors into one compact instrument.

The simplest type of net radiometer uses a single sensor to measure the sum of the four net radiation components. This type of instrument is sometimes referred to as a net pyrriadiometer.

NR Lite2 is a single-component net radiometer widely used in agriculture and hydrology. The thermopile detector is fitted with black PTFE coated conical absorbers on both sides that have a very wide spectral response from the ultraviolet (UV) to the far infrared (FIR). The signal output is the difference between the sun and sky radiation and the ground radiation and can be positive or negative, depending upon the conditions.

There is an integral mounting rod for fitting to masts and poles, a bubble level, 15 m long signal cable, and a stick to prevent birds settling on the instrument. The single output means that the short-wave and long-wave components and the upwards and downwards components cannot be separated. For this, use our four-component CNR 4 net radiometer.



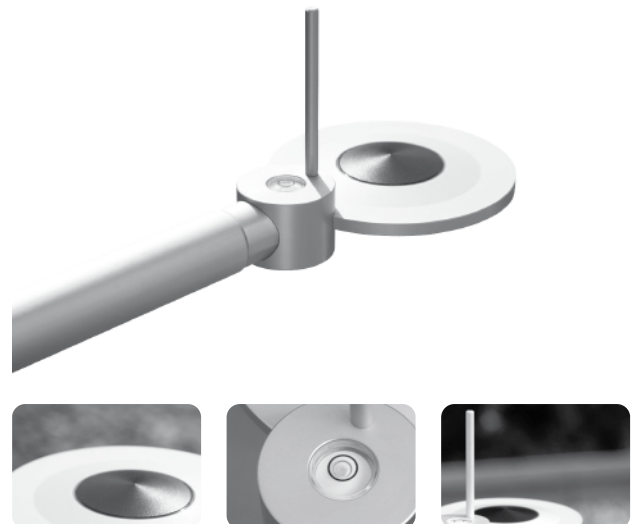
APPLICATIONS

The main applications for net radiometers are in agro-meteorology, in particular for the study of evapo-transpiration and in climatology, meteorology and hydrology for the measurement of the radiation balance. Monitoring over glaciers and ice fields is of particular interest to global warming studies. Net radiometers are often used in conjunction with a small automatic weather station and need to be easily portable.

CHOICE OF NET RADIOMETER

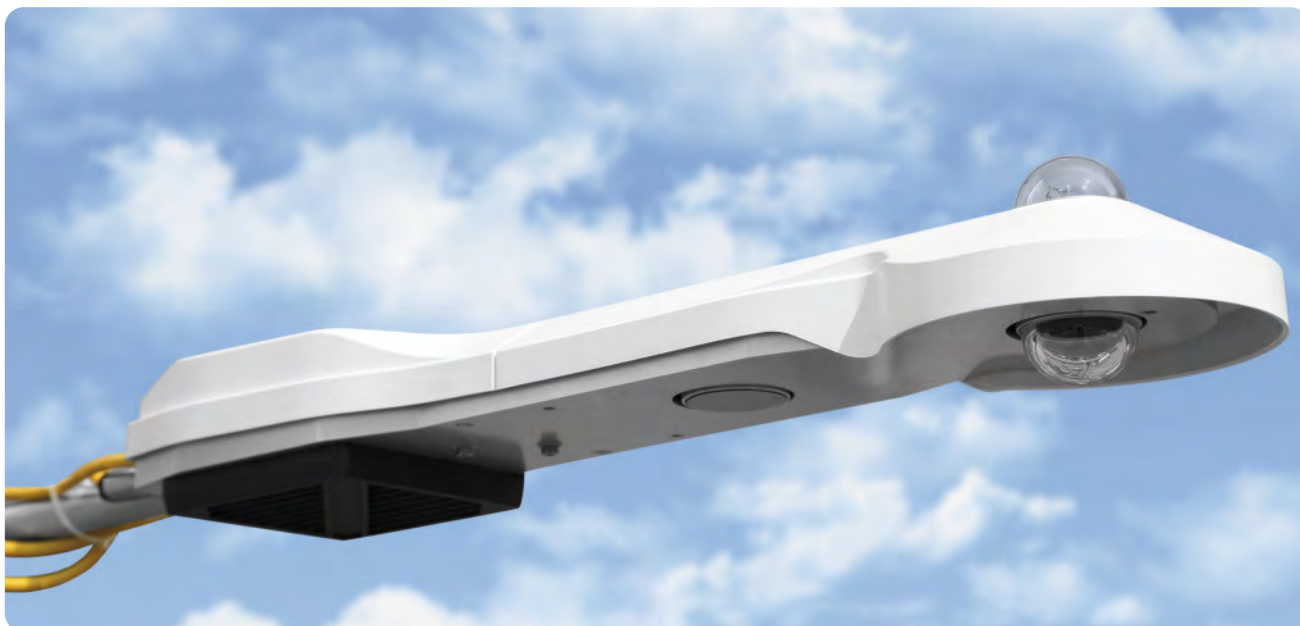
Kipp & Zonen offers a range of robust, lightweight, net radiometers that do not require power to operate. A mounting rod, bubble level and calibration certificate are always included.

NR Lite2 has a single output for total net radiation. CNR 4 measures all four components separately. Whatever the application, Kipp & Zonen can supply a suitable net radiometer.



CNR 4 is a four-component net radiometer for accurate and reliable measurements and can be used as the reference instrument for a network of lower performance net radiometers. There are four separate signal outputs and the integrated temperature sensors can be used to calculate the FIR radiation. The screw-in mounting rod, bubble level, and cables with waterproof connectors, make installation easy. The white sun shield reduces solar heating of the instrument body.

CNR 4 combines two ISO 9060 Second Class pyranometers for solar radiation with two pyrgeometers for infrared measurements, all integrated into the instrument body. The upper pyrgeometer has a silicon meniscus dome so that water rolls off and the field of view is 180°. The design is very light weight and includes a mounting rod as standard. An optional heated ventilation unit, the CNF 4, is available to minimise offsets, maximize stability and remove precipitation.



ACCESSORIES

CNF 4 Ventilation Unit

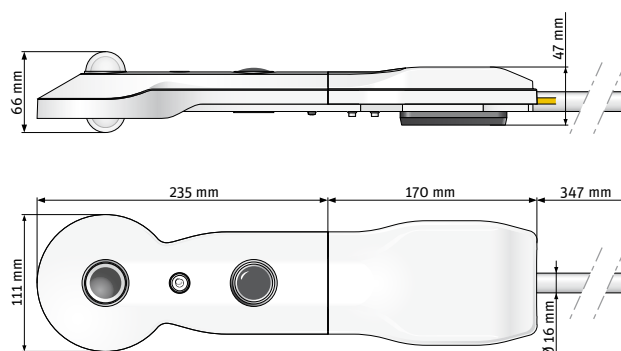
The Kipp & Zonen CNR 4 net radiometer is produced as the standard instrument or with an integrated ventilation unit and heater. The CNF 4 ventilation unit can also be bought as a kit for retro-fitting to a CNR 4 that was purchased without it.

CNF 4 provides a clean air flow over all four of the CNR 4 radiometer domes and windows and is designed to operate under all weather conditions. The only part that needs maintenance is the air inlet filter, which should be checked at regular intervals and cleaned or replaced when necessary.

The integrated 10 W heating can be switched on by the operator when required. This raises the temperature of the domes and windows slightly above ambient to prevent the formation of dew and frost and to disperse precipitation. The ventilation fan and heater run from 12 VDC and can be operated by the accessory CVP 2 universal AC-DC power adaptor.

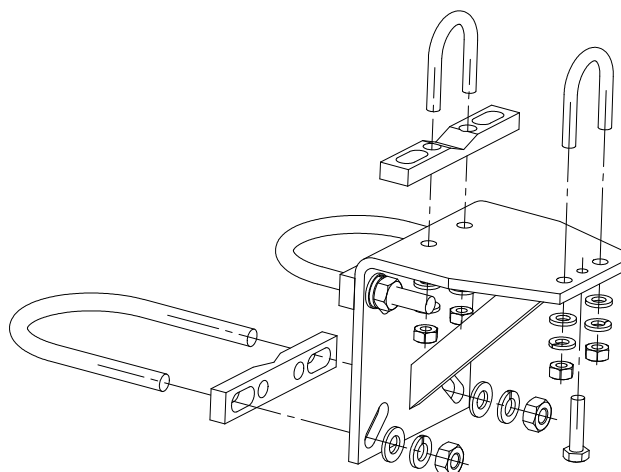
CMB 1 Mounting Bracket

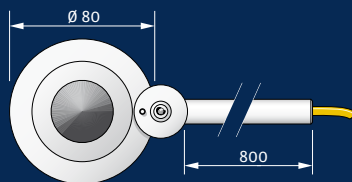
For attaching mounting rods of 12 to 20 mm diameter to poles, masts or walls. The radiometer can be levelled by rotating and tilting the rod. The bracket includes u-bolts for fixing to poles and masts from 22 to 60 mm diameter.



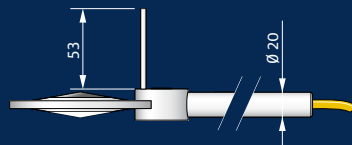
Specifications CNF 4

Ventilator fan power	5 W continuously
Heater power	10 W
Operating temperature	-40 °C to +70 °C
Cable voltage drop	0.07 V/m (with heater)
Power required	12 Volt DC, 1.3 A (with heater)
Weight	500 g

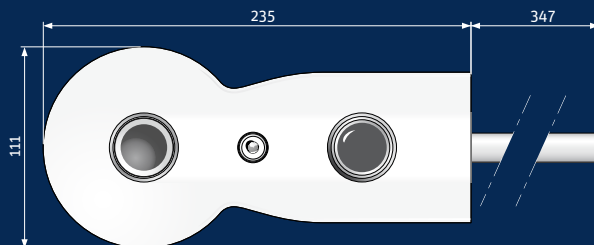




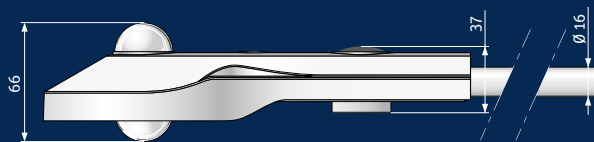
NR Lite2



All dimensions in mm



CNR 4



Specifications	NR Lite2	CNR 4
Number of signal outputs	1 - net total radiation	4 - incoming and reflected short-wave radiation downward and upward long-wave radiation
Pyrometer temperature sensors	N/A	10 K thermistor and Pt-100
Response time (95 %)	< 60 s	< 18 s
Non-linearity (over full range)	< 1 %	< 1 %
Temperature dependence of sensitivity	- 0.1 % / °C (typical)	< 5 % from -10 °C to +40 °C
Sensitivity	10 $\mu\text{V}/\text{W}/\text{m}^2$ (nominal)	7 to 20 $\mu\text{V}/\text{W}/\text{m}^2$ short-wave 5 to 10 $\mu\text{V}/\text{W}/\text{m}^2$ long-wave
Operating temperature	-40 °C to +80 °C	-40 °C to +80 °C
Spectral range (50 % points)	200 nm to 100 μm	300 to 2800 nm short-wave 4.5 to 42 μm long-wave
Field of view	180 ° upper and lower sensor	180 ° short-wave upper sensor 170 ° short-wave lower sensor 180 ° long-wave upper sensor 150 ° long-wave lower sensor
Mounting rod	Fixed, 800 mm long x 20 mm $\varnothing$	Screw-in, 350 mm long x 16 mm $\varnothing$
Standard cable	15 m fixed cable	10 m with connector
Cable length options	N/A	25 m, 50 m
Weight with rod (excluding cable(s))	490 g	850 g

Note: The performance specifications quoted are worst-case and/or maximum values



Go to www.kippzonen.com for your local distributor

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Kipp & Zonen B.V. reserve the right to alter specifications of the equipment described in this documentation without prior notice

CS106

Barometric Pressure Sensor



The CS106 barometer uses Vaisala's BAROCAP silicon capacitive sensor to measure barometric pressure over a 500 to 1100 millibar range. The CS106 outputs a linear signal of 0 to 2.5 Vdc, allowing it to be directly connected to Campbell Scientific dataloggers. The CS106 is compatible with all of our contemporary dataloggers and many of our retired dataloggers (e.g., CR510, CR10(X), CR23X).

Construction and Mounting

The CS106 is encased in a plastic shell (ABS/PC blend) fitted with an intake valve for pressure equilibration. It includes a 2.5 ft cable and a terminal strip for datalogger power and signal connections. The CS106 is typically mounted next to the datalogger inside an ENC12/14 or larger enclosure. The ENC100 is available for housing the CS106 in its own enclosure.

Ordering Information

Barometric Pressure Sensor

CS106 Vaisala PTB110 Barometer (500 to 1100 mb), with 30 in. cable.

Accessories

The following accessories are used when the barometer will be housed in a different enclosure than the datalogger.

ENC100 6.7 in. by 5.5 in enclosure for housing only the CS106.

CABLE5CBL-L 5-conductor, 24 AWG cable with drain wire and Santoprene jacket. Enter cable length, in feet, after the -L. Must choose a cable termination option (see below).

Cable Termination Options (choose one)

- PT** Cable terminates in pigtails for direct connection to datalogger's terminals.
- PW** Cable terminates in a connector for attachment to a prewired enclosure.



The ENC100 is a very small enclosure that can house one CS106. It includes a backplate, compression fitting, vent, and mounting bracket.

The CS106 includes a switching circuit that allows the datalogger to power the barometer only during measurement, which reduces power consumption. Sensor warm-up and measurement time is one second minimum.



Manufacturer's Specifications

Total Accuracy¹:	±0.3 mb @ +20°C
	±0.6 mb @ 0° to 40°C
	±1.0 mb @ -20° to +45°C
	±1.5 mb @ -40° to +60°C
Linearity:	±0.25 mb
Hysteresis:	±0.03 mb
Repeatability:	±0.03 mb
Calibration Uncertainty:	±0.15 mb
Long-Term Stability:	±0.1 mb per year
Operating Temperature:	-40° to +60°C
Dimensions:	2.7" x 3.8" x 1.1" (6.8 cm x 9.7 cm x 2.8 cm)
Weight:	3.2 oz (90 g)
Supply Voltage:	10 to 30 Vdc
Current Consumption:	<4 mA (active), <1 µA (quiescent)
Settling Time:	1 second to reach full accuracy after power-up
Response Time:	500 ms to reach full accuracy after a pressure step

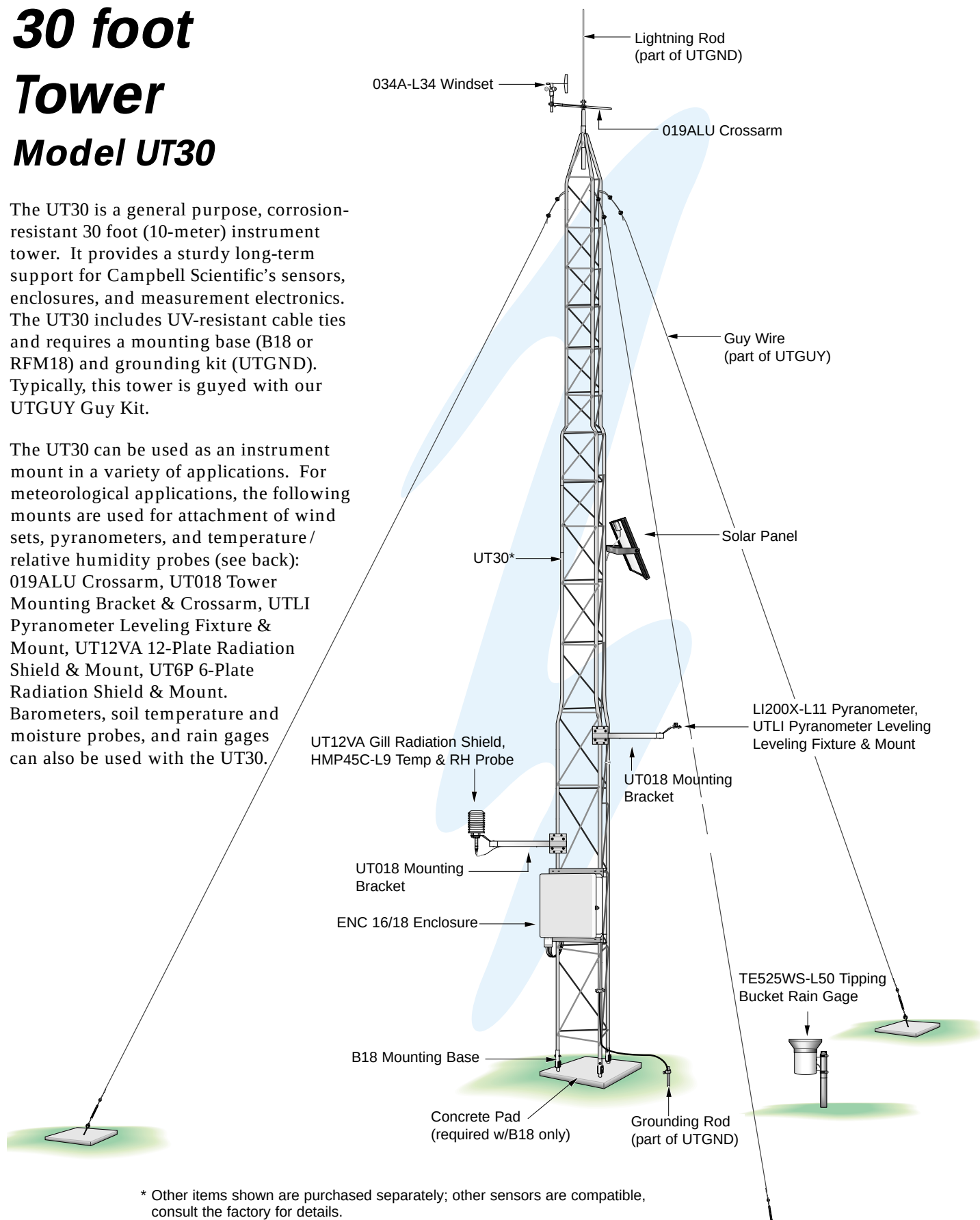
¹The root sum squared (RSS) of end point non-linearity, hysteresis, repeatability, and calibration uncertainty.



30 foot Tower Model UT30

The UT30 is a general purpose, corrosion-resistant 30 foot (10-meter) instrument tower. It provides a sturdy long-term support for Campbell Scientific's sensors, enclosures, and measurement electronics. The UT30 includes UV-resistant cable ties and requires a mounting base (B18 or RFM18) and grounding kit (UTGND). Typically, this tower is guyed with our UTGUY Guy Kit.

The UT30 can be used as an instrument mount in a variety of applications. For meteorological applications, the following mounts are used for attachment of wind sets, pyranometers, and temperature/relative humidity probes (see back): 019ALU Crossarm, UT018 Tower Mounting Bracket & Crossarm, UTLI Pyranometer Leveling Fixture & Mount, UT12VA 12-Plate Radiation Shield & Mount, UT6P 6-Plate Radiation Shield & Mount. Barometers, soil temperature and moisture probes, and rain gages can also be used with the UT30.



* Other items shown are purchased separately; other sensors are compatible, consult the factory for details.



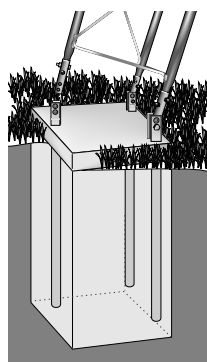
CAMPBELL SCIENTIFIC, INC.

815 W. 1800 N. • Logan, Utah 84321-1784 • (435) 753-2342 • FAX (435) 750-9540 • www.campbellsci.com

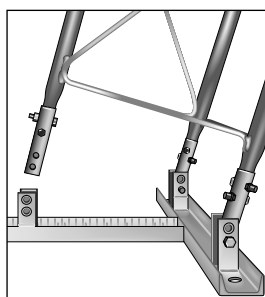
Specifications

Crossarm measurement height:	33 ft (10 m)
Shipping weight:	65 lbs (29 kg)
Material:	Hardened Drawn 6063-T832 aluminum
OD of vertical pipe:	1" (2.5 cm)
OD of cross support pipes:	0.375" (0.953 cm)
Guyed tower area requirements:	~34 ft diameter
Required concrete pad dimensions (B18 base only):	36"L x 36"W x 48"D (91 x 91 x 122 cm) This assumes heavy soil; light shifting, or sandy soils require a larger concrete pad.

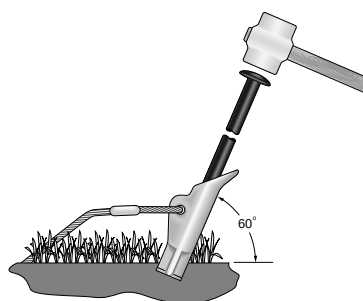
UT30 Accessories



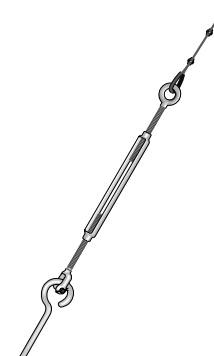
B18



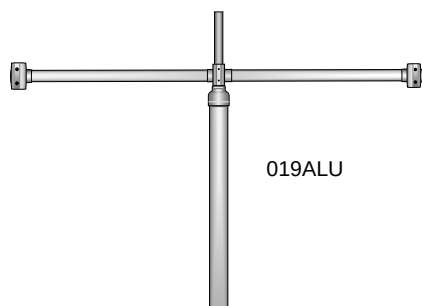
RFM18



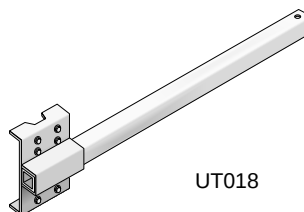
UTDUK



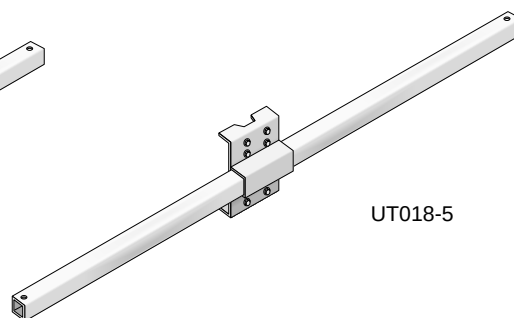
UTEYE



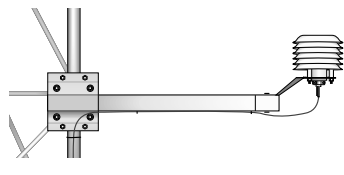
019ALU



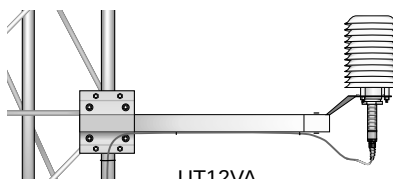
UT018



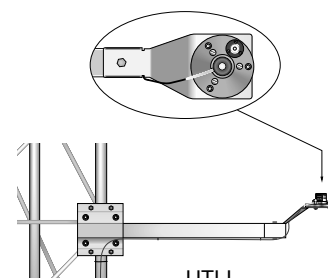
UT018-5



UT6P



UT12VA



UTLI



CAMPBELL SCIENTIFIC, INC.

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CR1000 Specifications

Electrical specifications are valid over a -25° to +50°C, non-condensing environment, unless otherwise specified. Recalibration recommended every three years. Critical specifications and system configuration should be confirmed with Campbell Scientific before purchase.

PROGRAM EXECUTION RATE

10 ms to one day @ 10 ms increments

ANALOG INPUTS (SE1-SE16 or DIFF1-DIFF8)

8 differential (DF) or 16 single-ended (SE) individually configured input channels. Channel expansion provided by optional analog multiplexers.

RANGES and RESOLUTION: Basic resolution (Basic Res) is the A/D resolution of a single A/D conversion. A DIFF measurement with input reversal has better (finer) resolution by twice than Basic Res.

Range (mV) ¹	DF Res (µV) ²	Basic Res (µV)
±5000	667	1333
±2500	333	667
±250	33.3	66.7
±25	3.33	6.7
±7.5	1.0	2.0
±2.5	0.33	0.67

¹Range overhead of ~9% on all ranges guarantees that full-scale values will not cause over range.

²Resolution of DF measurements with input reversal.

ACCURACY³:

±(0.06% of reading + offset), 0° to 40°C

±(0.12% of reading + offset), -25° to 50°C

±(0.18% of reading + offset), -55° to 85°C (-XT only)

³Accuracy does not include the sensor and measurement noise. Offsets are defined as:

Offset for DF w/input reversal = 1.5·Basic Res + 1.0 µV

Offset for DF w/o input reversal = 3·Basic Res + 2.0 µV

Offset for SE = 3·Basic Res + 3.0 µV

ANALOG MEASUREMENT SPEED:

Integration Type/Code	Integration Time	Settling Time	Total Time ⁴	
			SE w/ No Rev	DF w/ Input Rev
250	250 µs	450 µs	~1 ms	~12 ms
60 Hz ⁵	16.67 ms	3 ms	~20 ms	~40 ms
50 Hz ⁵	20.00 ms	3 ms	~25 ms	~50 ms

⁴Includes 250 µs for conversion to engineering units.

⁵AC line noise filter.

INPUT NOISE VOLTAGE: For DF measurements with input reversal on ±2.5 mV input range (digital resolution dominates for higher ranges).

250 µs Integration: 0.34 µV RMS

50/60 Hz Integration: 0.19 µV RMS

INPUT LIMITS: ±5 Vdc

DC COMMON MODE REJECTION: >100 dB

NORMAL MODE REJECTION: 70 dB @ 60 Hz when using 60 Hz rejection

INPUT VOLTAGE RANGE W/O MEASUREMENT

CORRUPTION: ±8.6 Vdc max.

SUSTAINED INPUT VOLTAGE W/O DAMAGE: ±16 Vdc max.

INPUT CURRENT: ±1 nA typical, ±6 nA max. @ 50°C; ±90 nA @ 85°C

INPUT RESISTANCE: 20 GΩ typical

ACCURACY OF BUILT-IN REFERENCE JUNCTION

THERMISTOR (for thermocouple measurements):

±0.3°C, -25° to 50°C

±0.8°C, -55° to 85°C (-XT only)

ANALOG OUTPUTS (VX1-VX3)

3 switched voltage, sequentially active only during measurement.

RANGE AND RESOLUTION:

Channel	Range	Resolution	Current Source/Sink
(VX 1-3)	±2.5 Vdc	0.67 mV	±25 mA

ANALOG OUTPUT ACCURACY (VX):

±(0.06% of setting + 0.8 mV), 0° to 40°C

±(0.12% of setting + 0.8 mV), -25° to 50°C

±(0.18% of setting + 0.8 mV), -55° to 85°C (-XT only)

VX FREQUENCY SWEEP FUNCTION: Switched outputs provide a programmable swept frequency, 0 to 2500 mv square waves for exciting vibrating wire transducers.

PERIOD AVERAGE

Any of the 16 SE analog inputs can be used for period averaging. Accuracy is ±(0.01% of reading + resolution), where resolution is 136 ns divided by the specified number of cycles to be measured.

INPUT AMPLITUDE AND FREQUENCY:

Voltage Gain	Input Range (±mV)	Signal (peak to peak)		Min Pulse Width (µV)	Max ⁸ Freq (kHz)
		Min. (mV) ⁶	Max (V) ⁷		
1	250	500	10	2.5	200
10	25	10	2	10	50
33	7.5	5	2	62	8
100	2.5	2	2	100	5

⁶Signal centered around Threshold (see PeriodAvg() instruction).

⁷With signal centered at the datalogger ground.

⁸The maximum frequency = 1/(twice minimum pulse width) for 50% of duty cycle signals.

RATIOMETRIC MEASUREMENTS

MEASUREMENT TYPES: Provides ratiometric resistance measurements using voltage excitation. 3 switched voltage excitation outputs are available for measurement of 4- and 6-wire full bridges, and 2-, 3-, and 4-wire half bridges. Optional excitation polarity reversal minimizes dc errors.

RATIOMETRIC MEASUREMENT ACCURACY:^{9,10,11}

±(0.04% of Voltage Measurement + Offset)

⁹Accuracy specification assumes excitation reversal for excitation voltages < 1000 mV. Assumption does not include bridge resistor errors and sensor and measurement noise.

¹⁰Estimated accuracy, ΔX (where X is value returned from the measurement with Multiplier = 1, Offset = 0):

BrHalf() instruction: ΔX = ΔV_x/N_x

BrFull() instruction ΔX = 1000·ΔV_x/N_x, expressed as mV·V⁻¹.

ΔV⁻¹ is calculated from the ratiometric measurement accuracy. See Resistance Measurements Section in the manual for more information.

¹¹Offsets are defined as:

Offset for DIFF w/input reversal = 1.5·Basic Res + 1.0 µV

Offset for DIFF w/o input reversal = 3·Basic Res + 2.0 µV

Offset for SE = 3·Basic Res + 3.0 µV

Excitation reversal reduces offsets by a factor of two.

PULSE COUNTERS (P1-P2)

2 inputs individually selectable for switch closure, high frequency pulse, or low-level ac. Independent 24-bit counters for each input.

MAXIMUM COUNTS PER SCAN: 16.7x10⁶

SWITCH CLOSURE MODE:

Minimum Switch Closed Time: 5 ms

Minimum Switch Open Time: 6 ms

Max. Bounce Time: 1 ms open w/o being counted

HIGH-FREQUENCY PULSE MODE:

Maximum Input Frequency: 250 kHz

Maximum Input Voltage: ±20 V

Voltage Thresholds: Count upon transition from below 0.9 V to above 2.2 V after input filter with 1.2 µs time constant.

LOW-LEVEL AC MODE: Internal ac coupling removes ac offsets up to ±0.5 Vdc.

Input Hysteresis: 12 mV RMS @ 1 Hz

Maximum ac Input Voltage: ±20 V

Minimum ac Input Voltage:

Sine Wave (mV RMS)	Range(Hz)
20	1.0 to 20
200	0.5 to 200
2000	0.3 to 10,000
5000	0.3 to 20,000

DIGITAL I/O PORTS (C1-C8)

8 ports software selectable, as binary inputs or control outputs. Provide on/off, pulse width modulation, edge timing, subroutine interrupts / wake up, switch closure pulse counting, high frequency pulse counting, asynchronous communications (UARTs), and SDI-12 communications. SDM communications are also supported.

LOW FREQUENCY MODE MAX: <1 kHz

HIGH-FREQUENCY MODE MAX: 400 kHz

SWITCH-CLOSURE FREQUENCY MAX: 150 Hz

EDGE TIMING RESOLUTION: 540 ns

OUTPUT VOLTAGES (no load): high 5.0 V ±0.1 V; low <0.1

OUTPUT RESISTANCE: 330 Ω

INPUT STATE: high 3.8 to 16 V; low -8.0 to 1.2 V

INPUT HYSTERESIS: 1.4 V

INPUT RESISTANCE: 100 kΩ with inputs <6.2 Vdc

220 Ω with inputs ≥6.2 Vdc

SERIAL DEVICE/RS-232 SUPPORT: 0 to 5 Vdc UART

SWITCHED 12 VDC (SW-12)

1 independent 12 Vdc unregulated source is switched on and off under program control. Thermal fuse hold current = 900 mA at 20°C, 650 mA at 50°C, 360 mA at 85°C.

CE COMPLIANCE

STANDARD(S) TO WHICH CONFORMITY IS DECLARED: IEC61326:2002

COMMUNICATIONS

RS-232 PORTS:

DCE 9-pin: (not electrically isolated) for computer connection or connection of modems not manufactured by Campbell Scientific.

COM1 to COM4: 4 independent Tx/Rx pairs on control ports (non-isolated); 0 to 5 Vdc UART

Baud Rates: selectable from 300 bps to 115.2 kbps.

Default Format: 8 data bits; 1 stop bits; no parity

Optional Formats: 7 data bits; 2 stop bits; odd, even parity

CS I/O PORT: Interface with telecommunications peripherals manufactured by Campbell Scientific.

SDI-12: Digital control ports C1, C3, C5, and C7 are individually configured and meet SDI-12 Standard v 1.3 for datalogger mode. Up to 10 SDI-12 sensors are supported per port.

PERIPHERAL PORT: 40-pin interface for attaching CompactFlash or Ethernet peripherals

PROTOCOLS SUPPORTED: PakBus, AES-128 Encrypted PakBus, Modbus, DNP3, FTP, HTTP, XML, HTML, POP3, SMTP, Telnet, NTCIP, NTP, Web API, SDI-12, SDM.

SYSTEM

PROCESSOR: Renesas H8S 2322 (16-bit CPU with 32-bit internal core running at 7.3 MHz)

MEMORY: 2 MB of flash for operating system; 4 MB of battery-backed SRAM for CPU usage and final data storage; 512 kB flash disk (CPU) for program files.

REAL-TIME CLOCK ACCURACY: ±3 min. per year. Correction via GPS optional.

REAL-TIME CLOCK RESOLUTION: 10 ms

SYSTEM POWER REQUIREMENTS

VOLTAGE: 9.6 to 16 Vdc

INTERNAL BATTERIES: 1200 mAh lithium battery for clock and SRAM backup that typically provides three years of backup

EXTERNAL BATTERIES: Optional 12 Vdc nominal alkaline and rechargeable available. Power connection is reverse polarity protected.

TYPICAL CURRENT DRAIN at 12 Vdc:

Sleep Mode: < 1 mA

1 Hz Sample Rate (1 fast SE meas.): 1 mA

100 Hz Sample Rate (1 fast SE meas.): 6 mA

100 Hz Sample Rate (1 fast SE meas. w/RS-232 communication): 20 mA

Active external keyboard display adds 7 mA (100 mA with backlight on).

PHYSICAL

DIMENSIONS: 23.9 x 10.2 x 6.1 cm (9.4 x 4 x 2.4 in); additional clearance required for cables and leads.

MASS/WEIGHT: 1 kg / 2.1 lb

WARRANTY

3 years against defects in materials and workmanship.



APPENDIX B

Standard Operating Procedures for Meteorological Sensors

 STANDARD OPERATING PROCEDURE	Title: Calibration and Audit Equipment Certification	
	Number: SOP 69	Page: 1 of 1
	Revision Number: 4	Effective Date: 09/18/2014 01/05/2010 (Rev 3)
Approval: Date:		Concurred By:

All calibration and audit equipment will be certified annually or more frequent, as necessary, against National Institute of Standards and Technology (NIST), A2LA, or NVLAP certified or traceable standards. Copies of all equipment certifications will be kept in hard copy and in electronic form. An equipment re-certification schedule will be kept and updated regularly. This schedule will include the audit/calibration equipment make, model, serial number, certification date, and date when certifications are due.

No meteorological sensors or air quality equipment will be calibrated or audited with uncertified equipment.

Calibration and audit equipment will be clearly marked with who performed the calibration, date of the calibration, date due for calibration, and equipment ID number.

Calibration or audit equipment found to be out of calibration will be tagged and segregated and not used until it is re-calibrated.

 STANDARD OPERATING PROCEDURE	Title: In-House Calibration of Test Equipment	
	Number: SOP 106	Page: 1 of 1
	Revision No: 2	Effective Date: 09/18/2014 01/05/2010 (Rev 1)
Approval: Date:		Concurred By:

Measuring devices such as thermometers and relative humidity devices will be calibrated at prescribed times and whenever the accuracy of the device appears to be suspect. Calibrations shall be against and traceable to certified equipment or reference standards having known valid relationships to recognized standards. Testing equipment which is new and which has not been certified against a known reference standard or is out of calibration shall be segregated and not used until a calibration has been established.

A record of the calibration will be established and will include documentation of all necessary information.

 STANDARD OPERATING PROCEDURE	Title: Equipment Inventory Procedure	
	Number: SOP 107	Page: 1 of 1
	Revision No: 2	Effective Date: 09/14/2014 02/10/2011 (Rev 0)
Approval: Date:		Concurred By:

Once procured equipment arrives at MSI Trinity's instrument laboratory, the packing slip is removed from the box and compared against the purchase requisition form. By project, an equipment inventory form is filled which documents the components ordered, date received, and equipment serial number. Copies of the project equipment inventory forms are distributed to the project manager; the original is placed in the project file. Packing slips are also placed in the project file.

 STANDARD OPERATING PROCEDURE	Title: Visual Inspection of Meteorological Equipment	
	Number: SOP 113	Page: 1 of 1
	Revision Number: 2	Effective Date: 09/18/2014 01/05/2010
Approval: Date:		Concurred By:

Upon arrival at site, a visual inspection of the tower and sensors will be performed. The Meteorological Station Visual Inspection Checklist shall be filled out completely, signed and dated.

If problems are noted, contact project manager and initiate a corrective action report (SOP 108), if needed.

Meteorological Station Visual Inspection Checklist

Meteorological Station ID:		
Date:	Time:	
Checks	Yes	No
1. Tower, guy wires, and anchors in good condition?		
2. Anemometer cup assemblies at all levels undamaged?		
3. Anemometers at all levels rotating freely?		
4. Wind direction vanes at all levels undamaged?		
5. Wind direction vanes at all levels rotating freely?		
6. Aspiration shields at all levels undamaged?		
7. Precipitation gauge funnel free of debris?		
8. Ground fault circuit interrupter outlet at precipitation gauge reset?		
9. Instrument cables and power cords secure with no evidence of damage or wear?		
10. There is no evidence of icing on any of the instruments?		
Comments:		
Signature	Date	

 STANDARD OPERATING PROCEDURE	Title: Data Collection and Initial Processing	
	Number: SOP 114	Page: 1 of 2
	Revision Number: 1	Effective Date: 10/15/2014 12/29/2009 (Rev. 0)
Approval:	Date:	Concurred By:

This SOP describes the steps taken by MSI's data management personnel to collect ambient air quality and meteorological data via telephone, cellular, or satellite modems. The primary purpose of daily data collection is to assure quality data capture and minimize loss by:

- Calling the datalogger at each station via telephone, cellular or satellite modem and downloading the past day's data into site-specific daily files.
- Reviewing the daily error and stacked plots to verify complete data collection or to identify problems.

RESPONSIBILITIES OF DATA ANALYST

The data analyst shall on a daily basis:

- Maintain the automatic data collection programs and support information
- Ensure that the workstation used for automatic data collection is properly configured for daily data poll.
- Review the status of the automatic data collection each morning to verify complete, error-free data collection, assure the integrity of the monitoring systems, identify problems, and initiate corrective action.
- Perform data retries as necessary.
- Review collected data files.
- Provide technical support to site operators, as needed.
- Ensure proper archive and storage of final raw data files.

Starting the Auto Poll Process

The polling schedule is set in LoggerNet scheduler. Care should be taken not to overlap polling existing stations. Verify that the scheduled task is properly set up by attempting a manual poll at project start.

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Manual Data Polling

Manual data polling is conducted when the automatic data collection process has failed. To run manual poll:

- Select site.
- Click the COLLECT NOW button in LoggerNet.
- Confirm connection and data bytes received.
- Retry as necessary if connection is unsuccessful.
- Contact internal support and then site operator as needed.

Data Naming and Storage

Each download is saved in a separate file and are named in accordance with these conventions: PPymmdd.raw. PP indicates project identifier, mm month, dd date, and yy for year. These files are the raw, non-QC'd data obtained directly from the dataloggers in the field. No editing of these files is to be performed. These raw files should be archived for future reference, if needed. The daily files are written to a monthly file called PPymm.raw which lives in the same directory. At the end of the month, this file is copied to PPymm.dat and can be modified, as necessary.

Level 0 Data Validation

Level 0 data validation is essentially raw data obtained directly from the data acquisition systems in the field. Level 0 data have been reduced and possibly reformatted, but are unedited and unreviewed. These data have not received any adjustments for known biases or problems that may have been identified during preventive maintenance checks or audits. These data are used to monitor the instrument operations daily, but should not be used for regulatory purposes.

Level 0 data validation is accomplished by:

- Collecting data via modem, and
- Initially screening the daily data for anomalies.

Data Management

Managing the data collected is just as important as correctly collecting the data. Generally, data is to be retained for a period of 3 years after final submittal. All information collected in any ambient air monitoring program should be organized in a logical and systematic manner.

 STANDARD OPERATING PROCEDURE	Title: Level 1 Data Validation	
	Number: SOP 115	Page: 1 of 8
	Revision Number: 1	Effective Date: 10/15/2014 12/01/2009 (Rev. 0)
Approval: _____ Date: _____		Concurred By: _____

Level 1 data validation involves quantitative and qualitative reviews for accuracy, completeness, and internal consistency. Quantitative checks are performed by MSI's software screening program. Qualitative checks are performed by meteorologists or trained personnel who manually review the data for outliers and problems.

After daily download, data are processed through MSI's quality control screening software to identify values that do not meet acceptance criteria. Raw data are graphed as stacked plots and are visually reviewed. Daily stacked plots of the raw data will be output to .pdf's. There would be one .pdf per day per station. Acceptance criteria that raw data are compared against are based on State, EPA and sensor/analyzer manufacturer recommendations.

Data Screening Procedures

Screening procedures generally include comparisons of measured values to upper and lower limits; these may be physical limits, such as an instrument threshold, or may be established based on experience or historical data. Other types of procedures employed in screening include assessments based on the rate of change of a variable (in these, data that change too rapidly or not at all are flagged as suspect) and assessments based on known physical principles relating two or more variables (e.g., the dew point should never exceed the dry-bulb temperature).

Screening may be regarded as an iterative process in which range checks and other screening criteria are revised as necessary based on experience. For example, an initial QA pass of a data set using default criteria may flag values which upon further investigation are determined to be valid for the particular site. Data which fail the screening test should be flagged for further investigation.

Recommended meteorological data screening criteria, as found in EPA's Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements, Version 2.0 Final, March 2008 is presented below in Table 1. Table 2 presents the air quality recommended data screening criteria as found in EPA's Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. II: Ambient Air Quality Monitoring Program. These are just examples to begin with and should be expanded upon and modified to be project specific for each monitoring station.

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Table 1 Meteorological Data Screening Criteria

Parameter	Criteria	Acceptance Range
WS/VWS	Hourly recorded WS/VWS	0 m/s $\geq$ WS $\geq$ 25 m/s WS varies $\leq$ 0.1 m/s for 3 consecutive hours WS varies $\leq$ 0.5 m/s for 12 consecutive hours
WD/VWD	Hourly recorded WD/VWD	0° $\geq$ WD $\leq$ 360° WD varies $\geq$ 1° for 3 consecutive hours
Temperature	Hourly recorded Temp.	Local record low $\geq$ temp $\leq$ local record high Temp. $\leq$ 5°C from previous hour Temp. varies $\geq$ 0.5°C for 12 consecutive hours
10m-2m Δ T	Hourly recorded 10m-2m difference	Daytime Δ T $<$ 0.1°C/m Nighttime Δ T $>$ -0.1 °C/m -3.0°C $>$ Δ T $<$ 5.0°C
RH/Dew Pt.	Hourly recorded RH	Dew pt. temp. $\leq$ amb. temp Dew pt. temp. $<$ 5°C change from previous hour Dew pt. temp. $\geq$ 0.5°C from previous hour and dew pt. temp $<$ ambient temp. for 12 consecutive hours
Solar Rad.	Hourly recorded solar rad.	Nighttime SR = 0 Daytime SR $<$ max. SR for date and latitude
Bar. Press.	Hourly recorded Bar. Press.	BP $<$ 1050 mb (sea level) or per site climatology BP $>$ 945 mb (sea level) or per site climatology

Table 2 Air Quality Data Screening Criteria

Requirement	Frequency	Acceptance Criteria
Ozone		
One point QC check	1 / 2 weeks	$\leq \pm 7\%$ percent difference
Zero/span check	1 / 2 weeks Daily	Zero drift: $\leq \pm 5$ ppb Zero drift: $\leq \pm 3$ ppb Span drift: $\leq \pm 7\%$
Shelter Temperature	Daily	20-30°C (hourly avg.) or manufacturer specs.
Carbon Monoxide		
Precision	1 / 2 weeks	$\pm 10\%$ percent difference
Zero/span check	1 / 2 weeks Daily	Zero drift: 0.6 ppm Zero drift: 0.4 ppm Span drift: 10%
Shelter Temperature	Daily	20-30°C (hourly avg.) or manufacturer specs.
Sulfur Dioxide		
Precision	1 / 2 weeks	$\pm 10\%$ percent difference
Zero/span check	1 / 2 weeks Daily	Zero drift: $\leq \pm 5$ ppb Zero drift: $\leq \pm 3$ ppb Span drift: 10%
Shelter Temperature	Daily	20-30°C (hourly avg.) or manufacturer specs.

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Table 2 Air Quality Data Screening Criteria (Continued)

Requirement	Frequency	Acceptance Criteria
NO₂		
One Point QC Check	1/ 2 weeks	±≤15% (percent difference)
Zero/span check	1/ 2 weeks Daily	Zero drift ≤±5 ppb Zero drift ≤±3 ppb Span drift≤±10%
Converter Efficiency	1 /2 weeks	96 – 104%
Shelter Temperature	Daily	20-30°C (hourly avg.) or manufacturer specs.
PM₁₀ Continuous		
Sampling period - 24 hours	Each sample period	1380-1500 minutes midnight to midnight
Average flow rate	Every 24 hours	Average within 5% of 16.67 liters/min
One-point flow rate verification	Monthly	±4% of transfer standard and 5% of design
PM_{2.5} Continuous		
Sampling period - 24 hours	Each sample period	1380-1500 minutes
Hour estimate	Every hour	Instrument dependent
Average flow rate	Every 24 hours	Average within 5% of 16.67 liters/min
Variability in flow	Every 24 hours	CV ≤2%
One-point flow rate verification	Monthly	±4% of transfer standard and 5% of design

Data Quality Control Flags

Per EPA's Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, EPA recommends the use of flags or result qualifiers to identify potential problems with data (or a sample). According to EPA, a flag is an indicator of the fact and the reason that a data value (a) did not produce a numeric result, (b) produced a numeric result but it is qualified in some respect relating to the type or validity of the result, or (c) produced a numeric result but for administrative reasons is not to be reported outside the organization.

Thus, quality control flags, consisting of a letter will be assigned to each datum to indicate its quality. Multiple flags can be applied to each data point such as data invalid due to calibration (I, CA). It is preferred to assign multiple flags if problem is known. A list of the quality control codes to be assigned to the data points are presented in Table 3.

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Table 3 Data Flags

Flag	Code	Description
V	0	Valid
BC/AT	9995/9986	Multi-point Calibration/ Calibration
AN	9980	Instrument Malfunction
AO	9981	Acts of Nature
BH	9965	Local Interference
BA	9993	Maintenance
BJ	9963	Operator Error
AZ	9992	Performance Audit
AX	9990	Precision Check
AV	9988	Power Failure
AQ	9983	Datalogger or Collection Failure
AE	9971	Shelter Temperature High
AE	9971	Shelter Temperature Low
TO	9961	Datalogger Time Off
BF	9998	Zero/span
AP	9982	Site Vandalism
AH	9974	Sample Flow Rate out of Limits
AI	9975	Insufficient Data (cannot calculate)
AL	9978	Voided by Operator
AM	9979	Miscellaneous Void
AS	9985	Poor Quality Assurance Results
AY	9991	QC Control Points (zero/span)
BE	9997	Building/Site Repair
BK	9962	Site computer/ datalogger down
DA	9951	Aberrant Data

All necessary supporting material, such as audit or calibration field sheets, and any site logs, should be used for the level 1 validation. Access to a daily weather archive should also be reviewed for use in relating suspect data with to local and regional meteorological conditions. Any problem data, such as data flagged in an audit, should be indicated as such. Data values considered questionable should be flagged for verification.

Data Validation Steps

The various steps involved in data validation are summarised below. Note that not all steps apply to all types of data:

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- > Check any incident log files, in the cases of loggers that automatically produce such files;
- > Check for power failures;
- > Check traces exhibiting noise, spikes, non-varying data, or influences of other equipment (e.g. air conditioner);
- > Check for uncharacteristic shapes of calibration curves;
- > Review of zero, span, one point QC verification information;
- > Create and examine 'calibration control plots' of zero and span outputs from calibrations as a function of time, and compare these against the expected range of variability;
- > Invalidate data associated with any calibration run which produces readings of zero or span outside the specified tolerance;
- > Use linear interpolation to correct for observed zero drift, span drift or clock error;
- > Check for data outside the plausible range;
- > Check for data that are inconsistent with measurements of other pollutants at the same site, for example NO and O₃ cannot coexist at high concentrations, ozone formation is a function of temperature and solar radiation, and neither NO₂ nor NO levels can ever exceed NO_x levels;
- > Investigate the cause of unexpected outlier measurements;
- > Check measurements for consistency with other monitoring stations in the region if available;
- > Conduct simple statistical tests on each month's data;
- > Flag data that are missing, questionable etc.; and
- > Record all validation steps for quality control.

Air Quality Data Reduction Using Calibration Information

An analyzer's response calibration curve relates the analyzer response to actual concentration units of measure, and the response of most analyzers tends to change (drift) unpredictably with passing time. These two conditions must be addressed in the mechanism that is used to process the raw analyzer readings into final concentration measurements. According to EPA, three practical methods are described below. They are listed in order of preference:

1) Universal Calibration. A fixed, "universal" calibration is established for the analyzer and used to calculate all ambient readings. All verifications and checks are used to measure the deviation of the current analyzer response from the universal calibration. Whenever this deviation exceeds the established zero and span adjustment limits, the analyzer is recalibrated.

2) Major Calibration Update. In this method, the calibration slope and intercept used to calculate ambient measurements are updated only for "major" calibration (multi-point verification/calibrations). All ambient measurements are calculated from the most recent major calibration. Between major calibrations, periodic zero and span calibrations are used to measure the difference between the most recent major calibration and the current instrument response.

3) Step-Change Update. The adjusted slope and intercept of the most recent calibration are used to calculate all subsequent ambient readings until updated by another calibration (i.e., no interpolation). No unadjusted zero or span readings are used, and ambient measurements can be calculated in real time if desired.

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Validation of Ambient Data Based on Calibration Information

When a zero or span drift check is determined to have failed the limits listed in Table 2, additional checks are performed to determine the cause of the failure. The following items are reviewed or performed:

- 1) Is the failure due to the automated system;
- 2) Check to see if failure is an outlier;
- 3) Re-run failed point concentration to verify failure;

If it is determined that a zero or span check does exceed the limits in table 2, then a multi-point calibration to correct the issue is conducted and the data are invalidated, if necessary back to the previous passing check.

Indicated failures which do not lead to invalidation include:

- > Calibration system issue;
- > Points are in tolerance after being rerun;
- > Multipoint calibration indicates no need for adjustment of the analyzer (i.e. "as found" in tolerance).

Dealing with Data near Detection Limits

Every instrument has an uncertainty associated with each measurement. This is normally described as $\pm$ a specific value. This means that at very low ambient concentrations, it is conceivable that an analyzer will report a negative value. In addition, most calibration and datalogging systems will also have an uncertainty measurement. It is necessary to calculate the total of all the uncertainties for the entire operation to determine what the overall uncertainty for the data is.

Occasionally, large negative spikes may occur due to instrumental error. These negative (and positive) spikes should be reviewed during the data analysis process to evaluate whether they are real or spurious. Inadequate or faulty heating of the inlet air on some particulate monitors (most commonly seen on BAMs) can allow moisture to affect the sample, giving rise to large positive spikes, normally followed by large negative spikes. It is recommended that both spikes be removed as invalid data, the temperature sensors checked for faults, and the inlet temperature reset. Unless there is good evidence to remove a value, it should be left in but flagged as suspicious.

In some situations the concentration of the pollutant being measured may be very near zero, in which case the measured value (after adjusting for drift of zero and span) may be less than the measurement limit of detection. In this situation, various practices have been adopted in the past. For example, the measurements could be reported as:

- (i) below the detection limit;
- (ii) zero;
- (iii) some value between zero and the detection limit, and;
- (iv) the actual measured value (positive or negative) whether or not it is below the detection limit.

Title: Level 1 Data Validation	Number: SOP 115	Revision Number: 1

EPA recommends the use of (iv). Even negative concentration readings should be retained, provided they lie within the range of expected instrument fluctuations. Any negative reading that is too large to be explained by normal instrument fluctuations should serve as an indication of faulty calibration or instrument operation, and should prompt further investigation.

In particular, if a negative value is found with a magnitude greater than the maximum daily zero-drift specified, the instrument is probably not complying with the required performance requirements. Unless such an anomaly can be resolved, the measurement system should be deemed faulty and all data should be invalidated back to a calibration that is free of doubt.

The minimum detection limits for several currently operated air quality analysers is presented in Table 4.

Table 4 Minimum Detection Limit for Air Quality Analysers

Analyser	Minimum Detection Limit
Teledyne API Ozone 400A or 400E	<0.6 ppb
Teledyne API NO/NO ₂ /NO _x 200E	<0.4 ppb
Teledyne API NO/NO ₂ /NO _x 200EU	50 ppt
Teledyne API SO ₂ 100A and 100E	<0.4 ppb
Teledyne API CO 300E	0.04 ppm
TEOM 1400ab	0.06 µg/m ³ (1-hour average)

Missing Data

Interpolation or extrapolation to fill in missing data should not be used in the process of producing a basic quality-assured data set.

Data Validation Summary Spreadsheet

It is important to maintain detailed, accurate records of changes to the data. The justification for all data invalidations will be permanently documented in a data validation summary spreadsheet. These records will save time and effort if questions arise about specific data at a later date.

At the end of each month, a data validation summary spreadsheet will be compiled indicating the following:

- > Measured parameters with suspicious or invalid data
- > Date and time of this data
- > Identification of data points that were flagged as suspect or invalid, and the reason why they were flagged
- > Systematic problems that affected the data
- > Any adjustments, deletions, or modifications, with a justification or reason for the change
- > Listing of values and value changes
- > Who performed the data validation and when

Hourly data files will be prepared for final quality assurance. These data files will contain only validated data and will have a .hry extension.

Title: Level 1 Data Validation	Number: SOP 115	Revision Number: 1

Reporting Intervals

Currently, hourly averages are the reporting interval for continuous particulate and gaseous data. These are the reporting intervals for AQS. These reporting intervals will meet most of the multiple objectives for supporting health effects studies, trends, NAAQS attainment decisions, and accountability of control strategies. However, with these objectives also comes the desire for data at finer time resolutions: 5 minute averages for gaseous pollutants and sub-hourly averages for certain particulate matter monitors. Examples of this need for finer time resolution of data include, but are not limited to: tracking air pollution episodes, providing data for exposure studies, model evaluation, and evaluating shorter averaging periods for potential changes to the NAAQS.

With this generation of data having a shorter averaging interval, the challenge becomes validation of all the data. EPA's historical perception has been that each criteria pollutant measurement needs to be verified and validated manually. To provide a consistent approach for the reporting interval of data, EPA has taken a tiered approach to data reporting. At the top tier, hourly data intervals will remain the standard for data reporting. Long term, networks will be capable of providing at least 5-minute intervals for those methods that have acceptable data quality at those averaging periods.

APPENDIX C

Corrective Action Report

 STANDARD OPERATING PROCEDURE	Title: Corrective Action Procedures	
	Number: SOP 54	Page: 1 of 1
	Revision Number: 2	Effective Date: 08/29/2016 01/05/2010 (Rev. 1)
Approval: _____ Date: _____		Concurred By: _____

Conditions adverse to quality will be identified promptly and will be corrected as soon as possible. The identification, cause, and corrective action for conditions adverse to quality will be documented and reported to the appropriate levels of management. Follow-up action shall be taken to verify implementation of the corrective action. A corrective action report form will be filled out that identified the problem or deficiency, the proposed corrective action, and the results of the corrective action.

APPENDIX D

Site Check Form

SITE VISIT CHECKLIST



Operator _____ Date _____
Site Name _____ Stn ID _____
Project _____ Time _____

Visit Type: Weekly _____ Unscheduled: _____

	Yes	No
Tower Straight	☐	☐
Guy wires taut, secured	☐	☐
Wind Sensors Intact (Propeller Blades, Vane Tail)	☐	☐
Temperature Aspirators Operational	☐	☐
Solar Panel Clean and Properly Oriented	☐	☐
Rain Gauge Funnel Clear of Debris/Snow/Ice	☐	☐
Signs of Sensor Damage	☐	☐
Sensors Level and Oriented Correctly	☐	☐
Datalogger Date/Time Correct	☐	☐
Boom Orientation OK	☐	☐
Sensor Outputs Checked and Functioning Properly	☐	☐
Grounding System Intact	☐	☐
Cellular Antenna Correctly Oriented	☐	☐
Area Free of Vandalism	☐	☐

Site Visit By: _____

APPENDIX E

Standard Operating Procedures for Meteorological Sensor Calibration

 STANDARD OPERATING PROCEDURE	Title: Wind Direction Calibration	
	Number: SOP M11	Page: 1 of 3
	Revision Number: 6	Effective Date: 09/18/2014 06/20/2008 (Rev. 5)
Approval: Date:		Concurred By:

The wind direction calibration will be performed by comparing the wind direction sensor readouts on the DAS and chart recorder with known wind directions established by using a theodolite or precision compass. Several points over the measurement range are verified using a direction template, assigned compass reference points, or established distant sighting targets. Differences between reference and sensor measured directions are recorded. Direction vane starting threshold will be checked using a torque disc or torque watch gauge.

Calibration Personnel Responsibilities

The person performing the calibration is responsible for the certification of the calibration standard before conducting calibrations. The calibration technician will calculate the results of the calibration and will inform the Project Manager of the preliminary findings.

Calibration Instrumentation and Forms

The calibration technician conducting the calibration will bring the following equipment to the site:

1. Professional classic pocket transit or precision compass with tripod,
2. R.M. Young Model 18212 Vane Angle Fixture,
3. R.M. Young Model 18331 Vane Torque Gauge,
4. Current magnetic declination angle for site to be calibrated,
5. Calibration field data sheets, and
6. (optional) Theodolite and True North solar angle program for computer.

Title: Wind Direction Calibration	Number: SOP M11	Revision Number: 6

Procedures

Calibration procedures are in accordance with the guidelines of the EPA Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV, Version 2.0 Final (EPA, March 2008).

1. For wind direction instruments that have crossarms, prior to lowering the tower or the crossarm, determine the crossarm alignment by sighting along it using a precision compass corrected for magnetic declination. Current magnetic declination is obtained using the latitude/longitude or UTM coordinates of the site and a magnetic declination calculation computer program. Optionally, if a solar viewing is possible, a theodolite can be set up and oriented using a solar angle computer program. The calibration person views the crossarm through the theodolite to verify alignment with reference to True North.
2. Once the crossarm is lowered, the person conducting the calibration positions the wind vane exactly parallel to the crossarm and records the reading.
3. Determine accuracy and linearity by mounting a direction template or calibration fixture and fixing the vane in at least the four cardinal directions. The vane is rotated sequentially through at least the four directions clockwise and then counter clockwise and the DAS readouts are recorded. (The tip and then the tail of the vane may also be pointed at established distant sighting targets.)
4. The difference between the station and calibration wind directions is calculated using the following equation:

$$\text{Diff.} = \text{System Wind Direction} - \text{Calibration Wind Direction}$$

The differences calculated above are compared with the EPA PSD recommended criteria of $\pm 5\%$ for the entire system (orientation plus linearity). If results exceed these criteria, the calibration person should recommend recalibration of the sensor or replacement of the potentiometer.

5. Determine starting threshold of the wind vane by measuring shaft rotational torque of the sensor using a torque gauge or disc. The measured torque should be less than the maximum allowable torque provided by the manufacturer corresponding to a 0.5 m/s wind speed threshold.

Title: Wind Direction Calibration	Number: SOP M11	Revision Number: 6

If the measured torque exceeds this value, the calibrator should recommend bearing and/or potentiometer replacement. If necessary, calculate the torque value that corresponds to the starting threshold of 0.5 m/s for a 10° deflection using the "k" value provided by the manufacturer and the following equation:

$$T = kU^2$$

Where: T = torque in gm-cm

U = wind speed in m/s

and k = constant

The torque gauge test determines if the wind vane starting threshold is less than or equal to the required specifications. The wind vane is considered to be within the recommended criteria if the indicated torque value is less than or equal to the calculated or stated maximum starting torque value. If the wind vane fails the test, the calibrator should recommend that the bearings and/or potentiometer be replaced.

 STANDARD OPERATING PROCEDURE	Title: Wind Speed Calibration	
	Number: SOP M12	Page: 1 of 2
	Revision Number: 4	Effective Date: 09/18/2014 06/20/2008 (Rev. 3)
Approval: Date:		Concurred By:

The wind speed calibration will be performed by temporarily replacing the anemometer cups or propeller with a constant RPM or synchronous motor and comparing the speed corresponding to the rotation rate as supplied by the manufacturer with the equivalent wind speed displayed by the instrument. Starting thresholds will be checked using a torque disk or torque watch gauge to measure shaft rotational torque.

Calibration Personnel Responsibilities

The calibration technician is responsible for the certification of the calibration standard before conducting calibrations. The calibration technician will calculate the results of the calibration and will report the preliminary findings to the Project Manager.

Calibration Instrumentation and Forms

The calibration technician will bring the following equipment to the site:

1. RM Young Model 18810 anemometer drive SN CAO1889.
2. RM Young Model 18310 Torque Disc.
3. Calibration field data sheets.

Procedures

Calibration procedures conform to the guidelines of the EPA Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV, Version 2.0 Final (EPA, March 2008).

1. Starting threshold is calibrated by checking sensor shaft rotational torque with a torque disc.

Title: Wind Speed Calibration	Number: SOP M12	Revision Number: 4

A. R.M. Young Model 18310 Torque Disc

With the anemometer sensor in the horizontal position, remove the anemometer cups or propeller and install the torque disc on the anemometer shaft. Use manufacturer-provided allowable torque values or calculate the torque value that corresponds to the starting threshold of 0.5 m/s using the "k" value provided by the manufacturer and the following equation:

$$T = kU^2$$

Where: T = torque in gm-cm

U = wind speed in m/s

and k = constant (from manufacturer)

Install the 0.1 gm screw weight in the appropriate hole of the torque disc that corresponds to the calculated torque value, and position the weight so that it is level with the anemometer shaft. Release the weight and note if the torque disc and anemometer shaft rotate freely. To measure the actual starting torque, change the position of the screw weight starting at the location closest to the shaft and move outward until the weight rotates freely from the horizontal. The weight of the screw times the distance from the shaft equals the torque in gm-cm.

2. The accuracy of wind speed measurements is tested at zero and at least two speeds within the operational range of the sensor. R.M. Young Model 18810 selectable speed anemometer drive will be used to generate stable calibration input speeds over the range of the sensor.

The calibration person removes the anemometer cups or propeller and joins the wind speed sensor shaft to the calibration motor with a coupling device.

3. Calculate the difference between the system and calibration wind speeds using the following equation:

$$\text{Diff.} = \text{System Wind Speed} - \text{Calibration Wind Speed}$$

The differences calculated above are compared with the USEPA.PSD recommended criteria of ± 0.2 m/s.

 STANDARD OPERATING PROCEDURE	Title: Temperature Calibration	
	Number: SOP M13	Page: 1 of 2
	Revision Number: 4	Effective Date: 09/18/2014 06/20/2008 (Rev. 3)
Approval:	Date:	Concurred By:

Calibration Personnel Responsibilities

The calibration technician is responsible for the certification of the calibration standard before conducting calibrations. He/She provides the method for calibrating the equipment. The calibration technician will calculate the results of the calibration and will report preliminary findings to the Project Manager.

Calibration Equipment

- Mercury-in-glass thermometer or digital thermometer calibrated with a laboratory NIST-traceable thermometer.
- Thermos bottles - one with hot water, one warm water, and one ice bath or aluminum blocks at different temperatures.
- Calibration forms.

Equipment Setup and Calibration Procedures

Calibration procedures are in accordance with the guidelines of the EPA Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV, Version 2.0 Final (EPA, March 2008).

Temperature sensing systems are calibrated by collocated intercomparison with a calibrated reference standard. If immersion in water is possible, the station temperature sensing system thermistor and the calibrated thermometer are immersed in a common water bath and the readings are compared at temperatures of approximately 0°, 20°, and 40°C (or 3 points over the expected measurement range at the site) or by using aluminum blocks inserted into wide-mouth thermos bottles to provide the medium for various reference temperatures. If delta-temperature is measured, the delta-temperature is checked by simultaneous insertion of delta-temperature sensors in the same medium and comparing outputs.

Title: Temperature Calibration	Number: SOP M13	Revision Number: 4

Data Reduction and Interpretation

Calculate the difference between the sensor and calibration temperatures using the equation:

$$\text{Diff.} = \text{System Temperature} - \text{Calibration Temperature}$$

The differences calculated above are then compared with the EPA recommended criteria of $\pm 0.5^{\circ}\text{C}$ and $\pm 0.1^{\circ}\text{C}$ for delta-temperature when the sensors are checked in the same medium.

 STANDARD OPERATING PROCEDURE	Title: Relative Humidity Calibration Procedures	
	Number: SOP M15	Page: 1 of 2
	Revision Number: 4	Effective Date: 09/18/2014 06/20/2008 (Rev. 3)
Approval: Date:		Concurred By:

Calibration Personnel Responsibilities

The calibration technician is responsible for the certification of the calibration standard before conducting calibrations. The calibration person will calculate the results of the calibration and will inform the Project manager of the preliminary findings.

Calibration Equipment

- Rotronic or other calibrated digital RH probe - or - a Sato or similar motor aspirated psychrometer.
- Booklet of psychometric tables.
- Water.
- Large plastic bucket (approx. 5 gallon size).
- Calibration forms.
- Portable barometer if using psychometric tables.

Equipment Setup and Calibration Procedures

Calibration procedures are in accordance with the guidelines of the EPA Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV, Version 2.0 Final (EPA, March 2008).

Relative humidity sensors are calibrated using one of two methods.

- 1) Collocating the station RH sensor and the calibrated RH sensor inside a plastic bucket where water can be added in the bottom of the bucket to provide several different calibration points.
- 2) Collocating the calibrated RH sensor or motor-aspirated psychrometer adjacent to the site sensor to sense the ambient conditions. Multiple readings are taken over several hours (wet bulb, dry bulb) and converted into RH using the manufacturer's tables.

Title: Relative Humidity Calibration	Number: SOP M15	Revision Number: 4

Data Reduction and Interpretation

Calculate the difference between the station and calibration relative humidity's using the equation:

$$\% \text{ Diff.} = \frac{\text{Station \% RH} - \text{Calibration \% RH}}{\text{Calibration \% RH}}$$

The mean of the percent differences calculated above is then compared with the EPA recommended criteria of ± 7 percent relative humidity.

 STANDARD OPERATING PROCEDURE	Title: Solar Radiation Calibration	
	Number: SOP M16	Page: 1 of 2
	Revision Number: 4	Effective Date: 9/30/2014 6/20/2008 (Rev. 3)
Approval: Date:		Concurred By:

Calibration Personnel Responsibilities

The calibration technician is responsible for the certification of the calibration standard before conducting equipment calibrations. The calibration technician will calculate the results of the calibration and will inform the Project Manager of the preliminary findings.

Calibration Equipment

- Certified Reference Standard Pyranometer
- Data Acquisition System with appropriate datalogger program
- Tripod mount for pyranometer

Equipment Setup and Calibration Procedures

Calibration procedures are in accordance with the guidelines of the EPA Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV, Version 2.0 Final (EPA, March 2008).

Solar radiation sensor calibrations are conducted by collocation of a certified reference pyranometer with the site pyranometer. A separate datalogger is utilized for the reference pyranometer and it is time-synchronized with the site data acquisition system prior to intercomparison. Averaging times of stored output data in the calibration datalogger must include at least the same outputs as in the site DAS. Periodic output readings from the site sensor and the reference are manually recorded during at least a three-hour or longer intercomparison period. To confirm the DAS output during darkness, the site sensor should be covered sufficiently to allow no light to penetrate and the sensor output should be verified to assure a near-zero value is recorded.

Title: Solar Radiation Calibration	Number: SOP M16	Revision Number: 4

Data Reduction and Interpretation

The station solar radiation outputs from the DAS and the corresponding calibration solar radiation values are intercompared by calculating the percent difference using the equation:

$$\text{Percent Diff.} = \frac{\text{Station solar radiation} - \text{Calibration solar radiation}}{\text{Calibration Solar Radiation}} * 100$$

The mean of the percent differences is then compared with the EPA recommended criteria of ± 5 percent of the calibration reference or ± 25 watts/m².

 STANDARD OPERATING PROCEDURE	Title: Barometric Pressure Calibration	
	Number: SOP M17	Page: 1 of 1
	Revision Number: 3	Effective Date: 09/30/2014 8/27/2007 (Rev. 2)
Approval:	Date:	Concurred By:

Calibration Personnel Responsibilities

The calibration technician is responsible for the certification of the calibration standard before conducting equipment calibrations. The calibration technician will calculate the results of the calibration and informs the Project Manager of the preliminary findings.

Calibration Equipment

- Certified Digital Barometer or digital or aneroid barometer standardized to local National Weather Service reference.

Equipment Setup and Calibration Procedures

Collocate calibration reference barometer with station barometric pressure sensor and record readings for intercomparison.

Data Reduction and Interpretation

Calculate the difference between the station and calibration reference barometric pressure (BP) using the equation:

$$\text{Difference} = \text{Station BP} - \text{Calibration BP}$$

The mean of the calculated differences is then compared with the EPA recommended criteria within of ± 3 mb of the calibration reference.

 STANDARD OPERATING PROCEDURE	Title: Net Radiation Calibration	
	Number: SOP M18	Page: 1 of 2
	Revision Number: 4	Effective Date: 10/14/2014 6/20/2008 (Rev. 3)
Approval: Date:		Concurred By:

Calibration Personnel Responsibilities

The calibration technician is responsible for the certification of the calibration standard before conducting calibrations. The calibration technician will calculate the results of the calibration and report the preliminary findings to the Project Manager.

Calibration Equipment

- Certified Reference Standard Net Radiometer
- Data Acquisition System with appropriate datalogger program
- Tripod mount for net radiometer
- Calibration field data sheets

Equipment Setup and Calibration Procedures

Calibration procedures are in accordance with the guidelines of the EPA Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV, Version 2.0 Final (EPA, March 2008).

Net radiation sensor calibrations are conducted by collocation of a certified reference net radiometer with the site net radiometer. A separate datalogger is utilized for the reference radiometer and it is time-synchronized with the site data acquisition system prior to intercomparison. Averaging times of stored output data in the calibration datalogger must include at least the same outputs as in the site DAS. Periodic output readings from the site sensor and the reference are manually recorded during at least a three-hour or longer intercomparison period.

Title: Net Radiation Calibration	Number: SOP M18	Revision Number: 4

Data Reduction and Interpretation

The station net radiation outputs from the DAS and the corresponding calibration net radiation values are intercompared by calculating the percent difference using the equation:

$$\text{Percent Diff.} = \frac{\text{Station net radiation} - \text{Calibration net radiation}}{\text{Calibration Net Radiation}} * 100$$

The mean of the percent differences is then compared with the EPA recommended criteria of ± 5 percent of the calibration reference or ± 25 watts/m².

APPENDIX F

Quality Assurance/Data Validation Logs, and Data Report Quality Assurance Checklist



DATA VALIDATION SITE ACTIVITY LOG

Site Name:

Activity:

- Calibration
- Maintenance
- Sensor Replacement
- Sensor Malfunction
- Performance Audit
- Other

Measurement Off-Line

[illegible]

MSI
Meteorological Solutions Inc.
A Trinity Consultants Company

Client _____
 Site Name _____
 MSI Project # _____
 Report Date _____
 Check by: _____

Summary Tables/Data File Check:											
Parameter:	10 WS	10 WD	2m Temp.	10m Temp.	ΔT	RH	SR	NR	BP	Prec.	Comments
Verify Missing Data											
Verify Off-Line Periods											
Verify Percent Recovery											
Verify Table Data Calculations											
Report Text Check											
Report Tables Check											
TOC Check											
Data Statistics Check											
Calibration Review											

APPENDIX C. CENTURY SEBREE SOURCE CHARACTERISTICS FOR SIP DEMONSTRATION

C-1. Modeled Release Parameters - 1-Hour SO2 NAAQS Modeling

Table C-1.1. List of Century Point Source Stack Parameters for 1-Hour SO2 NAAQS Modeling

Stack ID	Description	UTM East (m)	UTM North (m)	Elevation ¹ (m)	Stack Orientation ²	Emission Rate ^{4,5} (g/s)	Stack Height (m)	Stack Temp. ³ (K)	Exit Velocity ³ (m/s)	Stack Diameter (m)
A6_02	Remelt Furnace (90); Gas Burners	455,802	4,168,313	135.9	V	1.6920E-03	13.1	719.8	7.35	1.50
F1_01	Holding Furnaces (I1); Metal Processing	456,129	4,167,786	135.9	V	1.1355E-03	27.4	431.5	7.83	0.97
F1_02	Holding Furnaces (I2); Metal Processing	456,139	4,167,798	135.9	V	1.1355E-03	27.4	431.5	7.83	0.97
F1_03	Holding Furnaces (I3); Metal Processing	456,161	4,167,821	135.9	V	1.1355E-03	27.4	431.5	7.83	0.97
F1_04	Holding Furnaces (I4); Metal Processing	456,174	4,167,835	135.9	V	1.1355E-03	27.4	431.5	7.83	0.97
F1_05	Holding Furnaces (I5); Metal Processing	456,190	4,167,854	135.9	V	1.1355E-03	27.4	431.5	7.83	0.97
F1_06	Holding Furnaces (I6); Metal Processing	456,201	4,167,866	135.9	V	1.1355E-03	27.4	431.5	7.83	0.97
F2_01	Holding Furnaces (I7); Metal Processing	456,217	4,167,883	135.9	V	1.1355E-03	27.4	431.5	7.83	0.97
F2_02	Holding Furnaces (I8); Metal Processing	456,228	4,167,895	135.9	V	1.1355E-03	27.4	431.5	7.83	0.97
H1_01	Homogenizing Furnace (I1)	456,220	4,167,811	135.9	C	1.0085E-03	18.9	755.4	12.53	1.22
H2_01	Homogenizing Furnace (2I)	456,229	4,167,822	135.9	C	1.0085E-03	18.9	755.4	12.53	1.22
H3_01	Homogenizing Furnace (3I)	456,238	4,167,833	135.9	C	1.0085E-03	18.9	755.4	12.53	1.22
H4_01	Homogenizing Furnace (I3I)	456,288	4,167,896	135.9	C	1.0458E-03	21.3	794.3	17.53	0.46
N2_213 ⁶	Anode Bake Furnace (261 Furnace)	456,090	4,168,046	135.9	V	2.5164E+01	65.0	360.9	8.77	2.59
S5_01 ⁷	Electrode Boiler (S5) (EI)	455,952	4,168,046	135.9	V	9.3377E-04	29.9	433.2	2.13	0.91
S7_01	Green Mill Boiler	455,960	4,168,051	135.9	C	9.4124E-04	29.9	433.2	2.16	0.91
E1_02N	Potline #1 (E1); Potline #1 A-398 Scrubbers	455,865	4,167,889	134.2	V	2.5304E+01	24.6	372.0	10.54	3.84
E1_02S	Potline #1 (E1); Potline #1 A-398 Scrubbers	455,808	4,167,824	134.2	V	2.5304E+01	24.6	372.0	10.58	3.84
E3_02N	Potline #2 (E3); Potline #2 A-398 Scrubbers	455,797	4,167,950	134.2	V	2.5304E+01	24.6	372.0	11.72	3.84
E3_02S	Potline #2 (E3); Potline #2 A-398 Scrubbers	455,740	4,167,886	134.2	V	2.5304E+01	24.6	372.0	11.76	3.84
E5_02N	Potline #3 (E5); Potline #3 A-398 Scrubbers	455,694	4,168,041	134.2	V	2.5304E+01	32.0	366.5	12.61	3.44
E5_02S	Potline #3 (E5); Potline #3 A-398 Scrubbers	455,636	4,167,976	134.2	V	2.5304E+01	32.0	366.5	12.56	3.44
A3	Building 004 Security Boiler	455,798	4,167,624	135.9	C	9.4124E-05	7.0	477.6	2.08	0.41
A4	Building 044 Main Building Boiler	455,884	4,167,671	135.9	C	1.2550E-04	4.6	477.6	2.19	0.46
A7 ⁸	Building 004 Water Heater	455,794	4,167,627	135.9	C	1.6546E-04	7.0	477.6	3.65	0.41
A9 ⁸	Building 004 Miller Picking Boiler	455,798	4,167,629	135.9	C	1.3446E-04	7.3	477.6	21.11	0.15

Stack ID	Description	UTM East (m)	UTM North (m)	Elevation ¹ (m)	Stack Orientation ²	Emission Rate ^{4,5} (g/s)	Stack Height (m)	Stack Temp. ³ (K)	Exit Velocity ³ (m/s)	Stack Diameter (m)
I4	Building 134F Boiler	456,161	4,167,876	135.9	C	1.4119E-04	3.7	477.6	2.46	0.46

¹ Elevation of the plant grade.

² A stack orientation of "V" indicates a vertical unobstructed release and is modeled as a standard point source in AERMOD using the 'POINT' keyword in the source pathway. A stack orientation of "C" indicates an obstructed or "capped" release and is modeled as a capped point source in AERMOD using the regulatory default 'POINTCAP' keyword in the source pathway.

³ For the Anode Bake Furnace (N2_213) and the Potline A-398 Stacks (E1-02N/S,E3-02N/S,E5-02N/S), the average flow rates and temperatures recorded from the stack testing events during the past 6 years covering 2017-2022 are used in the modeling analyses. Annual stack testing is required on these units for PMACT compliance, which means at least one set of test data for each year was used to determine the averages.

⁴ Emissions for the Anode Bake Furnace (N2_213) and the Potline A-398 Stacks (E1-02N/S,E3-02N/S,E5-02N/S) are inflated by 1.266 relative to proposed 30-day average hourly emission rates in consideration of the 1-hour form of the SO₂ NAAQS. (Refer to Section 2.8.6 in the report.)

⁵ Emission rates represent base emissions scenario. For the highest ABF emissions scenario, the Anode Bake Furnace (N2_213) and the Potline A-398 Stacks (E1-02N/S,E3-02N/S,E5-02N/S) emission rates are 3.7818E+01 g/s and 2.3237E+01 g/s per potline stack, respectively. For the highest Potline emissions scenario, the Anode Bake Furnace (N2_213) and the Potline A-398 Stacks (E1-02N/S,E3-02N/S,E5-02N/S) emission rates are 1.7649E+01 g/s and 2.6532E+01 g/s per potline stack, respectively.

⁶ The Anode Bake Furnace stack height and diameter take into account the planned replacement of the existing 70-ft tall, 4.2-ft diameter stack with a new 213.2-ft tall, 8.5-ft diameter stack to be situated adjacent to the existing stack.

⁷ Note that in the modeling report, this unit is referenced as the Indirect Heat Exchanger (S6). The Electrode Boiler (S5) has been removed, but has identical heat input capacity and stack parameters to the Indirect Heat Exchanger (S6); therefore, the model represents emissions from S6.

⁸ The Building 004 Water Heater (A7) and Building 004 Miller Pickling Boiler (A9) have been removed from service. However, they are retained in the model files to remain consistent with the previously submitted modeling protocol.

C-1. Modeled Release Parameters - 1-Hour SO₂ NAAQS Modeling

Table C-1.2. List of Century Buoyant Line Source Parameters for 1-Hour SO₂ NAAQS Modeling

Stack ID	Description	UTM East (m)	UTM North (m)	Elevation ¹ (m)	Emission Rate ^{2,3} (g/s)	Release Height (m)	End UTM East (m)	End UTM North (m)
E1_01A	E1-1- Potroom 101 Roof Vent	455,736	4,167,705	135.9	5.1641E-01	14.80	455,977	4,167,978
E1_01B	E1-1- Potroom 102 Roof Vent	455,698	4,167,738	135.9	5.1641E-01	14.80	455,939	4,168,011
E3_01A	E3-1- Potroom 103 Roof Vent	455,668	4,167,765	135.9	5.1641E-01	14.80	455,909	4,168,038
E3_01B	E3-1- Potroom 104 Roof Vent	455,631	4,167,798	135.9	5.1641E-01	14.80	455,872	4,168,071
E5_01A	E5-1- Potroom 105 Roof Vent	455,567	4,167,854	135.9	5.1641E-01	14.80	455,808	4,168,127
E5_01B	E5-1- Potroom 106 Roof Vent	455,530	4,167,887	135.9	5.1641E-01	14.80	455,770	4,168,161

¹ Elevation of the plant grade.

² Emissions are inflated in consideration of the 1-hour form of the SO₂ NAAQS. Refer to Section 2.8.6 in the report.

³ Emission rates represent base emissions scenario. For the highest ABF and highest potline emissions scenarios, the emission rates are 4.7423E-01 g/s per roof vent and 5.4146E-01 g/s per roof vent, respectively.

Parameter	Description	Value	Units	Basis
XL	Average Building Length	369.11	meters	Design Drawings
HBL	Average Building Height	14.78	meters	Design Drawings
WBL	Average Building Width	19.81	meters	Design Drawings
WML	Average Line Source Width	2.44	meters	Design Drawings
DXL	Average Separation Between Buildings	35.0	meters	Measured from Aerial Imagery
w	Exit Velocity	0.84	m/s	Semiannual PMACT Testing Events (2020-2022)
Ts	Exit Temperature	299.6	K	Semiannual PMACT Testing Events (2020-2022)
Ts-Ta	Delta Temperature	13.28	K	Ibid. and Century Met Tower Data
g	Gravitational Acceleration	9.81	m/s ²	Constant
FPRIMEL	Average Buoyancy Parameter	330.0	m ⁴ /s ³	$= g \cdot XL \cdot WML \cdot w \cdot (Ts - Ta) / Ts$

C-1. Modeled Release Parameters - 1-Hour SO₂ NAAQS Modeling

Table C-1.3. List of Century Volume Source Parameters for 1-Hour SO₂ NAAQS Modeling

Stack ID	Description	UTM East (m)	UTM North (m)	Elevation ¹ (m)	Emission Rate (g/s)	Release Height (m)	Initial Lat. Dim. (m)	Initial Vert. Dim. (m)
IA20	Five Crucible Pre-Heater Stations (< 1 MMBtu/hr each)	456,160	4,167,824	135.9	3.7351E-04	7.62	13.47	7.09
IA21	Auto Sow Casting Pre-Heater Stations (0.5 MMBtu/hr each)	456,160	4,167,824	135.9	1.4940E-04	7.62	13.47	7.09

¹ Elevation of the plant grade.

APPENDIX D. BREC SOURCE CHARACTERISTICS FOR SIP DEMONSTRATION

D-1. Modeled Release Parameters - 1-Hour SO2 NAAQS Modeling

Table D-1.1. List of Big Rivers Point Source Stack Parameters for 1-Hour SO2 NAAQS Modeling

Stack ID	Description	UTM East (m)	UTM North (m)	Elevation ¹ (m)	Stack Orientation	Emission Rate (g/s)	Stack Height ² (m)	Stack Temp. (K)	Exit Velocity (m/s)	Stack Diameter (m)
GREEN1	Green Unit #1	455,890	4,166,718	129.5	V	1.7292E+01	88.6	327.0	22.00	4.57
GREEN2	Green Unit #2	455,836	4,166,727	129.5	V	1.7292E+01	88.6	327.0	26.00	4.57
GREEN11	Green Fuel Gas Heating	455,392	4,166,639	128.9	V	1.3253E-01	6.1	322.0	4.08	0.91
REIDTURB	Reid Combustion Turbine (Diesel Combustion)	455,595	4,166,758	130.2	V	5.5220E+01	33.5	844.3	9.57	4.88

¹ Elevation of the plant grade.

² Stack heights for Green Units #1 and #2 are based on Good Engineering Practice (GEP) height.

APPENDIX E. NEARBY SOURCE CHARACTERISTICS FOR SIP DEMONSTRATION

E-1. AERMOD Model Inputs: 1-hour SO2 NAAQS Inventory Sources

Table E-1.1. Regional Inventory Sources Modeled as Point Sources for 1-Hour SO2 NAAQS Analysis

Stack ID	Model ID	Description	UTM East ^{2,3} (m)	UTM North ^{2,3} (m)	Elevation ¹ (m)	SO2 Emission Rate ^{2,4} (g/s)	Stack Height ^{2,3} (m)	Stack Temperature ^{2,3} (K)	Exit Velocity ^{2,3} (m/s)	Diameter ^{2,3} (m)
3319-EU 01-1	REG01	Big Rivers Electric Corp - Wilson Station	492898	4144764	119.13	2.550156E+02	182.88	325.93	7.59	10.36
3319-EU 06-1	REG02	Big Rivers Electric Corp - Wilson Station	492898	4144764	119.13	5.614864E-03	2.36	836.48	45.64	0.13
3319-EU 07-1	REG03	Big Rivers Electric Corp - Wilson Station	492898	4144764	119.13	8.617836E-05	2.36	836.48	45.64	0.13
CULLEY3	REG04	SIGECO - FB Culley Generating Station	471448	4195764	113.00	1.349731E+02	152.10	326.00	13.04	6.1
P01	REG05	Warrick Newco	470698	4196856	119.00	2.459479E+01	60.66	359.67	15.49	6.1
P02M01	REG06	Warrick Newco	471118	4196959	119.00	6.148697E+00	14.94	355.22	14.79	1.89
P02M02	REG07	Warrick Newco	471133	4196954	119.00	6.148697E+00	14.94	355.22	14.79	1.89
P02M03	REG08	Warrick Newco	471112	4196939	119.00	6.148697E+00	14.94	355.22	14.79	1.89
P02M04	REG09	Warrick Newco	471129	4196934	119.00	6.148697E+00	14.94	355.22	14.79	1.89
P03M01	REG10	Warrick Newco	470771	4196912	119.00	4.099131E+00	14.94	350.22	18.82	1.54
P03M02	REG11	Warrick Newco	470768	4196902	119.00	4.099131E+00	14.94	350.22	18.82	1.54
P03M03	REG12	Warrick Newco	470765	4196891	119.00	4.099131E+00	14.94	350.22	18.82	1.54
P03M04	REG13	Warrick Newco	470762	4196882	119.00	4.099131E+00	14.94	350.22	18.82	1.54
P03M05	REG14	Warrick Newco	470759	4196871	119.00	4.099131E+00	14.94	350.22	18.82	1.54
P03M06	REG15	Warrick Newco	470756	4196861	119.00	4.099131E+00	14.94	350.22	18.82	1.54
P04M01	REG16	Warrick Newco	470750	4196918	119.00	4.099131E+00	14.94	350.78	15.65	1.54
P04M02	REG17	Warrick Newco	470748	4196908	119.00	4.099131E+00	14.94	350.78	15.65	1.54
P04M03	REG18	Warrick Newco	470745	4196898	119.00	4.099131E+00	14.94	350.78	15.65	1.54
P04M04	REG19	Warrick Newco	470742	4196887	119.00	4.099131E+00	14.94	350.78	15.65	1.54
P04M05	REG20	Warrick Newco	470739	4196877	119.00	4.099131E+00	14.94	350.78	15.65	1.54
P04M06	REG21	Warrick Newco	470736	4196867	119.00	4.099131E+00	14.94	350.78	15.65	1.54
P05W	REG22	Warrick Newco	471749	4196703	119.00	1.229739E+01	22.25	350.96	16.10	1.64
P5E1	REG23	Warrick Newco	471758	4196701	119.00	1.229739E+01	22.25	350.96	16.10	1.17
WPP1_3	REG24	Alcoa Power Plant	470738	4196346	119.00	9.096011E+01	115.82	329.00	16.48	7.12
WPP4	REG25	Alcoa Power Plant	470710	4196364	119.00	5.644015E+01	115.82	329.00	15.80	6.1

¹ For Wilson Station imported sources into AERMOD and ran AERMAP with 1-arc second (approximately 30 meter resolution) NED data to get source elevations. For other sources, used elevations from model data provided by IDEM.

² For nearby sources located in Kentucky (Wilson Station sources), potential emission rate, source locations, and stack parameters retrieved from 2021 KYEIS, unless otherwise noted.

³ Modeling data for nearby sources located in Indiana (FB Culley Generating Station, Warrick Newco, and Alcoa Power Plant) were provided by the Indiana Department of Environmental Management (IDEM) on January 31, 2024.

⁴ Emission rates for nearby sources located in Indiana (FB Culley Generating Station, Warrick Newco, and Alcoa Power Plant) were obtained from permit documents. For FB Culley Generating Station and Alcoa Power Plant, the modeled emission rates were from the controlled potential-to-emit (PTE) from the Technical Support Documents (TSD) accompanying latest permits. For Warrick Newco, the modeled emission rates were from Condition D.2.3 limit for the potline stacks from the latest permit.

E-1. AERMOD Model Inputs: 1-hour SO₂ NAAQS Inventory Sources

Table E-1.2. Regional Inventory Sources Modeled as Buoyant Line Sources for 1-Hour SO₂ NAAQS Analysis

Stack ID	Model ID	Description	UTM East ² (m)	UTM North ² (m)	Elevation ¹ (m)	SO ₂ Emission Rate ³ (g/s)	Release Height ² (m)	End UTM East ² (m)	End UTM North ² (m)
L01	REG26	Warrick Newco	471118	4196695	119.00	1.923419E-01	14.02	471199	4196983
L02	REG27	Warrick Newco	471087	4196705	119.00	1.923419E-01	14.02	471167	4196993
L03	REG28	Warrick Newco	471023	4196723	119.00	1.923419E-01	14.02	471105	4197010
L04	REG29	Warrick Newco	470991	4196732	119.00	1.923419E-01	14.02	471072	4197019
L05	REG30	Warrick Newco	470960	4196740	119.00	1.923419E-01	14.02	471040	4197027
L06	REG31	Warrick Newco	470928	4196748	119.00	1.923419E-01	14.02	471008	4197037
L07	REG32	Warrick Newco	470896	4196757	119.00	1.923419E-01	14.02	470975	4197047
L08	REG33	Warrick Newco	470862	4196767	119.00	1.923419E-01	14.02	470943	4197055
L09	REG34	Warrick Newco	470801	4196785	119.00	1.923419E-01	14.02	470879	4197073
L10	REG35	Warrick Newco	470767	4196792	119.00	1.923419E-01	14.02	470847	4197083

¹ Imported sources into AERMOD and ran AERMAP with 1-arc second (approximately 30 meter resolution) NED data to get source elevations.

² Modeling data for Warrick Newco were provided by the Indiana Department of Environmental Management (IDEM) on January 31, 2024.

³ The modeled emission rates for roof vents were calculated using the Condition D.2.3 limit for the potline stacks from the latest permit and an assumption of 98.46% roof vent hood capture, which was reported by Warrick Newco in the Q2 2023 Quarterly Title V Report, to determine an equivalent allowable roof vent emission rate.

APPENDIX F. SITE-SPECIFIC MODEL OPTIONS EVALUATION MODELING FILES

The modeling file zipped directory will be submitted concurrently with this modeling report to Mr. Kevin Davis (Division) via email. The zipped directory will contain all input and output data files used to generate the results from the site-specific model options evaluation presented in this report. The following provides a description of the contents of each folder included in the zipped directory.

AERMAP

- ▶ Contains the AERMAP input (.inp), output (.out), receptor (.rec), and source (.src) files for the modeling analysis receptor grids described in **Section 2.7** and the nearby sources described in **Section 2.10**.

MET

- ▶ AERMET - Contains the AERMET input and output files that were used to create the model-ready meteorological files based on the Century On-site, Evansville (KEVV) surface, and Nashville (KBNA) upper air characteristics.
- ▶ AERMINUTE – Contains the AERMINUTE raw ASOS one-minute data (.dat), raw ASOS five-minute data (.dat), raw hourly ISHD data files (.ish), input files (.inp) and output files (.dat) for the KEVV one-minute data processing.
- ▶ AERSURFACE
 - KEVV – Contains the NLCD16 data (.tif) for tree canopy, impervious surfaces, and land cover. AERSURFACE input (.inp) and output (.dat) files for KEVV based on average (AVG), wet (WET), and dry (DRY) moisture conditions.
 - CENTURY – Contains the NLCD16 data (.tif) for tree canopy, impervious surfaces, and land cover. AERSURFACE input (.inp) and output (.dat) files for the Century facility based on average (AVG), wet (WET), and dry (DRY) moisture conditions.
- ▶ Model-Ready – Contains the surface (.sfc) and profile (.pfl) meteorological data files based on Century on-site surface characteristics (substituted with KEVV surface characteristics when missing) and KBNA upper air characteristics that were utilized in this modeling analysis.
- ▶ On-Site – Contains the hourly on-site data measured at the Century on-site meteorological data tower for the modeling period (2017-2022).

BPIP

- ▶ Contains the input (.inp), output (.out), and summary (.sum) files from the building downwash analysis. This analysis includes all modeled sources and buildings.

AERMOD

- ▶ Hourly Emissions Files
 - Individual A398 Stacks – Contains the hourly emissions files with each A398 stack modeled individually. These same hourly emissions files were used in those modeling scenarios considering plume merging for the A398 stacks.
 - Representative A398 Stack – Contains the hourly emissions files with each grouping of A398 stacks modeled as a single representative stack.
- ▶ The following folders contain the AERMOD input (.ami), output (.aml), highest 4th high plot (.plt) files, and rank files (.rnk) for their respective 1-hour SO₂ modeling analyses as described in **Appendix A**.
 - Rural – No urban option or plume merging were applied in this scenario. Groups of potline stacks are modeled as a single representative stack for each group.

- Urban 1M - Urban option with a population of 1,000,000 and no plume merging were applied in this scenario. Groups of potline stacks are modeled as a single representative stack for each group.
 - Urban 1M 10 Stacks - Urban option with a population of 1,000,000 and no plume merging were applied in this scenario. Potline A398 stacks were modelled as individual stacks.
 - Urban 1M Merge - Urban option with a population of 1,000,000 and plume merging for the A398 stacks were applied in this scenario. Groups of potline stacks are modeled as a single representative stack for each group.
 - Urban 2M - Urban option with a population of 2,000,000 and no plume merging were applied in this scenario. Groups of potline stacks are modeled as a single representative stack for each group.
 - Urban 2M 10 Stacks - Urban option with a population of 2,000,000 and no plume merging were applied in this scenario. Potline A398 stacks were modelled as individual stacks.
 - Urban 2M Merge - Urban option with a population of 2,000,000 and plume merging for the A398 stacks were applied in this scenario. Groups of potline stacks are modeled as a single representative stack for each group.
- SIP - Contains the 1-hour SO₂ AERMOD input (.ami), output (.aml), and highest 4th high plot (.plt) files for the current and future stack configurations for the base emissions scenario and the files for the future stack configuration for the highest ABF and highest potline emissions scenarios as described in **Section 2** of this report.

APPENDIX K

Century Aluminum Permit Application August 14, 2024

August 14, 2024

Ms. Michelle McCloskey
Permit Support Section Manager
Kentucky Division for Air Quality
300 Sower Blvd, 2nd Floor
Frankfort, KY 40601

*RE: Title V Permit Revision Application to Establish New SO₂ Emission Limits Consistent with Values Used for SO₂ Nonattainment SIP Modeling Demonstration
Century Aluminum Sebree, LLC; (Source ID 21-101-00029; Agency Interest #1788)*

Dear Ms. McCloskey:

Century Aluminum Sebree, LLC (Century) owns and operates a primary aluminum production facility in Robards, Kentucky near the town of Sebree (Sebree Plant). The facility is a major source under the Title V operating permit program and currently operates in accordance with Title V operating permit V-19-010 R2, issued by the Kentucky Division for Air Quality (Division). The existing permit expires on November 11, 2024.¹

Consistent with discussions with the Division, Century is submitting this application to facilitate the issuance of a revision to the current Title V permit (i.e., prior to renewal) that establishes new federally enforceable conditions limiting SO₂ emissions as well as other requirements consistent with the emissions and stack configuration used in the State Implementation Plan (SIP) modeling demonstration analysis recently submitted on August 7, 2024.

1. Background and Purpose for Application

The U.S. Environmental Protection Agency (EPA) promulgated the current 1-hour SO₂ National Ambient Air Quality Standards (NAAQS) at 75 parts per billion (ppb) on June 22, 2010. Compliance with the 1-hour SO₂ NAAQS is determined based on monitor data using a three-year average of the 4th highest daily maximum concentration. Based on SO₂ concentration data measured at the ambient monitoring station located southwest of the Sebree Plant operations area during the 2017-2019 period, which exceeded the NAAQS, portions of Henderson and Webster Counties in Kentucky surrounding the Sebree Plant were designated as nonattainment with respect to the 1-hour SO₂ NAAQS effective on April 30, 2021.²

The nonattainment designation triggers the requirement for the Division to develop a revision to the Kentucky SIP to demonstrate that attainment with the 1-hour SO₂ will be achieved no later than 5 years after the effective date of the designation (i.e., by April 30, 2026). One component of the SIP is a modeling

¹ An application to renew the existing Title V permit was submitted to the Division on May 10, 2024 and is currently under review.

² Sebree SO₂ DRR Site, AQS Site ID: 21-101-1011.

analysis demonstrating that the NAAQS will be attained following the application of a planned control strategy. On behalf of Century, Trinity Consultants prepared and submitted an air dispersion modeling report to the Division on August 7, 2024, documenting this SIP modeling analysis and demonstrating that attainment of the 1-hour SO₂ NAAQS in the Henderson-Webster County nonattainment area can be achieved following the implementation of the control strategy represented. This control strategy includes the planned construction and use of a new stack for the Anode Bake Furnace and the imposition of new lower limits on allowable SO₂ emissions from Sebree Plant emission units. The new emission limits being proposed for SO₂ will lower the allowable SO₂ emissions from the Anode Bake Furnace and Potlines by almost 1,000 tpy from 5,853 tpy to 4,946 tpy.³

The purpose of this permit revision application is to facilitate the establishment of new federally enforceable conditions establishing new limits on SO₂ emissions and governing the construction of the new Anode Bake Furnace stack, consistent with the representations used in the modeling demonstration report. There are no physical or operational changes being proposed to existing processes and emission units and the only construction activity addressed by this permit revision is the planned installation of the new Anode Bake Furnace stack and some new fencing on the western and southern property boundary.

2. Facility Operations Overview

Facility Location

The Sebree Plant is located on State Highway Junction 2096/2097, 3.8 miles (6.1 km) northeast of the city center of Sebree, Kentucky in Henderson County near the borders of McLean and Webster Counties. The Sebree Plant is surrounded by a large tract of controlled property in all directions. It is bounded on the east by the Green River and open farmland, on the west by the Edward T. Breathitt Pennyrite Parkway (I-69), light industry, and farmland/wooded areas, on the south by Big Rivers Electric Corporation, and on the north by wooded areas. Refer to maps showing the location of the facility and an aerial view of the main site operations in the Title V permit renewal application recently submitted to the Division on May 10, 2024.



Facility Operations Overview

At the Sebree Plant, Century produces primary aluminum through the electrolytic reduction of raw alumina (Al₂O₃) in vessels termed reduction cells or “pots”. Century operates three nearly identical potlines at the Sebree Plant. Each potline is composed of two potrooms that each contain 64 reductions cells for a total of 128 cells per potline.

Each pot in the potrooms is constructed as a complete electrolytic circuit with anode, cathode, and electrolyte. The exterior of the pots consists of a rectangular steel shell lined with refractory thermal

³ The emission rates cited are for the Anode Bake Furnace and Potlines operations only, but they make up of 99% of the facility SO₂ emissions. The total potential SO₂ emissions from all other sources, which primarily include natural gas-fired boilers, furnaces, heaters, and engines are roughly 0.9 tpy.

August 14, 2024

insulation. Raw material inputs to the pots include alumina, bath, carbon anodes, and various other additives to the aluminum production process such as aluminum fluoride. Within the pot is an inner lining of carbon (the cathode). Carbon anode blocks are placed just below the surface of a fluoride electrolyte (cryolite) to complete the reaction circuit. A current is applied to metal rods attached to the anode blocks, which passes through the molten bath (molten aluminum, cryolite, and alumina) and the carbon cathode lining, and then to the current collector bars. The molten aluminum formed in the reduction cells (as it is liberated from alumina with oxygen) settles between the anode and cathode where it accumulates. The oxygen liberated reacts with the carbon anode blocks forming carbon dioxide. The accumulated molten metal is siphoned from the pots into crucibles each day. The anode blocks, which are gradually consumed by the reaction in the pots, last a few weeks before they must be replaced with new anodes.

The emissions from the reduction cells in each potline are captured through hooding systems and are sent to two Alcoa A-398 alumina fluidized bed dry scrubbers, each of which has five reactors. Thus, for three potlines, there are a total of six alumina fluidized bed dry scrubbers with each one serving half of the pots on a potline. Any fugitive emissions not caught by the hooding system are vented through the roof of two potroom buildings comprising each potline.

To provide baked carbon anodes to the reduction cells, Century operates an anode paste mixing and forming operation and an anode bake furnace, in which the “green anodes” are baked. The green anodes are formed from petroleum coke, recycled spent anode material, and coal tar pitch, which serves as a binder. The formed anodes are compressed and placed within the bake furnace, where they are baked to remove volatiles, leaving a solid carbon block. The emissions from the paste mixing and anode forming units are vented to a common control device, a Proceadair dry coke scrubber. The emissions from the anode bake furnace are sent to an Alcoa A-446 alumina fluidized bed scrubber.

The molten aluminum produced by the reduction cells from all three potlines is sent to the casthouse to be formed into billets and T-bars, along with other products. The casthouse utilizes natural gas-fired holding furnaces to condition molten aluminum and homogenizing furnaces to condition the aluminum billets.

Most of the major equipment and emission units at the Sebree Plant were constructed in 1972 and operations began in 1973. The original emission units included Potlines 1 and 2, an Anode Bake Furnace and other support operations. Potline 3 and a second Anode Bake Furnace (now out of service) began operation in 1979. In 2010, following the implementation of an amperage increase project, the production capacity of the plant was increased. The plant currently has a permitted capacity of 253,531 tons per year of aluminum from the potlines.

Emissions Profile and Source Classification

The majority of emissions from the Sebree Plant emanate from the A-398 dry scrubber system stacks on each potline, and from the A-446 dry scrubber stacks of the Anode Bake Furnace. There are also multiple baghouses and storage tank vent filter systems at the plant that minimize PM emissions from material handling operations, but emissions from these processes are relatively small in comparison.

Title V Source Classification

The Sebree Plant is a major source under the Title V operating permit program (401 KAR 52:020) since potential emissions of at least one regulated pollutant (e.g., SO₂) exceeds 100 tpy. The plant will remain a Title V major source following this permit action.

HAP Source Classification

The Sebree Plant is a major source of hazardous air pollutants (HAPs) because site-wide potential emissions of at least one individual HAP (e.g., HF) are greater than 10 tpy. The potential emissions of all HAPs combined are also greater than 25 tpy. The plant will remain a major HAP source following this permit action. Thus, this permit action does not trigger any HAP permitting requirements.

NSR Source Classification

The Sebree Plant is located in Henderson County, Kentucky, which has been designated by U.S. EPA as unclassified/attainment for all criteria pollutants except SO₂.⁴ Therefore, with respect to the federal New Source Review (NSR) permitting program, the nonattainment SIP permitting program requirements are potentially relevant for projects involving increases in SO₂ emissions, and the Prevention of Significant Deterioration (PSD) program requirements are relevant for all other regulated NSR pollutants.

Kentucky has incorporated the requirements of the PSD permitting program into its SIP at 401 KAR 51:017.⁵ These PSD regulations specifically define 28 industrial source categories for which the major source threshold is 100 tpy of any regulated pollutant.⁶ The major source threshold for facilities not on this “List of 28” is 250 tpy. Since the facility industrial classification (production of primary aluminum) is included on the “List of 28” source categories, the major source threshold under the PSD program for the facility is 100 tpy of a regulated NSR pollutant.

Since the potential emissions of at least one regulated NSR pollutant currently exceeds 100 tpy, the Sebree Plant is classified as an existing major stationary source under the PSD program. It is also a major source under the nonattainment NSR program for SO₂ since potential emissions of SO₂ exceed 100 tpy. The plant has undergone three PSD permit actions in its lifespan, including the installation of Potline 3 in 1979, the refurbishment of the Anode Bake Furnace in 2008 (V-05-088 R1) and the amperage increase project in 2010 that raised the production capacity of Potlines 1-3 (V-05-088 R2).

This permit action does not involve physical or operational changes that will result in any emission increases. In contrast, the main objective is the establishment of new lower allowable SO₂ emission limits. Thus, this permit action does not trigger any NSR permitting requirements.

3. Planned Installation of New Anode Bake Furnace (ABF) Stack

The emissions from the Anode Bake Furnace (Emission Unit N2) at the Sebree Plant are pulled to an Alcoa A-446 alumina fluidized bed scrubber via induced draft fans. The A-446 consists of three alumina scrubber and baghouse modules operating in parallel that provide control for fluorides, particulate matter, and polycyclic organic matter (POM). The A-446 scrubber system is not designed to provide control for SO₂. As shown in Figure 1, each of the three scrubber modules exhausts out a dedicated stack situated on top of the adjacent scrubber modules. Each of the three adjacent existing stacks has a 70-ft release height and 4.2-ft exit diameters.

⁴ 401 KAR 51:010, Section 2.

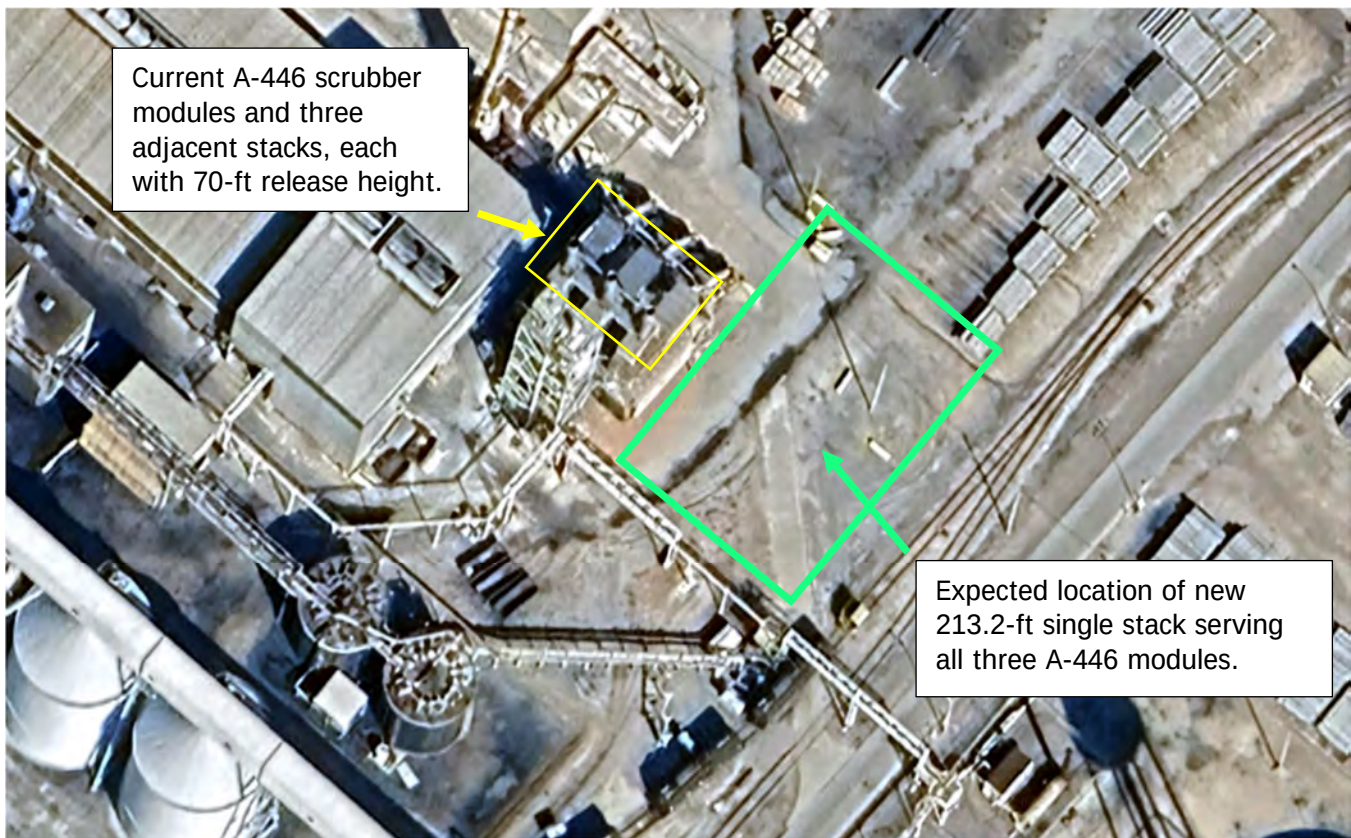
⁵ 40 CFR 51.166(a)(1)

⁶ 401 KAR 51:001, Section 1 (118)(a)(2)(a)

The air dispersion modeling analysis conducted for the SIP modeling demonstration reflects the planned installation of a new 213.2-ft tall stack for the Anode Bake Furnace.⁷ The new stack is expected to have an exit diameter of approximately 8.5-ft. As shown in Figure 1, Century currently plans to locate the new stack approximately 20-30 meters southeast of the existing A-446 scrubber. The new stack will be constructed while the Anode Bake Furnace and A-446 alumina scrubber system remain in operation. Once the new stack is constructed, the tie-in duct work will be installed during an outage to re-route the exhausts from the three A-446 scrubber modules to the new stack.

Century has obtained a preliminary bid from a prospective stack vendor; however, the final engineering work for the new stack has not yet been completed. Based on information provided by the vendor, Century currently expects that it will take up to 12 months to finalize engineering, construct the stack, and complete the tie-in with the existing A-446 scrubber system. A draft suggested set of conditions governing the planned installation of the new stack is included in Section I of the Title V permit as shown in the markup document provided in Attachment 4 of this application for consideration by the Division.

Figure 1. Current and Planned Stacks for Anode Bake Furnace



⁷ The new stack will conform to good engineering practice (GEP) stack height requirements. Additionally, as noted in Section 6.4 of EPA's Guidance for 1-Hour SO₂ Nonattainment SIP Submissions, April 23, 2014, installation of a new stack within GEP is not a prohibited dispersion technique so long as facility-wide allowable SO₂ emissions are less than 5,000 tpy. With the establishment of new proposed SO₂ emission limits via this permit action, the facility-wide potential SO₂ emissions for the Seabree Plant are 4,947 tpy (4,946 from the ABF and potlines and less than 1 tpy from all other emission units).

4. Planned Installation of New Fencing

As documented in the SO₂ Nonattainment SIP Modeling Report submitted to the Division on August 7, 2024, a permanent fence is currently in place on the western property boundary from Moss and Moss Road (an east-west road traversing the property) down to the main plant entrance. Century is planning to extend the permanent fence down along the remaining western property boundary and then east over to the Green River. This new fencing is being planned to more clearly establish the existing ambient air boundary for the facility. Century has obtained a bid for the new fencing from a prospective vendor and is working on scheduling the erection. The new extended fence sections are anticipated to be in place within the next 3 months.

A draft suggested set of conditions covering the planned installation of the new fence sections is included the Section I of the Title V permit as shown in the markup document provided in Attachment 4 of this application for consideration by the Division.

5. Proposed New SO₂ Emission Limits

Emission rates representative of future allowable SO₂ emission rates were used for all Century Sebree emission sources in the SO₂ Nonattainment SIP Modeling Report consistent with requirements specified in Section 6.1 of Appendix A to EPA's Nonattainment SIP Guidance.⁸ As noted, the primary objective of this permit application is to establish the federally enforceable conditions in an amended Title V permit covering the newly proposed (and lower) SO₂ emission limits for the Anode Bake Furnace and Potlines.⁹ This section of the application lays out the proposed values and form of the new SO₂ emission limits, consistent with what was represented in the SIP modeling analysis.

Existing Annual SO₂ Emission Limit

The existing Title V permit already includes a condition limiting the allowable SO₂ emissions from the Anode Bake Furnace and Potlines combined to 5,853 tpy on a 12-month rolling total basis. This limit was established as part of a PSD permit action completed on October 4, 2010 (V-05-088 R2), which covered the potline production capacity increase accomplished through the implementation of new higher amperage technology. The V-05-088 permit and all subsequent Title V permits since have mandated that Century utilize a sulfur mass balance calculation approach to quantify monthly SO₂ emissions from the ABF and potlines, and then to use these monthly values to quantify the 12-month rolling total SO₂ emissions for comparison against the limit. This approach yields accurate estimates of monthly emissions based on the known quantities of sulfur entering the process through the raw material streams.

Averaging Period for SO₂ Emission Limits

Century is proposing that the form of the new SO₂ emission limits needed to cap SO₂ emissions at levels represented in the SIP modeling analysis be established as monthly average hourly emission rates (lb/hr). Although the SO₂ NAAQS has a 1-hour averaging time, as noted in Section V.D.2 of the SO₂ Nonattainment SIP Guidance memorandum from EPA, use of emission limits with averaging times as long as 30 days is appropriate and would still be protective of the NAAQS under certain conditions. A consideration for the use of 30-day average limits is the normal variability of SO₂ emissions.

⁸ Guidance for 1-Hour SO₂ Nonattainment SIP Submissions, Memorandum from Stephen D. Page, Director, to Regional Air Division Directors, Regions 1-10, dated April 23, 2014.

⁹ New SO₂ emission limits are not needed for other SO₂ emission sources at the plant (which make up less than 0.1% of total SO₂ emissions) because they each were modeled at their maximum unconstrained potential-to-emit values.

Because each Potline at the Sebree Plant has numerous pots (128 per potline) in continuous operation, even while each pot individually operates on a batch cycle, it is reasonable to treat each potline as a whole as operating in a continuous, steady-state manner. It is further reasonable to expect that the SO₂ emission rate from the potlines is relatively stable and that short-term variability in SO₂ emissions from the potlines is relatively low. In a similar vein, although the anodes within a given pit in the ABF are processed on a batch cycle, because there are multiple firing trains in operation continuously and so many pits moving stepwise through their respective baking cycle, this operating characteristic will dampen large swings in total SO₂ emission rates from the ABF. Also, it is statistically improbable that a peak 1-hour emission rate occurring from one of the dry alumina scrubber systems (i.e., two separate systems for each potline and one for the ABF) would coincide with a peak occurring in the same hour at another scrubber system at the plant. For all these reasons, regulating allowable SO₂ emission rates for the ABF and potlines via monthly average emission limits is appropriate.

As noted in EPA's SO₂ Nonattainment SIP Guidance, the agency normally expects that any SO₂ emission limit with an averaging time longer than 1 hour would need to reflect a downward adjustment to compensate for the loss of stringency inherent in applying a longer-term average limit. To assist with the application of the recommended adjustment approach, EPA provides example calculations to determine a suitable 30-day average limit in Appendix C of the Guidance. Consistent with this approach, in spite of the expected relatively steady-state nature of SO₂ emissions from the potlines and Anode Bake Furnace, the proposed monthly average SO₂ emission limits were adjusted upwards to yield higher 1-hour emission rates that were used in the SIP modeling analysis. Specifically, Century used the 30-day to 1-hour ratio of 0.79 specified for uncontrolled SO₂ sources in Appendix D of the SO₂ Nonattainment SIP Guidance to define the 1-hour emission rates that were modeled (i.e., emission rates used in the modeling analysis were 1.266 times the monthly average emission limit values proposed in this application).

Magnitude and Form of SO₂ Emission Limits

The existing Title V permit already has operating limits that cap the maximum sulfur content of the petroleum coke and pitch used in the making of anodes at 3% and 0.8%, respectively. The permit also sets the maximum production rate for the potlines at 253,531 tons per year and lists the current capacity of the Anode Bake Furnace at 155,402 tons per year of green anodes.¹⁰ Given these production capacities and sulfur content limits, and taking into account average historical values for other key process variables such as the recipe for green anodes (coke, pitch, and recycled anode butts material), the packing coke make-up rate, the average baked anode:green anode weight ratio, and the potline anode consumption rate, a maximum expected SO₂ emission rate can be derived via a mass balance. This is the same mass balance calculation methodology (documented further below) being proposed as the compliance demonstration method. As documented in the sample derivation calculations provided in Attachment 2, the proposed new allowable SO₂ emission rate for the Anode Bake Furnace and Potlines combined is **1,129 lb/hr** (monthly average). This is based on an expected normal distribution of SO₂ emissions between the Anode Bake Furnace (158 lb/hr) and Potlines (971 lb/hr), as shown in Table 1. If this monthly average hourly emissions rate is extrapolated out for 8,760 hours per year, the proposed limit equates to a new limit on annual SO₂ emissions of 4,946 tpy. This is almost a 1,000 tpy reduction from the current SO₂ annual limit of 5,853 tpy.

Century acknowledges that the Division may prefer to also establish separate individual SO₂ emission limits on the Anode Bake Furnace and Potlines to account for the distribution of SO₂ emissions from these two sources used in the SIP modeling analysis. However, if this is done, it would be necessary to account for

¹⁰ The green anode process capacity is expressed in the permit as 17.74 ton/hr (annual average). This is derived from the capacity of the refurbished Anode Bake Furnace set in the V-05-088 R1 permit action, 145,730 tons of baked anodes per year (or 16.64 ton/hr on an hourly average basis). At the time of that permit action, the average baked anode:green anode weight ratio was 93.786%; thus, the equivalent green anode maximum processing rate was set to 17.74 ton/hr (16.64 / 0.93786).

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month-to-month variability in the distribution between the Anode Bake Furnace and Potlines. This monthly distribution variability can be caused by numerous process factors such as changes in green anode sulfur content, anode bake furnace performance, and potline anode consumption rates. Therefore, in addition to the proposed monthly average SO₂ emission limit on the Anode Bake Furnace and Potlines combined, which is based on a normal expected distribution of emissions between the two sources, in anticipation that the Division will choose to establish separate SO₂ emission limits on the Anode Bake Furnace and Potlines, Century is also proactively proposing separate individual emission limits at the expected source-specific maximums. Because of the mass balance governing SO₂ emissions, in months when the SO₂ emissions from the Anode Bake Furnace are higher, the SO₂ from the Potlines will necessarily be lower, and in months when the SO₂ emissions from the Potlines are higher, the SO₂ from the Anode Bake Furnace will necessarily be lower. This will also be enforced via the single combined monthly average emission limit set for the Anode Bake Furnace and Potlines combined.

The separate “Highest ABF” and “Highest Potline” source specific emission limits being proposed are listed in Table 1 along with the base normal combined emission limit. The emission rates for the Highest ABF and Highest Potline scenarios consider the changes in monthly distribution of SO₂ emissions measured via the mass balance during the past three years. In the SIP modeling analysis conducted, all three of the emission scenarios listed in Table 1 were separately modeled to show that attainment can be achieved under both the normal expected distribution profile and either extreme. Therefore, it is appropriate to establish the source-specific emission limits (if that approach is pursued by the Division) at the source-specific high values highlighted in green in Table 1.

Table 1. Proposed New Monthly Average SO₂ Emission Limits for Anode Bake Furnace and Potlines

Emissions Scenario^a	ABF^b (lb/hr)	Potlines^b (lb/hr)	ABF + Potlines Combined^b (lb/hr)	ABF + Potlines Combined^c (tpy)
Base Expected Emissions	158	971	1,129	4,946
Highest ABF Scenario	237	892	1,129	4,946
Highest Potlines Scenario	111	1,018	1,129	4,946

- All three emission scenarios were modeled in the SO₂ Nonattainment SIP Modeling Demonstration analysis. As documented in the report for that analysis, the emission rates modeled were inflated above the monthly average values listed by a factor of 1.266 to account for the 1-hour form of the SO₂ NAAQS
- All lb/hr emission rates listed are monthly average values. Proposed emission limits are highlighted in green.
- The annual emission values are shown for reference only. These values are the equivalent annual emission rates if monthly average hourly emissions occur all 8,760 hours in a year.

A draft suggested set of new emission limit conditions encompassing the emission limits highlighted in Table 1 is included the Section D, Condition 3 of the Title V permit as shown in the markup document provided in Attachment 4 of this application for consideration by the Division.

Proposed Compliance Demonstration Method

Century understands that an appropriate suite of testing, monitoring, and recordkeeping provisions will need to be in place in the Title V permit to make the new SO₂ emission limits federally enforceable. Use of continuous emission monitoring systems (CEMS) is one method that can be appropriate in certain contexts considering the short-term form of the SO₂ NAAQS. However, Century asserts that a mass balance approach combined with periodic validation stack testing continues to be the most accurate, suitable, and practically feasible methodology for demonstrating compliance with the new proposed SO₂ emission limits. Due to the multi-stack configuration of the potline A-398s and the long roof vents on each potroom building,

there is no practical or economically feasible way to deploy CEMS as the compliance method. Additionally, even if not for the numerous stacks involved, the severe operating environment in the potlines could potentially lead to ongoing performance and maintenance challenges that would make it difficult for CEMS to reliably provide accurate SO₂ data. In contrast, the mass balance provides an accurate basis for defining emissions since there are few inputs and these inputs are well characterized. Essentially all the sulfur coming into the plant through the raw materials is assumed to be emitted, and those inputs to the plant can be accurately quantified. The primary inputs consist of process rates and sulfur content data.¹¹ In its SO₂ Nonattainment SIP Guidance document, EPA acknowledges that some types of sources with longer-term emission limits (e.g., monthly averages) may be suitably regulated without the use of CEMS when SO₂ emissions are a direct function of process rates and sulfur content data and those sulfur content measurements are of a sufficient frequency and accuracy to effectively characterize SO₂ emissions. This is precisely the situation for the Sebree Plant SO₂ emission sources.

The compliance demonstration method language for the existing annual SO₂ emission limit in the Title V permit states that compliance shall be determined using the "Alcan SO₂ Calculation Engine". This was the terminology originally used for the mass balance methodology employed by the Sebree Plant to calculate SO₂ emissions for emission inventory and compliance purposes. However, the permit does not specify the details on how the calculation should be performed. With the establishment of new lower limits driven by the SIP attainment plan, and given that the new limits will now be set on a monthly average rather than an annual basis, with likely source-specific emission limits in addition to the combined limit, Century anticipates that the Division will be looking to better define the specifics of the mass balance calculations. In that context, to enhance the enforceability of the mass balance approach, Century is proactively proposing that a new Appendix B be added to the Title V permit that clearly delineates the inputs and mass balance calculations that will be conducted monthly moving forward to demonstrate compliance with the emission limits. A draft of the proposed new Appendix B is included in Attachment 3 of this application for consideration and review by the Division, should the agency desire to add more specificity to the permit. In conjunction with the inclusion of this new Appendix B, Century is also proposing to enhance the existing sulfur content sampling, monitoring, and recordkeeping requirements in the Title V permit as the sulfur content data is a primary input to the mass balance calculations. The reworded and enhanced sampling conditions are included Section B, Condition 3i and 5g of the Title V permit as shown in the markup document provided in Attachment 4 of this application.

To support and validate the ongoing SO₂ emission calculations that will be performed using the mass balance approach described, Century anticipates that the Division will also want to set up some degree of and frequency of emissions testing for SO₂ to periodically validate the emissions data from the mass balance. The existing Title V permit already includes provisions that require once-per-term testing of a representative potline A-398 scrubber system and a separate annual test of a representative potline roof monitor. Consistent with the representations made in the Title V Permit renewal application submitted on May 10, 2024, Century is requesting a revision to the permit language governing this testing in Conditions 3.r.i and 3.r.ii in Section B (Subject Item 4 Requirements: Existing Potlines) to better clarify the SO₂ testing requirements of the potline primary and secondary emissions.¹² The suggested edits for the SO₂ testing are to extend the once-per-permit-term requirement currently in place for the potline A-398 scrubber system

¹¹ The sulfur content in samples of petroleum coke and anode material are measured daily by trained and qualified personnel in an on-site laboratory that operates under an ISO 9001:2015 certified quality management system. The current sampling method used is ASTM Method D6376.

¹² Although not specifically relevant to the current permit action, to remain consistent with changes represented in the renewal application, the permit markup also shows suggested edits for CO testing to clarify that once per permit term testing is only required of a representative potline stack and roof monitor. This is how the permit condition has historically been interpreted and applied and the edits to the permit language are only intended to make this clearer.

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stacks to the roof vents as well. The potline roof vents contribute only a tiny fraction to total plant SO₂ emissions. Century already invests significant resources to sample sulfur content of the raw materials needed to quantify total SO₂ emissions from the facility accurately on a mass balance basis. Therefore, Century contends that a once per permit term test for the roof vents (along with the A-398 scrubbers) is sufficient for validating the SO₂ emissions data available from the mass balance.

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This application report and included attachments constitute a complete Title V significant revision application for the Sebree Plant with items required under 401 KAR 52:020, Section 16(2). In addition to this application letter, a DEP7007AI Administrative Information form is provided in Attachment 1 to facilitate the Division's processing of the application. Other DEP7007 series forms that would normally be required for applications involving physical or operational changes are not relevant to the purpose of this application.

A markup of relevant sections of the current Title V permit with permit condition changes Century believes are appropriate to the objectives of this permit action is provided in Attachment 4. These new and revised permit conditions are provided only as suggestions to help facilitate processing and review of the application and Century acknowledges the Division's responsibility and authority to draft the amended permit.

If Division staff have any immediate questions or need information as part of the agency's review and processing of this application, they can contact our consultant, Mr. Paul J. Smith, P.E., of Trinity Consultants at (859) 341-8100 x1802, psmith@trinityconsultants.com, or me at 270-521-6215, christopher.goddard@centuryaluminum.com. Given the need to coordinate the activities of this permit action with the Division's SO₂ Nonattainment SIP efforts, Century is suggesting that a meeting be arranged immediately following this submittal to facilitate discussions and decisions on the key matters to be addressed through the permit revision. We will follow up with Permit Review Branch staff in this regard.

Sincerely,



Chris Goddard
Environmental Manager

Attachments

cc: Mr. Michael Kennedy, P.E., KDAQ
Ms. Amy Tempus-Doom, P.E., KDAQ
Mr. Paul J. Smith, P.E., Trinity Consultants

ATTACHMENT 1

DEP7007 Application Forms

Division for Air Quality 300 Sower Boulevard Frankfort, KY 40601 (502) 564-3999	DEP7007AI Administrative Information ☐ Section AI.1: Source Information ☐ Section AI.2: Applicant Information ☐ Section AI.3: Owner Information ☐ Section AI.4: Type of Application ☐ Section AI.5: Other Required Information ☐ Section AI.6: Signature Block ☐ Section AI.7: Notes, Comments, and Explanations	Additional Documentation ☐ Additional Documentation attached

Source Name:	<u>Century Aluminum Sebree, LLC</u>
KY EIS (AFS) #:	21- <u>101-00029</u>
Permit #:	<u>V-19-010 R2</u>
Agency Interest (AI) ID:	<u>1788</u>
Date:	<u>8/12/2024</u>

Section AI.1: Source Information					
Physical Location	Street:	<u>9404 State Route 2096</u>			
	Address:	City: <u>Robards</u>	County: <u>Henderson</u>	Zip Code:	<u>42452</u>
		Street or			
		P.O. Box:	<u>9404 State Route 2096</u>		
Mailing Address:		City: <u>Robards</u>	State: <u>KY</u>	Zip Code:	<u>42452</u>

Standard Coordinates for Source Physical Location	
Longitude: <u>-87.501351</u> (decimal degrees)	Latitude: <u>37.65378</u> (decimal degrees)

Primary (NAICS) Category: <u>Alumina Refining and Primary Aluminum Production</u>	Primary NAICS #: <u>331313</u>

Classification (SIC) Category:		<u>Primary Production of Aluminum</u>		Primary SIC #: <u>3334</u>	
Briefly discuss the type of business conducted at this site:		At the Seebree Plant, Century produces primary aluminum through the electrolytic reduction of raw alumina (Al ₂ O ₃) in vessels termed reduction cells or "pots". Century operates three nearly identical potlines at the Seebree Plant. Raw material inputs to the pots include alumina, bath, carbon anodes, and various other additives to the aluminum production process such as aluminum fluoride. The molten aluminum produced by the reduction cells from all three potlines is sent to the casthouse to be formed into billets and T-bars, along with other products. The casthouse utilizes natural gas-fired holding furnaces to condition molten aluminum and homogenizing furnaces to condition the aluminum billets.			
Description of Area Surrounding Source:	☒ Rural Area ☐ Urban Area	☐ Industrial Park ☐ Industrial Area	☐ Residential Area ☐ Commercial Area	Is any part of the source located on federal land? ☐ Yes ☒ No	Number of Employees: ~500
Approximate distance to nearest residence or commercial property: <u>Approximately 2,500 ft</u>		Property Area: <u>Approximately 2,600 acres</u>		Is this source portable? ☐ Yes ☒ No	
What other environmental permits or registrations does this source currently hold or need to obtain in Kentucky?					
NPDES/KPDES:	☒ Currently Hold	☐ Need	☐ N/A		
Solid Waste:	☒ Currently Hold	☐ Need	☐ N/A		
RCRA:	☐ Currently Hold	☐ Need	☒ N/A		
UST:	☐ Currently Hold	☐ Need	☒ N/A		
Type of Regulated Waste Activity:	☐ Mixed Waste Generator ☒ Generator ☐ Recycler ☐ Other: _____ ☐ U.S. Importer of Hazardous Waste ☐ Transporter ☐ Treatment/Storage/Disposal Facility ☐ N/A				

Section AI.2: Applicant Information

Applicant Name: Chris Goddard

Title: (if individual) Environmental Manager

Mailing Address: **Street or P.O. Box:** 9404 State Route 2096
City: Robards **State:** KY **Zip Code:** 42452

Email: (if individual) christopher.goddard@centuryaluminum.com

Phone: 270-521-6215

Technical Contact

Name: Same as Applicant

Title: _____

Mailing Address: **Street or P.O. Box:** _____
City: _____ **State:** _____ **Zip Code:** _____

Email: _____

Phone: _____

Air Permit Contact for Source

Name: Same as Applicant

Title: _____

Mailing Address: **Street or P.O. Box:** _____
City: _____ **State:** _____ **Zip Code:** _____

Email: _____

Phone: _____

Section AI.3: Owner Information☒ **Owner same as applicant****Name:** _____**Title:** _____**Mailing Address:** **Street or P.O. Box:** _____
City: _____ **State:** _____ **Zip Code:** _____**Email:** _____**Phone:** _____**List names of owners and officers of the company who have an interest in the company of 5% or more.****Name****Position**

Section AI.4: Type of Application

Current Status:	☒ Title V	☐ Conditional Major	☐ State-Origin	☐ General Permit	☐ Registration	☐ None
Requested Action: (check all that apply)	☐ Name Change	☐ Initial Registration	☒ Significant Revision	☐ Administrative Permit Amendment		
	☐ Renewal Permit	☐ Revised Registration	☐ Minor Revision	☐ Initial Source-wide Operating Permit		
	☐ 502(b)(10) Change	☐ Extension Request	☐ Addition of New Facility	☐ Portable Plant Relocation Notice		
	☐ Revision	☐ Off Permit Change	☐ Landfill Alternate Compliance Submittal	☐ Modification of Existing Facilities		
	☐ Ownership Change	☐ Closure				
Requested Status:	☒ Title V	☐ Conditional Major	☐ State-Origin	☐ PSD	☐ NSR	☐ Other:

Is the source requesting a limitation of potential emissions?

☒ Yes ☐ No

Pollutant:	Requested Limit:	Pollutant:	Requested Limit:
☐ Particulate Matter	_____	☐ Single HAP	_____
☐ Volatile Organic Compounds (VOC)	_____	☐ Combined HAPs	_____
☐ Carbon Monoxide	_____	☐ Air Toxics (40 CFR 68, Subpart F)	_____
☐ Nitrogen Oxides	_____	☐ Carbon Dioxide	_____
☒ Sulfur Dioxide	<u>Refer to application letter.</u>	☐ Greenhouse Gases (GHG)	_____
☐ Lead	_____	☐ Other	_____

For New Construction:

Proposed Start Date of Construction:
(MM/YYYY)

NA

Proposed Operation Start-Up Date: (MM/YYYY)

NA

For Modifications:

Proposed Start Date of Modification:
(MM/YYYY)

NA

Proposed Operation Start-Up Date: (MM/YYYY)

NA

Applicant is seeking coverage under a permit shield.

☐ Yes

☒ No

Identify any non-applicable requirements for which permit shield is sought on a separate attachment to the application.

Section AI.5 Other Required Information

Indicate the documents attached as part of this application:

☐ DEP7007A Indirect Heat Exchangers and Turbines	☐ DEP7007CC Compliance Certification
☐ DEP7007B Manufacturing or Processing Operations	☐ DEP7007DD Insignificant Activities
☐ DEP7007C Incinerators and Waste Burners	☐ DEP7007EE Internal Combustion Engines
☐ DEP7007F Episode Standby Plan	☐ DEP7007FF Secondary Aluminum Processing
☐ DEP7007J Volatile Liquid Storage	☐ DEP7007GG Control Equipment
☐ DEP7007K Surface Coating or Printing Operations	☐ DEP7007HH Haul Roads
☐ DEP7007L Mineral Processes	☐ Confidentiality Claim
☐ DEP7007M Metal Cleaning Degreasers	☐ Ownership Change Form
☐ DEP7007N Source Emissions Profile	☐ Secretary of State Certificate
☐ DEP7007P Perchloroethylene Dry Cleaning Systems	☐ Flowcharts or diagrams depicting process
☐ DEP7007R Emission Offset Credit	☐ Digital Line Graphs (DLG) files of buildings, roads, etc.
☐ DEP7007S Service Stations	☐ Site Map
☐ DEP7007T Metal Plating and Surface Treatment Operations	☐ Map or drawing depicting location of facility
☐ DEP7007V Applicable Requirements and Compliance Activities	☐ Safety Data Sheet (SDS)
☐ DEP7007Y Good Engineering Practice and Stack Height Determination	☐ Emergency Response Plan
☐ DEP7007AA Compliance Schedule for Non-complying Emission Units	☒ Other: ____ Refer to application letter and attachments.
☐ DEP7007BB Certified Progress Report	

Section AI.6: Signature Block

I, the undersigned, hereby certify under penalty of law, that I am a responsible official*, and that I have personally examined, and am familiar with, the information submitted in this document and all its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the information is on knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false or incomplete information, including the possibility of fine or imprisonment.

Levi Chaffin

Authorized Signature

Levi Chaffin

Type or Printed Name of Signatory

8/14/2024

Date

Sebree Plant Manager

Title of Signatory

*Responsible official as defined by 401 KAR 52:001.

Section AI.7: Notes, Comments, and Explanations

ATTACHMENT 2

Derivation of Proposed Allowable SO₂ Emission Rates

1. Derivation of SO2 Emission Limits for ABF and Potlines Using Mass Balance Methodology

- > The proposed SO2 emission limits are derived as documented below based on the same mass balance methodology used for calculating actual SO2 emissions on a monthly basis. Instead of using actual process rates and sulfur content data, the process capacity limits and maximum sulfur content specifications are used. Other process input variables are based on historical averages.

1.1 Anode Production Rates and Packing Coke Usage Rate

Baked anode (BA) production:	145,730 tpy	Represented capacity in V-05-088 R1 permit action.
Ratio of baked anode to green anode weight:	95.440 %	2021-2023 average
Green anode (GA) process rate:	152,693 tpy	= 145,730 tpy / 0.9544
Packing coke usage rate:	5.5 kg/mt BA	Updated make-up rate beginning in 2022
Packing coke usage (%):	0.55%	= 5.5 kg/mt / 1000 kg/mt
Packing coke process rate:	801.5 tpy	= 145,730 tpy x 0.0055

1.2 Anode Sulfur Contents

1.2.1 Raw Material Sulfur Contents

Pitch:	0.8% sulfur	Pitch sulfur content limit from V-05-088 R2
Petroleum Coke:	3.0% sulfur	Pet coke sulfur content limit from V-05-088 R2
Packing Coke:	3.0% sulfur	Monthly average packing coke sulfur content
Green Anode to Pet Coke Sulfur Ratio:	73.11%	2021-2023 average; Takes into account % of recycled butts, pet coke, and pitch in anode recipe

1.2.2 Anode Sulfur Contents

Green anode sulfur content:	2.1933% sulfur	= 3.0% x 73.11%
Ratio of BA sulfur content to GA sulfur content:	94.72%	2021-2023 average
Baked anode sulfur content:	2.0775% sulfur	

1.3 ABF SO2 Emissions

1.3.1 ABF SO2 Emissions (Based on ABF Capacity)

- > The sulfur input to the ABF is the sulfur in the green anodes plus the sulfur in the added packing coke.

Sulfur input rate to ABF:	3,373 tpy	= (152,693 tpy x 2.1933%) + (801.5 tpy x 3.0%)

- > The sulfur leaving the ABF is the sulfur in the baked anodes that are then sent to the potlines.

Sulfur output rate from ABF:	3,028 tpy	= 145,730 tpy x 2.0775%

- > Based on a mass balance, the sulfur released at the ABF is the sulfur input minus the sulfur output.

Sulfur released from anodes and sent to A-446:	345.5 tpy	= 3,373 tpy - 3,028 tpy

- > 100% of the sulfur released from the ABF is conservatively assumed to be emitted as SO2. The SO2 emissions are thus directly calculated from the sulfur release based on the molecular weight ratio between SO2 and S.

SO2 emissions from A-446 scrubber (annual total):

$$345.5 \text{ tpy of sulfur} / 32 \text{ lb S/lbmole S} \times 1 \text{ lbmole SO}_2/\text{lbmole S} \times 64 \text{ lb SO}_2/\text{lbmole SO}_2 = 691.0 \text{ tpy}$$

$$\text{SO}_2 \text{ emissions from A-446 scrubber (hourly average): } 691.0 \text{ tpy} \times 2000 \text{ lb/ton} / 8760 \text{ hr/yr} = 157.8 \text{ lb/hr}$$

1.4 Potline SO2 Emissions

1.4.1 Potline Sulfur Released (Based on Anodes Consumed)

Potlines production capacity (plantwide):	253,531 ton Al/yr	Operating limit established in V-05-088 R2
Anode consumption rate:	0.4308 t/t Al	2021-2023 average
Baked anode sulfur content:	2.0775% sulfur	See Section 1.2.2

> The sulfur released from the potlines is directly calculated based on the sulfur content in the placed anodes and the anode consumption rate.

Total sulfur released from potlines:	2,269 tpy	= 253,531 ton Al/yr x 0.4308 t/t Al x 2.0775% S

1.4.2 Potline SO2 Emissions

> A portion of the sulfur is emitted as COS. For purposes of these mass balance calculations, Century also conservatively assumes that none of the sulfur is released as condensable particulate even though it is expected that up to 2% can be emitted in this form. Thus, the amount not emitted as COS, is assumed to be emitted as SO2.

% of anode sulfur emitted as COS:	6.25%	Assumption embedded within PMACT COS limit
% of anode sulfur emitted as CPM:	0%	Conservatively set to 0 for mass balance purposes
% of anode sulfur emitted as SO2:	93.75%	= (1- 6.25% - 0%)
SO2 emissions from potlines (annual total):	4,254 tpy	= 2,269 tpy x 93.75% x 64 lb SO2/32 lb S
SO2 emissions from potlines (hourly average):	971 lb/hr	= 4,254 tpy x 2000 lb/ton / 8760 hr/yr

1.4.3 Combined Potline and ABF SO2 Potential Emissions

Combined potlines and ABF SO2 emission rate:	4,946 tpy	= 691.0 tpy + 4,254.5 tpy (rounded to nearest ton)
Combined SO2 emission rate (hourly average):	1,129 lb/hr	= 4,946 tpy x 2000 lb/yr / 8760 hr/yr

ATTACHMENT 3

Proposed New Appendix B for Title V Permit

SO₂ Mass Balance Emissions Calculation Methodology To Be Used for Demonstrating Compliance with SO₂ Emission Limits

SULFUR MASS BALANCE EMISSION CALCULATION METHODOLOGY

This appendix documents the sulfur mass balance methodology that Century Aluminum shall use in calculating the monthly average SO₂ emission rates (lb/hr) from the Anode Bake Furnace (Emission Unit N2) and Potline Operations (Emission Units E1, E3, and E5) to demonstrate compliance with the SO₂ emission limits in Section D of the permit.

Anode Bake Furnace SO₂ Emissions

The coal tar pitch, petroleum coke, and the recycled anode butts material mixed into the green anode paste that is pressed into green anode blocks, as well as the packing coke used to cover the anodes during the baking process, all contain sulfur. As the anodes and packing coke are heated in the Anode Bake Furnace, the sulfur they contain can be volatilized and oxidized to form SO₂.¹

Given these operating characteristics, the monthly average SO₂ emissions from the Anode Bake Furnace can be accurately quantified using a mass balance approach. In this mass balance, the sulfur input to the Furnace is calculated based on (1) the sulfur content and process rate of green anodes and (2) the sulfur content and usage rate of packing coke. The sulfur output from the Furnace is based on the sulfur content and process rate of baked anodes removed from the Furnace. The difference between the sulfur input to the Furnace and sulfur leaving the Furnace represents the net sulfur released to the A-446 dry alumina scrubber system. The SO₂ emission rate is then calculated by conservatively assuming that all sulfur released from the Furnace is emitted as SO₂ (i.e., not accounting for any portion that may be released as particulate sulfate or other sulfur compounds). The sulfur that is retained in the baked anodes is transferred to and emitted at the potlines. Thus, for the Anode Bake Furnace, the calculation of SO₂ emissions requires data on (1) the process rates of green anodes, baked anodes, and packing coke, and (2) their respective sulfur contents.

Process Rates for Green Anodes, Baked Anodes, and Packing Coke

Condition 5.g in Section B (Subject Item 6 – Anode Bake Furnace) of the Title V permit requires Century to track and record the monthly process rate (tons/month) of green anodes placed in and baked anodes removed from the Anode Bake Furnace. The process weights are determined by weighing each anode loaded and unloaded in the pits during a given month. In the baking process, volatiles in the anodes are released and thus the weight of a given anode after it is baked is less than its weight starting out as a green anode. This ratio of the total weight of baked anodes to green anodes is relatively consistent and is thus used in the mass balance to define the monthly green anode process rate based on the measured mass of baked anodes removed from the furnace.² Specifically, in a given calendar year, Century shall use the

¹ SO₂ is also generated as a by-product of natural gas combustion in the Anode Bake Furnace although in negligible quantities compared to the SO₂ generated from the liberation of sulfur from the anodes.

² Historically, Century used independently measured weights of green anodes placed in and baked anodes removed from the Anode Bake Furnace each month in the mass balance calculations. However, because of the long baking cycles and capacity of the Furnace, there could be situations, for example, where more baked anodes are removed in a calendar month than were placed. So that green anode and baked anode weights used in the mass balance for a given calendar month have the same count basis, Century now uses a calculated green anode process rate based on the baked anode process rate for a given month.

three-year average baked anode:green anode weight ratio to define the green anode process rate used in the mass balance calculation for a given month based on the measured amount of baked anodes removed from the furnace that month.³

Condition 5.g in Section B of the Title V permit also requires Century to track and record the monthly packing coke usage. This is determined based on the make-up supply of packing coke added each month. The weight ratio of packing coke added to baked anodes produced is consistent from month to month. Thus, the amount of packing coke used generally rises and falls with the baked anode production rate from month to month.

Monthly Average Sulfur Content Data

Conditions 3.i.i and 3.i.ii in Section B (Subject Item 6 – Anode Bake Furnace) of the Title V permit requires that Century collect samples of green anode paste (just upstream of the Anode Press) and core samples of baked anodes at least once daily and to measure the sulfur content using ASTM Method D6376 or an approved alternative method. Condition 3.i.iii of the Title V permit also requires that a sample of packing coke be tested at least monthly to measure its sulfur content. The samples within a month are then aggregated to define the monthly average sulfur contents for each of the three materials (green anodes, baked anodes, and packing coke), which are then input into the SO₂ mass balance calculation.

Monthly Average SO₂ Emissions from Anode Bake Furnace

The monthly average SO₂ emission rate (lb/hr) from the Anode Bake Furnace operations shall be calculated monthly using Equation B-1.

$$E_{SO_2-ABF} = \frac{[(P_{GA})(\%S_{GA}) + (P_{PC})(\%S_{PC}) - (P_{BA})(\%S_{BA})]}{H} \left(\frac{64}{32} \right) (2000) \quad \text{Equation B-1}$$

where:

E_{SO_2-ABF} = Monthly average SO₂ emissions from ABF (lb/hr)

P_{GA} = Mass of green anode blocks baked during month (ton/month), set equal to P_{BA} divided by the current three-year average baked anode:green anode weight ratio

$\%S_{GA}$ = Average green anode paste sulfur content (weight %) for month based on all valid daily samples tested

P_{PC} = Packing coke consumed during month (ton/month), based on make-up rate of packing coke added to system during the month

$\%S_{PC}$ = Average packing coke sulfur content (weight %) for month based on all valid samples collected and tested in the month

³ For example, during the three-year period of 2021 to 2023, the mass of baked anodes removed the Anode Bake Furnace averaged 95.44% of the mass of green anodes placed in the Furnace during the same period. Thus, for mass balance calculations in 2024, Century defines sulfur inputs from green anodes based on a calculated green anode process rate for the month of $1/0.9544 \times$ the baked anode process rate for the month. For 2025, an updated three- year average baked anode:green anode weight ratio for 2022 to 2024 would be used, and so on.

P_{BA} =	Measured mass of baked anode blocks removed from the furnace during month (ton/month)
$\%S_{BA}$ =	Average baked anode core samples sulfur content (weight %) for month based on all valid daily samples tested.
H =	Operating hours in the month (hr/month)
$64/32$ =	Mass ratio of SO_2 to S (lb/lbmole / lb/lbmole) where 1 lbmole SO_2 = 1 lbmole S
2000 =	Conversion of tons to lb (2,000 lb/ton)

The monthly average SO_2 emission rate (lb/hr) determined from Equation B-1 shall be computed to demonstrate compliance with the Anode Bake Furnace SO_2 emission limit in Section D, Condition 3.c.

Potline Operations SO_2 Emissions

The rodded baked anodes used to form one part of the electrolytic cell in the pots of each potline contain sulfur, which can be volatilized and oxidized to form SO_2 , carbonyl sulfide (COS), and other trace sulfur compounds as the anodes are consumed in the pots. The sulfur content of the baked anodes processed is known based on daily core samples extracted and tested. The anode consumption rate, a key performance metric of the plant, is also closely measured and tracked, as required by Condition 4.f.iii in Section B (Subject Item 4 – Existing Potlines) of the Title V permit. These two inputs define, on a mass balance basis, the maximum amount of sulfur that is released from the potline operations.

Of the sulfur released from the consumed anodes in the potlines, some percentage will be released as COS and particulate sulfate compounds. Although up to 2% of the sulfur is believed to be emitted as particulate sulfate, for purposes of defining SO_2 emissions from the potline operations via this mass balance methodology, it is conservatively assumed that all the sulfur is emitted as either SO_2 or COS.

The *National Emission Standards for Hazardous Air Pollutants for Primary Aluminum Reduction Plants* (40 CFR 63 Subpart LL, “PMACT”) sets an emission limit on COS emissions from potlines at 3.9 lb/ton (40 CFR 63.843(e)). In the PMACT regulation, **40 CFR 63.847(j) stipulates that COS emissions be calculated monthly on a mass balance basis** using Equation 4 of the regulation shown below, which considers the anode consumption rate and sulfur content of the anodes consumed.

$$E_{\text{COS}} = [K] \times \left[\frac{Y}{Z} \right] \times [S] \quad \text{Equation 4 in 40 CFR 63.847(j)}$$

where:

E_{COS} =	the emission rate of COS during calendar month, lb/ton of aluminum produced
K =	factor accounting for molecular weights and conversion of sulfur to carbonyl sulfide; $K = 234$
Y =	the mass of anode consumed in the potline during the calendar month, tons
Z =	the mass of aluminum produced by the potline during the calendar month, tons
S =	the weighted average fraction of sulfur in the anode coke consumed in the production of aluminum during the calendar month (e.g., if the weighted average sulfur content of the anode coke consumed during the calendar month was 2.5 percent, then $S = 0.025$). The

weight of anode coke used during the calendar month of each different concentration of sulfur is used to calculate the overall weighted average fraction of sulfur.

In the K factor of Equation 4, EPA embeds a presumed conversion of sulfur to COS based on industry data available at the time of the last revision of the PMACT in 2015. Considering the average amounts of sulfur in raw petroleum coke converted to COS and typical percentage of anodes comprised of petroleum coke, EPA found that the sulfur to COS conversion rate ranged from 4.5% to 10%. As shown in the calculation below, the embedded COS conversion rate used for the COS emission limit in the PMACT is 6.25%.

$$\text{COS Conversion Rate} = 234 \times \left(\frac{32.065 \frac{\text{lb S}}{\text{lbmole S}}}{60.07 \frac{\text{lb COS}}{\text{lbmole COS}}} \right) \left(\frac{1 \text{ lbmole S}}{1 \text{ lbmole COS}} \right) \left(\frac{\text{ton}}{2,000 \text{ lb}} \right) = 6.25\%$$

To remain consistent with the methodology EPA prescribes in the PMACT for calculating monthly average SO₂ emissions, this same 6.25% sulfur to COS conversion rate is used in the monthly potline mass balance SO₂ emission calculations. Specifically, the monthly average SO₂ emission rate from the Potlines shall be calculated monthly using Equation B-2.

$$E_{SO_2-Potlines} = \frac{[(A)(\%S_{BA})]}{H} (93.75\%) \left(\frac{64}{32} \right) (2000) \quad \text{Equation B-2}$$

where:

$E_{SO_2-Potlines}$ = Monthly average SO₂ emissions from Potlines (lb/hr)

A = Total anode consumption in the potlines during month (ton/month), based on the potline production rate (ton aluminum/month) and the monthly average anode consumption rate (ton anode/ton aluminum).

$\%S_{BA}$ = Average baked anode core samples sulfur content (weight %) for month based on all daily samples tested

H = Operating hours in the month (hr/month)

93.75% = Assumed conversion of sulfur to SO₂ with the balance being COS (6.25%)

64/32 = Ratio of mass of SO₂ to S (lb/lbmole / lb/lbmole) where 1 lbmole SO₂ = 1 lbmole S

2000 = Conversion of tons to lb (2,000 lb/ton)

The monthly average SO₂ emission rate (lb/hr) determined from Equation B-2 shall be computed to demonstrate compliance with the Potlines Operations SO₂ emission limit in Section D, Condition 3.d.

Combined Anode Bake Furnace and Potline Operations SO₂ Emissions

The monthly average combined SO₂ emission rate from the Anode Bake Furnace and Potlines Operations shall be calculated monthly using Equation B-3.

$$E_{SO_2-Combined} = E_{SO_2-ABF} + E_{SO_2-Potlines} \quad \text{Equation B-3}$$

where:

$E_{SO_2-Combined}$ = Monthly average SO₂ emissions from Andoe Bake Furnace and Potlines Combined (lb/hr)

E_{SO_2-ABF} = Monthly average SO₂ emissions from Anode Bake Furnace (lb/hr)

$E_{SO_2-Potlines}$ = Monthly average SO₂ emissions from Potlines (lb/hr)

The monthly average SO₂ emission rate (lb/hr) determined from Equation B-3 shall be computed to demonstrate compliance with the combined Anode Bake Furnace and Potlines Operations SO₂ emission limit in Section D, Condition 3.b.

ATTACHMENT 4

Proposed Redline /Strikeout Markups to Existing Permit

Only Sections with proposed edits are included

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS

SUBJECT ITEM 4 REQUIREMENTS: Existing Potlines

EU	Equip. Desig.	Cons. Date	Description	Controls	Material	Capacity (tons/hr)
Emission Group VIII: Potlines						
E1	E1-1 (P4, P5)	8/4/1972	Potline 1 Roof Monitors	None – Vents to Atmosphere	Aluminum	9.65*
	E1-2 (P2, P3)		Potline 1	A-398 Dry Alumina Scrubbers: 161S A-398 161N A-398		
E3	E3-1 (P8, P9)	8/4/1972	Potline 2 Roof Monitors	None – Vents to Atmosphere	Aluminum	9.65*
	E3-2 (P6, P7)		Potline 2	A-398 Dry Alumina Scrubbers: 162S A-398 162N A-398		
E5	E5-1 (3P, 4P)	8/1/1979	Potline 3 Roof Monitors	None – Vents to Atmosphere	Aluminum	9.65*
	E5-2 (1P, 2P)		Potline 3	A-398 Dry Alumina Scrubbers: 163S A-398 163N A-398		

*Refer to 1. Operating Limitations (e) – The hourly capacity values listed are based upon an annual average.

APPLICABLE REGULATIONS:

401 KAR 51:017, *Prevention of significant deterioration of air quality*

401 KAR 53:010, *Ambient air quality standards for HF & TF*

401 KAR 61:165, *Existing primary aluminum reduction plants*

401 KAR 63:002, Section 2(4)(bb), 40 C.F.R. 63.840 to 63.855, Tables 1 to 4, and Appendix A (Subpart LL), *National Emission Standards for Hazardous Air Pollutants for Primary Aluminum Reduction Plants*, applicable with respect to each existing CWPB1 potline associated with primary aluminum production and located at a major source as defined in 40 CFR 63.2.

40 CFR 64, *Compliance Assurance Monitoring*, applicable to Potlines #1-3 with respect to PM₁₀/PM_{2.5}. Refer to Appendix A-1.

1. Operating Limitations:

- a. At all times, the permittee shall operate and maintain any affected source, including associated air pollution control equipment and monitoring equipment, in a manner consistent with safety and good air pollution control practices for minimizing emissions. Determination of whether such operation and maintenance procedures are being used will be based on information available to the Division which may include, but is not limited to,

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

monitoring results, review of operation and maintenance procedures, review of operation and maintenance records and inspection of the source. [40 CFR 63.843(f)]

- b. The permittee shall comply with the requirements of 40 CFR 63.854(a)(1) through (8) during periods of operation other than startup. [40 CFR 63.854(a)]
 - i. Ensure the potline scrubbers and exhaust fans are operational at all times. [40 CFR 63.854(a)(1)]
 - ii. Ensure that the primary capture and control system is operating at all times. [40 CFR 63.854(a)(2)]
 - iii. Hood covers should be replaced as soon as possible after each potroom operation. [40 CFR 63.854(a)(3)]
 - iv. Inspect potlines daily and perform the work practices specified in 40 CFR 63.854(a)(4)(i) through (iii). [40 CFR 63.854(a)(4)]
 - 1) Identify unstable pots as soon as practicable but in no case more than 12 hours from the time the pot became unstable; [40 CFR 63.854(a)(4)(i)]
 - 2) Reduce cell temperatures to as low as practicable, and follow the written operating plan described in 40 CFR 63.854(b)(4) if the cell temperature exceeds the specified high temperature limit; and [40 CFR 63.854(a)(4)(ii)]
 - 3) Reseal pot crusts that have been broken as often and as soon as practicable. [40 CFR 63.854(a)(4)(iii)]
 - v. Ensure that hood covers fit properly and are in good condition. [40 CFR 63.854(a)(5)]
 - vi. If the exhaust system is equipped with an adjustable damper system, the hood exhaust rate for individual pots must be increased whenever hood covers are removed from a pot, provided that the exhaust system will not be overloaded by placing too many pots on high exhaust. [40 CFR 63.854(a)(6)]
 - vii. Dust entrainment must be minimized during material handling operations and sweeping of the working aisles. [40 CFR 63.854(a)(7)]
 - viii. Only tapping crucibles with functional aspirator air return systems (for returning gases under the collection hooding) can be used, unless the regulatory authority approves an alternative tapping crucible. [40 CFR 63.854(a)(8)]
- c. The permittee shall comply with the requirements of 40 CFR 63.854(a)(1) through (8) and (b)(1) through (4) during periods of startup for each affected potline. [40 CFR 63.854(b)]
 - i. Develop a potline startup schedule before starting up the potline. [40 CFR 63.854(b)(1)]
 - ii. Keep records of the number of pots started each day. [40 CFR 63.854(b)(2)]
 - iii. Inspect potlines daily and adjust pot parameters to their optimum levels, as specified in the operating plan described in 40 CFR 63.854(b)(4), including, but not limited to: alumina addition rate, exhaust air flow rate, cell voltage, feeding level, anode current and liquid and solid bath levels. [40 CFR 63.854(b)(3)]
 - iv. Prepare a written operating plan to minimize emissions during startup to include, but not limited to, the requirements in 40 CFR 63.854(b)(1) through (3). The operating plan must include a specified high temperature limit for pots that will trigger corrective action. [40 CFR 63.854(b)(4)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

Compliance Demonstration:

Refer to 5. Specific Recordkeeping Requirements (k).

- d. In the event of a recorded violation of the fluoride standard (either HF or TF) prescribed in 401 KAR 53:010, the Cabinet shall require that remedial measures be initiated from the source(s) responsible for causing said violation. [401 KAR 61:165, Section 4(2)]

Compliance Demonstration:

In the event of a recorded violation of the fluoride standard (either HF or TF) prescribed in 401 KAR 53:010, the permittee shall initiate remedial measures for the source(s) responsible for causing the violation. A record of these immediate remedial measures and a corrective action plan for future corrective action and remediation must be submitted to the Division with the next quarterly report required in 6. Specific Reporting Requirements (j).

- e. The total aluminum production shall not exceed 253,531 cumulative tons per year from Potlines 1, 2, & 3, on a rolling 12-month basis. [401 KAR 51:017]

Compliance Demonstration:

Refer to 4. Specific Monitoring Requirements (f)(ii) and 5. Specific Recordkeeping Requirements (h)(ii).

- f. The permittee shall operate each dry scrubber/baghouse system when the associated potline is in operation. [401 KAR 51:017]

Compliance Demonstration:

Records shall be kept of the times when the units are operating but the control devices are not. Records shall also be kept of the maintenance activities for the control devices.

- g. The petroleum coke used to make the green anodes shall not exceed 3.0 percent sulfur by weight and the pitch shall not exceed 0.80 percent sulfur by weight as measured by the standard ASTM method, an approved alternative method, or by vendor Certificate of Analysis (per shipment basis). [401 KAR 51:017]

Compliance Demonstration:

Refer to 5. Specific Recordkeeping Requirements (h)(v).

- h. The permittee shall follow good design and combustion practices for the potlines to control CO emissions. The standard operating procedures for following good operational procedures shall be kept available at site for inspection. Records shall be kept of continuing practices and maintenance. [401 KAR 51:017]

Compliance Demonstration:

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

Refer to 5. Specific Recordkeeping Requirements (h)(ix).

- i. Refer to **SECTION D**.

2. Emission Limitations:

- a. For each potline (combined roof monitor and stack emissions), the permittee shall not discharge or cause to be discharged into the atmosphere any emissions of TF, POM, or PM in excess of the applicable limits in 40 CFR 63.843(a)(1) through (3). [40 CFR 63.843(a)]
 - i. Emissions of TF shall not exceed 1.9 lb/ton (0.95 kg/Mg) of aluminum produced. [40 CFR 63.843(a)(1)(i)]
 - ii. Emissions of POM shall not exceed 1.1 lb/ton (0.55 kg/Mg) of aluminum produced. [40 CFR 63.843(a)(2)(iv)]
 - iii. Emissions of PM shall not exceed 7.4 lb/ton (3.7 kg/Mg) of aluminum produced. [40 CFR 63.843(a)(3)(i)]
- b. Emissions of COS shall not exceed 3.9 lb/ton (1.95 kg/Mg) of aluminum produced for each potline (combined roof monitor and stack emissions). [40 CFR 63.843(e)]
- c. The owner or operator may average emissions from potlines and demonstrate compliance with the limits in 40 CFR 63, Subpart LL, Tables 1 through 3 using the procedures in 40 CFR 63.846(b)(1) through (3). [40 CFR 63.846(b)]
 - i. Semiannual average emissions of TF shall not exceed 1.6 lb/ton if 3 potlines are averaged or 1.7 lb/ton if 2 potlines are averaged. The emission rate shall be calculated based on the total primary and secondary emissions from all potlines comprising the averaging group over the period divided by the quantity of aluminum produced during the period, from all potlines comprising the averaging group. To determine compliance with the applicable emission limit in 40 CFR 63, Subpart LL, Table 1 for TF emissions, the permittee shall determine the average emissions (in lb/ton) from each potline from at least three runs per potline semiannually for TF secondary emissions and at least three runs per potline primary control system each year using the procedures and methods in 40 CFR 63.847 and 63.849. The permittee shall combine the results of secondary TF average emissions with the TF results for the primary control system and divide total emissions by total aluminum production. [40 CFR 63.846(b)(1)]
 - ii. Semiannual average emissions of POM shall not exceed 0.9 lb/ton if 3 potlines are averaged, or 1 lb/ton if 2 potlines are averaged. The emission rate shall be calculated based on the total primary and secondary emissions from all potlines comprising the averaging group over the period divided by the quantity of aluminum produced during the period, from all potlines comprising the averaging group. To determine compliance with the applicable emission limit in 40 CFR 63, Subpart LL, Table 2 for POM emissions, the permittee shall determine the average emissions (in lb/ton) from each potline from at least three runs per potline semiannually for POM secondary emissions and at least three runs per potline primary control system each year for POM primary emissions using the procedures and methods in 40 CFR 63.847 and 63.849. The permittee shall combine the results of secondary POM average emissions with the POM

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

results for the primary control system and divide total emissions by total aluminum production. [40 CFR 63.846(b)(2)]

- iii. Semiannual average emissions of PM shall not exceed 6.1 lb/ton. The emission rate shall be calculated based on the total primary and secondary emissions from all potlines comprising the potline group over the period divided by the quantity of aluminum produced during the period, from all potlines comprising the averaging group. To determine compliance with the applicable emission limit in 40 CFR 63, Subpart LL, Table 3 for PM emissions, the permittee shall determine the average emissions (in lb/ton) from each potline from at least three runs per potline semiannually for PM secondary emissions and at least three runs per potline primary control system each year for PM primary emissions using the procedures and methods in 40 CFR 63.847 and 63.849. The permittee shall combine the results of secondary PM average emissions with the PM results for the primary control system and divide total emissions by total aluminum production. [40 CFR 63.846(b)(3)]

Compliance Demonstration:

1. The permittee shall determine compliance with the applicable TF, POM, or PM emission limits using the following equations and procedures: [40 CFR 63.847(e)]

- A. Compute the emission rate (E_p) of TF, POM, or PM from each potline using the following equation: [40 CFR 63.847(e)(1)]

$$E_p = \frac{[(C_{s1} \times Q_{sd})_1 + (C_{s2} \times Q_{sd})_2]}{(P \times K)}$$

Where:

- E_p = emission rate of TF, POM, or PM from a potline, lb/ton (kg/Mg);
- C_{s1} = concentration of TF, POM, or PM from the primary control system, mg/dscf (mg/dscm);
- Q_{sd} = volumetric flow rate of effluent gas corresponding to the appropriate subscript location, dscf/hr (dscm/hr);
- C_{s2} = concentration of TF, POM, or PM as measured for roof monitor emissions, mg/dscf (mg/dscm);
- P = aluminum production rate, ton/hr (Mg/hr);
- K = conversion factor, 453,600 mg/lb (106 mg/kg) for TF, POM, and PM;
- ₁ = subscript for primary control system effluent gas; and
- ₂ = subscript for secondary control system or roof monitor effluent gas.

- B. Determine the weight of the aluminum tapped from the potline using the monitoring devices required in 40 CFR 63.848(j). [40 CFR 63.847(e)(5)]
- C. Determine the aluminum production rate (P) by dividing the number of hours in the calendar month into the weight of aluminum tapped from the potline during the calendar month that includes the three runs of a performance test. [40 CFR 63.847(e)(6)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

D. Refer to **3. Testing Requirements (d), (f), and (g)** and **7. Specific Control Equipment Operating Conditions (b)**.

2. The permittee shall calculate, for each potline, the emission rate of COS for each calendar month of operation using the following equation: [40 CFR 63.847(j)]

$$E_{COS} = [K] \times \left[\frac{Y}{Z} \right] \times [S]$$

Where:

E_{COS} = the emission rate of COS during the calendar month, pounds per ton of aluminum produced;

K = factor accounting for molecular weights and conversion of sulfur to carbonyl sulfide = 234;

Y = the mass of anode consumed in the potline during the calendar month, tons;

Z = the mass of aluminum produced by the potline during the calendar month, tons; and

S = the weighted average fraction of sulfur in the anode coke consumed in the production of aluminum during the calendar month (e.g., if the weighted average sulfur content of the anode coke consumed during the calendar month was 2.5 percent, then $S = 0.025$). The weight of anode coke used during the calendar month of each different concentration of sulfur is used to calculate the overall weighted average fraction of sulfur.

Compliance is demonstrated if the calculated value of E_{COS} is less than the applicable standard for COS emissions in 40 CFR 63.843(e). Refer to **3. Testing Requirements (l)**.

- d. The permittee shall not cause to be discharged into the atmosphere: [401 KAR 61:165, Section 3]
- i. From any potroom roof monitor any gases which exhibit ten (10) percent opacity or greater during normal potroom operation except start-up cells; [401 KAR 61:165, Section 3(1)]
 - ii. From any potroom roof monitor section directly above sick cells or start-up cells any gases which exhibit forty (40) percent opacity or greater; [401 KAR 61:165, Section 3(2)]
 - iii. From any dry scrubbing plant primary control system any gases which exhibit ten (10) percent opacity or greater. [401 KAR 61:165, Section 3(3)]

Compliance Demonstration:

Refer to **4. Specific Monitoring Requirements (e)** and **5. Specific Recordkeeping Requirements (h)(iii)**.

- e. The permittee shall not, from a dry scrubbing plant, cause to be discharged into the atmosphere gases which contain total fluorides in excess of one and nine-tenths (1.9) lb/ton of aluminum produced. [401 KAR 61:165, Section 4(1)(a) and 401 KAR 51:017]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

Compliance Demonstration:

Compliance 2. **Emission Limitations** (e) shall be demonstrated by complying with 2. **Emission Limitations** (a)(i) or (c)(i).

- f. The permittee shall not allow CO emissions from the potlines (combined roof monitor and stack emissions) to exceed 233.6 lb/ton of aluminum produced. [401 KAR 51:017]
- g. The permittee shall not allow PM emissions from the potlines (combined roof monitor and stack emissions) to exceed 4.88 lb/ton of aluminum produced. [401 KAR 51:017]
- h. The permittee shall not allow PM₁₀/PM_{2.5} emissions from the potlines (combined roof monitor and stack emissions) to exceed 2.1 lb/ton of aluminum produced. [401 KAR 51:017]

Compliance Demonstration:

Refer to 3. **Testing Requirements** (r).

- i. For SO₂ standards, refer to **SECTION D 3**.
- j. For HF standards, refer to **SECTION D 4**.
- k. For TF standards, refer to **SECTION D 5**.

3. Testing Requirements:

- a. The permittee shall prepare a site-specific test plan prior to the initial performance test according to the requirements of 40 CFR 63.7(c). The test plan shall include procedures for conducting the initial performance test and for subsequent performance tests required in 40 CFR 63.848 for emission monitoring. In addition to the information required by 40 CFR 63.7, the test plan shall include: [40 CFR 63.847(b)]
 - i. Procedures to ensure a minimum of three runs are performed annually for the primary control system for each source; [40 CFR 63.847(b)(1)]
 - ii. For a source with a single control device exhausted through multiple stacks, procedures to ensure that at least three runs are performed annually by a representative sample of the stacks satisfactory to the Division; [40 CFR 63.847(b)(2)]
 - iii. Procedures for establishing the frequency of testing to ensure that at least one run is performed before the 15th of the month, at least one run is performed after the 15th of the month, and that there are at least 6 days between two of the runs during the month, or that secondary emissions are measured according to an alternate schedule satisfactory to the Division. [40 CFR 63.847(b)(8)]
- b. Following approval of the site-specific test plan, the permittee shall conduct a performance test to demonstrate initial compliance according to the procedures in 40 CFR 63.847(d). If a performance test has been conducted on the primary control system for the potlines within the 12 months prior to the compliance date, the results of that performance test may be

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

used to demonstrate initial compliance. The permittee shall conduct the performance test: [40 CFR 63.847(c)]

- i. During the first month following: [40 CFR 63.847(c)(1)]
 - 1) October 7, 1999 for TF testing. [40 CFR 63.847(a)(1)]
 - 2) October 17, 2016 for calculation of COS emissions pursuant to 40 CFR 63.847(j). [40 CFR 63.847(a)(2)(ii)]
 - 3) October 16, 2017 for POM and PM testing. [40 CFR 63.847(a)(2)(iii)]
 - ii. For an existing potline that was shut down at the time compliance would have otherwise been required and is subsequently restarted, by the 180th day following startup for a potline or potroom group. The 180-day period starts when the first pot in a potline or potroom group is energized. [40 CFR 63.847(c)(3)(i)]
- c. The initial performance test and all subsequent performance tests shall be conducted in accordance with the applicable requirements of the general provisions in 40 CFR 63, Subpart A, the approved test plan, and the procedures in 40 CFR 63.847. Performance tests shall be conducted under such conditions as the Division specifies to the permittee based on representative performance of the affected source for the period being tested. Upon request, the permittee shall make available to the Division such records as may be necessary to determine the conditions of performance tests. [40 CFR 63.847(d)]
- d. For each potline, the permittee shall measure and record the emission rates of TF, POM and PM exiting the outlet of the primary control system and the rate of secondary emissions exiting through each roof monitor. Using the equation in 40 CFR 63.847(e)(1), the permittee shall compute and record the average of at least three runs semiannually for secondary emissions and at least three runs each year for the primary control system to determine compliance with the applicable emission limit. Compliance is demonstrated when the emission rates of TF, POM, and PM are equal to or less than the applicable emission limits in 40 CFR 63.843 or 40 CFR 63.846. [40 CFR 63.847(d)(1)]
- e. If the permittee has performed more than one test of primary emission control device(s) for a potline during the previous consecutive 12 months, the average of all runs performed in the previous 12-month period shall be used to determine the contribution from the primary emission control system. [40 CFR 63.847(d)(3)]
- f. Using the procedures in 40 CFR 63.847 and in the approved test plan, the permittee shall monitor emissions of TF and PM from each potline by conducting annual performance tests on the primary control system and semiannual performance tests on the secondary emissions. The permittee shall compute and record the average semiannually from at least three runs for secondary emissions and the average from at least three runs for the primary control system to determine compliance with the applicable emission limit. The permittee shall include all valid runs in the semiannual average. The duration of each run for secondary emissions shall represent a complete operating cycle. Potline emissions shall be recorded as the sum of the average of at least three runs from the primary control system

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

and the average of at least three runs from the roof monitor or secondary emissions control device. [40 CFR 63.848(a)]

- g. Using the procedures in 40 CFR 63.847 and in the approved test plan, the permittee shall monitor emissions of POM from each potline stack annually and secondary potline POM emissions semiannually. The permittee shall compute and record the semiannual average from at least three runs for secondary emissions and at least three runs for the primary control systems to determine compliance with the applicable emission limit. The permittee shall include all valid runs in the semiannual average. The duration of each run for secondary emissions shall represent a complete operating cycle. The primary control system shall be sampled over an 8-hour period, unless site-specific factors dictate an alternative sampling time subject to the approval of the Division. Potline emissions shall be recorded as the sum of the average of at least three runs from the primary control system and the average of at least three runs from the roof monitor or secondary emissions control device. [40 CFR 63.848(b)]
- h. The permittee shall use the following reference methods to determine compliance with the applicable emission limits for TF, POM, PM, and conduct visible emissions observations: [40 CFR 63.849(a)]
 - i. Method 1 in 40 CFR 60, Appendix A for sample and velocity traverses; [40 CFR 63.849(a)(1)]
 - ii. Method 2 in 40 CFR 60, Appendix A for velocity and volumetric flow rate; [40 CFR 63.849(a)(2)]
 - iii. Method 3 in 40 CFR 60, Appendix A for gas analysis; [40 CFR 63.849(a)(3)]
 - iv. Method 13A or Method 13B in 40 CFR 60, Appendix A, or an approved alternative, for the concentration of TF where stack or duct emissions are sampled; [40 CFR 63.849(a)(4)]
 - v. Method 13A or Method 13B and Method 14 or Method 14A in 40 CFR 60, Appendix A or an approved alternative method for the concentration of TF where emissions are sampled from roof monitors not employing wet roof scrubbers; [40 CFR 63.849(a)(5)]
 - vi. Method 315 in 40 CFR 63, Appendix A or an approved alternative method for the concentration of POM where stack or duct emissions are sampled; [40 CFR 63.849(a)(6)]
 - vii. Method 315 in 40 CFR 63, Appendix A and Method 14 or 14A in 40 CFR 60, Appendix A or an approved alternative method for the concentration of POM where emissions are sampled from roof monitors not employing wet roof scrubbers. Method 315 need not be set up as required in the method. Instead, when using Method 14A, replace the Method 14A monitor cassette filter with the filter specified by Method 315. Recover and analyze the filter according to Method 315. When using Method 14, test at ambient conditions, do not heat the filter and probe, and do not analyze the back half of the sampling train; [40 CFR 63.849(a)(7)]
 - viii. Method 5 in 40 CFR 60, Appendix A or an approved alternative method for the concentration of PM where stack or duct emissions are sampled; [40 CFR 63.849(a)(8)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- ix. Method 17 and Method 14 or Method 14A in 40 CFR 60, Appendix A or an approved alternative method for the concentration of PM where emissions are sampled from roof monitors not employing wet roof scrubbers. Method 17 need not be set up as required in the method. Instead, when using Method 14A, replace the Method 14A monitor cassette filter with the filter specified by Method 17. Recover and analyze the filter according to Method 17. When using Method 14, test at ambient conditions, do not heat the filter and probe, and do not analyze the back half of the sampling train; [40 CFR 63.849(a)(9)]
- x. Method 22 in 40 CFR 60, Appendix A or an approved alternative method for determination of visual emissions; [40 CFR 63.849(a)(12)]
- i. Except as provided in 40 CFR 63.845(g)(1), references to “potroom” or “potroom group” in Method 14 in 40 CFR 60, Appendix A shall be interpreted as “potline” for the purposes of 40 CFR 63, Subpart LL. [40 CFR 63.849(c)]
- j. For sampling using Method 14 in 40 CFR 60, Appendix A, the permittee shall install one Method 14 manifold per potline in a potroom that is representative of the entire potline, and this manifold shall meet the installation requirements specified in 40 CFR 60, Appendix A, Method 14, Section 2.2.1. [40 CFR 63.849(d)]
- k. The permittee may use an alternative test method for TF or POM emissions providing: [40 CFR 63.849(e)]
 - i. The permittee has already demonstrated the equivalency of the alternative method for a specific plant and has received previous approval from the U.S. EPA or the Division for TF or POM measurements using the alternative method; or [40 CFR 63.849(e)(1)]
 - ii. The permittee demonstrates to the satisfaction of the Division that the results from the alternative method meet the criteria specified in 40 CFR 63.848(d)(1) and (d)(3) through (d)(6). The results from the alternative method shall be based on simultaneous sampling using the alternative method and the following reference methods: [40 CFR 63.849(e)(2)]
 - 1) For TF, Methods 13 and 14 or Method 14A in 40 CFR 60, Appendix A; or [40 CFR 63.849(e)(2)(i)]
 - 2) For POM, Method 315 in 40 CFR 63, Appendix A and Method 14 in 40 CFR 60, Appendix A. [40 CFR 63.849(e)(2)(ii)]
- l. The permittee shall use either ASTM D4239-14e1 or ASTM D6376-10 (incorporated by reference; see 40 CFR 63.14) for determination of the sulfur content in anode coke shipments to determine compliance with the applicable emission limit for COS emissions. [40 CFR 63.849(f)]
- m. Reference methods as defined in Appendix A of 40 CFR 60 or as otherwise specified, filed by reference in 401 KAR 50:015, except as provided for in 401 KAR 50:045, shall be used to determine compliance with the standards prescribed in 401 KAR 61:165, Sections 3, 4 and 5 as follows: [401 KAR 61:165, Section 7(1)]
 - i. For sampling emissions from stacks: [401 KAR 61:165, Section 7(1)(a)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- 1) Reference Method 13A or 13B for the concentration of total fluoride and the associated moisture content; [401 KAR 61:165, Section 7(1)(a)(1)]
- 2) Reference Method 1 for sample and velocity traverses; [401 KAR 61:165, Section 7(1)(a)(2)]
- 3) Reference Method 2 for velocity and volumetric flow rate; [401 KAR 61:165, Section 7(1)(a)(3)]
- 4) Reference Method 3 for gas analysis; and [401 KAR 61:165, Section 7(1)(a)(4)]
- 5) Reference Method 5 for particulate emissions. [401 KAR 61:165, Section 7(1)(a)(5)]
- ii. For sampling emissions from roof monitors not employing stacks or pollutant collection systems: [401 KAR 61:165, Section 7(1)(b)]
 - 1) Reference Method 14 and Kentucky Method 130 for the concentration of gaseous fluorides and associated moisture content; [401 KAR 61:165, Section 7(1)(b)(1)]
 - 2) Reference Method 1 for sample and velocity traverses; [401 KAR 61:165, Section 7(1)(b)(2)]
 - 3) Reference Method 2 and Reference Method 14 for velocity and volumetric flow rate; and [401 KAR 61:165, Section 7(1)(b)(3)]
 - 4) Reference Method 3 for gas analysis. [401 KAR 61:165, Section 7(1)(b)(4)]
- iii. For opacity determination: Reference Method 9. [401 KAR 61:165, Section 7(1)(c)]
- n. For Reference Method 13A or 13B, 14, and Kentucky Method 130, the sampling time for each run shall be at least eight (8) hours for any potroom sample, and the minimum sample volume shall be six and eight-tenths (6.8) dscm (240 dscf) for any potroom sample except that shorter sampling times or smaller volumes, when necessitated by process variables or other factors, may be approved by the Cabinet. [401 KAR 61:165, Section 7(2)]
- o. The air pollution control system for each affected facility shall be constructed so that volumetric flow rates and total fluoride emissions can be accurately determined using applicable methods specified under 401 KAR 61:165, Section 7(1). [401 KAR 61:165, Section 7(3)]
- p. For the purposes of demonstrating compliance with the requirements of 401 KAR 61:165, the rate of aluminum production is determined by dividing 720 hours into the weight of aluminum tapped from the affected facility during a period of thirty (30) days prior to and including the final run of a performance test. [401 KAR 61:165, Section 7(4)]
- q. For each run for any plant with an emission limitation expressed in lbs/ton of aluminum produced, potroom group emissions expressed in kg/metric ton of aluminum produced shall be determined using the equation in 401 KAR 61:165, Appendix A. [401 KAR 61:165, Section 7(5)]
- r. The following compliance tests shall be performed to demonstrate compliance with all emission limitations listed above for CO, SO₂, PM, PM₁₀, and PM_{2.5}:

Commented [PS1]: Refer to Section 5 of the application letter for additional discussion regarding the proposed edits to the potline CO and SO₂ testing permit condition language.

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- i. The permittee shall perform testing according to Reference Method 10 for CO emissions **from a representative potline A-398 scrubber system and from a representative potline roof monitor** once within the 5 year permit term of permit V-19-010. ~~Where similar potlines exist, the permittee may perform sampling on a representative potline.~~
 - ii. The permittee shall perform testing according to Reference Method 6 for SO₂ emissions **from a representative potline A-398 scrubber system** once within the 5 year permit term of permit V-19-010. ~~Where similar potlines exist, the permittee may perform sampling on a representative potline.~~ The permittee shall also perform ~~annual~~ testing of **SO₂ emissions from** the roof monitors associated with a representative potline to determine the contribution from the roof monitors to the SO₂ emissions **once within the 5 year permit term limit.** ~~The test shall be performed within 180 days of the issuance of permit V-19-010.~~
 - iii. The permittee shall conduct a performance test for particulate emissions (filterable PM, PM₁₀, PM_{2.5} and Condensable Particulate) once every 12 months during the life of permit V-19-010. The tests shall be performed according to Reference Method 5 and Reference Method 201A/202 for particulate emissions (filterable PM, PM₁₀, PM_{2.5} and Condensable Particulate). Where similar potlines exist, the permittee may perform sampling on a representative potline. These tests can be performed simultaneously with the testing required by 40 CFR 63, Subpart LL.
 - iv. The permittee may use other test methods as approved by the Division.
 - s. For sampling emissions from roof monitors not employing stacks or pollutant collection systems, the permittee may use Reference Method 14A for the concentration of gaseous fluorides and associated moisture content in lieu of the methods specified in 401 KAR 61:165, Section 7(1)(b)(1).
 - t. If the permittee chooses to perform representative sampling on a potline in lieu of performing testing on each potline, the permittee shall ensure that each potline is equipped for sampling (both stack and roof monitor sampling) such that different potlines can be sampled in future tests.
 - u. Pursuant to 401 KAR 61:005, Section 2(2) and 401 KAR 50:045, Section 1, performance testing using the reference methods specified in 401 KAR 50:015 shall be conducted as required by the Division.
- 4. Specific Monitoring Requirements:**
- a. The permittee shall determine the operating limits and monitoring frequency for each control device that is to be monitored as required in 40 CFR 63.848(f). [40 CFR 63.847(h)]
 - i. For potlines, the permittee shall determine upper and/or lower operating limits, as appropriate, for each monitoring device for the emission control system from the values recorded during each of the runs performed during the initial performance test and from historical data from previous performance tests conducted by the methods specified in 40 CFR 63, Subpart LL. [40 CFR 63.847(h)(1)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- ii. The permittee may redetermine the upper and/or lower operating limits, as appropriate, based on historical data or other information and submit an application to the Division to change the applicable limit(s). The redetermined limits shall become effective upon approval by the Division. [40 CFR 63.847(h)(3)]
- b. As an alternative to semiannual monitoring of TF, POM or PM secondary emissions from each potline using the methods in 40 CFR 63.849, the permittee may perform semiannual monitoring of TF, POM or PM secondary emissions from one potline using the test methods in 40 CFR 63.849(a) or (b) to represent the performance of similar potline(s). The similar potline(s) shall be monitored using an alternative method that meets the requirements of 40 CFR 63.848(d)(1) through (7). Two or more potlines are similar if the permittee demonstrates that their structure, operability, type of emissions, volume of emissions and concentration of emissions are substantially equivalent. [40 CFR 63.848(d)]
 - i. To demonstrate (to the satisfaction of the Division) that the level of emission control performance is the same or better, the permittee shall perform an emission test using an alternative monitoring procedure for the similar potline simultaneously with an emission test using the applicable test methods. The results of the emission test using the applicable test methods shall be in compliance with the applicable emission limit for existing or new potlines in 40 CFR 63.843 or 40 CFR 63.844. An alternative method: [40 CFR 63.848(d)(1)]
 - 1) For TF emissions, shall account for or include gaseous fluoride and cannot be based on measurement of particulate matter or particulate fluoride alone; and [40 CFR 63.848(d)(1)(i)]
 - 2) For TF, POM and PM emissions, shall meet or exceed Method 14 criteria. [40 CFR 63.848(d)(1)(ii)]
 - ii. An HF continuous emission monitoring system is an approved alternative for the monitoring of TF secondary emissions. [40 CFR 63.848(d)(2)]
 - iii. If the permittee elects to use an alternative monitoring procedure, the permittee shall establish an alternative emission limit based on at least nine simultaneous runs using the applicable test methods and the alternative monitoring method. All runs shall represent a full process cycle. [40 CFR 63.848(d)(3)]
 - iv. The permittee shall derive an alternative emission limit for the HF continuous emission monitor or an alternative method using either of the following procedures: [40 CFR 63.848(d)(4)]
 - 1) Use the highest value from the alternative method associated with a simultaneous run by the applicable test method that does not exceed the applicable emission limit; or [40 CFR 63.848(d)(4)(i)]
 - 2) Correlate the results of the two methods (the applicable test method results and the alternative monitoring method results) and establish an emission limit for the alternative monitoring system that corresponds to the applicable emission limit. [40 CFR 63.848(d)(4)(ii)]
 - v. The permittee shall submit the results required in 40 CFR 63.848(d)(4) and all supporting documentation to the Division for review and approval. [40 CFR 63.848(d)(5)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- vi. The Division will review and approve or disapprove the request for an alternative method and alternative emission limit. The criterion for approval shall be a demonstration (to the satisfaction of the Division) that the alternative method and alternative emission limit achieve a level of emission control that is the same as or better than the level that would have otherwise been achieved by the applicable method and emission limit. [40 CFR 63.848(d)(6)]
 - vii. If the alternative method is approved by the Division, the permittee shall perform semiannual emission monitoring using the approved alternative monitoring procedure to demonstrate compliance with the alternative emission limit for each similar potline. [40 CFR 63.848(d)(7)]
 - c. The permittee shall install, operate, and maintain a monitoring device to determine the daily weight of aluminum produced. [40 CFR 63.848(j)]
 - d. The permittee shall install, use, and maintain ambient air monitoring equipment for the detection of fluorides in accordance with such methods as the Cabinet shall prescribe; establish and maintain records of same; and make periodic emission reports at intervals prescribed by the Cabinet. [401 KAR 61:165, Section 6(3)]
 - e. The permittee shall perform a qualitative visual observation of the opacity of emissions at each stack and roof monitor daily and maintain a log of the observations. If visible emissions from a stack or roof monitor are observed (not including condensed water in the plume), then an inspection of process/control equipment shall be initiated and corrective action taken. If visible emissions are present after the corrective action, the permittee shall determine the opacity using Reference Method 9. The Method 22 observations performed for 40 CFR 63, Subpart LL may also be used to meet the qualitative requirement for the stack. [401 KAR 52:020, Section 10]
 - f. For each emission unit listed above, the permittee shall monitor the following parameters: [401 KAR 52:020, Section 10]
 - i. Monthly hours of operation;
 - ii. Monthly and 12-month rolling throughput for each potline;
 - iii. Monthly anode consumption **rate** in **pPotlines 1-3 (ton anode/ton aluminum produced)**.
 - g. For Potlines 1-3, refer to Appendix A for CAM requirements pursuant to 40 CFR 64.
 - h. Refer to **SECTION F**.
- 5. Specific Recordkeeping Requirements:**
- a. The permittee shall develop a written startup plan as described in 40 CFR 63.854(b) that contains specific procedures to be followed during startup periods of potline(s). Compliance with the applicable standards in 40 CFR 63.854(b) will be demonstrated through site inspection(s) and review of site records by the Division. [40 CFR 63.847(k)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- b. The permittee shall maintain files of all information (including all reports and notifications) required by 40 CFR 63.10(b) and by 40 CFR 63, Subpart LL. [40 CFR 63.850(e)]
- c. The permittee shall retain each record for at least 5 years following the date of each occurrence, measurement, maintenance, corrective action, report, or record. The most recent 2 years of records must be retained at the facility. The remaining 3 years of records may be retained offsite; [40 CFR 63.850(e)(1)]
- d. The permittee may retain records on microfilm, on a computer, on computer disks, on magnetic tape, or on microfiche; [40 CFR 63.850(e)(2)]
- e. The permittee may report required information on paper or on a labeled computer disc using commonly available and compatible computer software; and [40 CFR 63.850(e)(3)]
- f. In addition to the general records required by 40 CFR 63.10(b), the permittee shall maintain records of the following information: [40 CFR 63.850(e)(4)]
 - i. Daily production rate of aluminum; [40 CFR 63.850(e)(4)(i)]
 - ii. Records supporting the monitoring of similar potlines demonstrating that the performance of similar potlines is the same as or better than that of potlines sampled by manual methods; [40 CFR 63.850(e)(4)(vi)]
 - iii. Records supporting a request for reduced sampling of potlines; [40 CFR 63.850(e)(4)(vii)]
 - iv. The current implementation plan for emission averaging and any subsequent amendments; [40 CFR 63.850(e)(4)(ix)]
 - v. Records, such as a checklist or the equivalent, demonstrating that the daily visual inspection of the exhaust stack for each control device has been performed as required in 40 CFR 63.848(g), including the results of each inspection; [40 CFR 63.850(e)(4)(xi)]
 - vi. For a potline equipped with an HF continuous emission monitor, records of information and data required by 40 CFR 63.10(c); [40 CFR 63.850(e)(4)(xii)]
 - vii. Records documenting the corrective actions taken when the limit(s) for an operating parameter established under 40 CFR 63.847(h) were exceeded or when visible emissions indicating abnormal operation were observed from a control device stack during a daily inspection required under 40 CFR 63.848(g). [40 CFR 63.850(e)(4)(xiii)]
 - viii. Records documenting any POM data that are invalidated due to the installation and startup of a cathode; [40 CFR 63.850(e)(4)(xiv)]
 - ix. Records documenting the portion of TF that is measured as particulate matter and the portion that is measured as gaseous when the particulate and gaseous fractions are quantified separately using an approved test method; [40 CFR 63.850(e)(4)(xv)]
 - x. Records of the occurrence and duration of each malfunction of operation (i.e. process equipment) or the air pollution control equipment and monitoring equipment; and [40 CFR 63.850(e)(4)(xvi)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- xi. Records of actions taken during periods of malfunction to minimize emissions in accordance with 40 CFR 63.843(f) and 63.844(f), including corrective actions to restore malfunctioning process and air pollution control and monitoring equipment to its normal or usual manner of operation. [40 CFR 63.850(e)(4)(xvii)]
- g. Records of the installation, use, and maintenance of the ambient air monitoring equipment required by 401 KAR 61:165. [401 KAR 61:165, Section 6(3)]
- h. For each emission unit listed above, the permittee shall maintain the following records: [401 KAR 52:020, Section 10]
 - i. Monthly hours of operation;
 - ii. Monthly and 12-month rolling throughput for each potline;
 - iii. The qualitative visual observations required by **4. Specific Monitoring Requirements (e)**, including the date, time, initials of observer, whether any emissions were observed (yes/no), any Method 9 readings taken, and any corrective action taken including results due to observed emissions;
 - iv. Monthly anode consumption in potlines 1-3;
 - v. Records of sulfur contents of coal and pitch from standard ASTM method, an approved alternative method, or by vendor Certificate of Analysis per shipment basis;
 - vi. Records of ambient air monitoring results for fluorides;
 - vii. Records of calibration for all monitoring devices;
 - viii. Records of the quarterly ambient monitoring data reports required by **6. Specific Reporting Requirements (e)**.
 - ix. Records of standard operating procedures, continuing practices, and maintenance used to meet **1. Operating Limitations (h)**.
 - x. Records of violations of the ambient air standards for total and gaseous fluorides as prescribed in 401 KAR 53:010. [401 KAR 61:165, Section 4(2)]
- i. The permittee shall record the occurrence, duration, cause and any corrective action taken for any incident or malfunction that occurs that causes or might cause an exceedance of the particulate emission or opacity standard when an emission unit is in operation. A log of Method 9 observations (if performed) shall be kept and made available for inspection. [401 KAR 52:020, Section 10]
- j. For Potlines 1-3:
 - i. The permittee shall comply with the recordkeeping requirements specified in **SECTION F**. The permittee shall maintain records of monitoring data, monitor performance data, corrective actions taken, any written quality improvement plan required pursuant to 40 CFR 64.8 and any activities undertaken to implement a quality improvement plan, and other supporting information required to be maintained under 40 CFR 64 (such as data used to document the adequacy of monitoring, or records of monitoring maintenance or corrective actions). [40 CFR 64.9(b)(1)]
 - ii. Instead of paper records, the permittee may maintain records on alternative media, such as microfilm, computer files, magnetic tape disks, or microfiche, provided that the use

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

of such alternative media allows for expeditious inspection and review, and does not conflict with other applicable recordkeeping requirements. [40 CFR 64.9(b)(1)]

k. Refer to **SECTION F**.

6. Specific Reporting Requirements:

- a. If the permittee chooses to average emissions, the permittee shall develop and submit an implementation plan for emission averaging to the Division for review and approval according to the following procedures and requirements: [40 CFR 63.846(d)]
 - i. The permittee shall submit the implementation plan no later than 6 months before the date that the facility intends to comply with the emission averaging limits. [40 CFR 63.846(d)(1)]
 - ii. The permittee shall include the following information in the implementation plan or in the application for an operating permit for all emission sources to be included in an emissions average: [40 CFR 63.846(d)(2)]
 - 1) The identification of all emission sources (potlines) in the average; [40 CFR 63.846(d)(2)(i)]
 - 2) The assigned TF, POM and/or PM emission limit for each averaging group of potlines; [40 CFR 63.846(d)(2)(ii)]
 - 3) The specific control technologies or pollution prevention measures to be used for each emission source in the averaging group and the date of its installation or application. If the pollution prevention measures reduce or eliminate emissions from multiple sources, the permittee shall identify each source; [40 CFR 63.846(d)(2)(iii)]
 - 4) The test plan for the measurement of TF, POM and/or PM emissions in accordance with the requirements in 40 CFR 63.847(b); [40 CFR 63.846(d)(2)(iv)]
 - 5) The operating parameters to be monitored for each control system or device and a description of how the operating limits will be determined; [40 CFR 63.846(d)(2)(v)]
 - 6) If the permittee requests to monitor an alternative operating parameter pursuant to 40 CFR 63.848(l): [40 CFR 63.846(d)(2)(vi)]
 - A. A description of the parameter(s) to be monitored and an explanation of the criteria used to select the parameter(s); and [40 CFR 63.846(d)(2)(vi)(A)]
 - B. A description of the methods and procedures that will be used to demonstrate that the parameter indicates proper operation of the control device; the frequency and content of monitoring, reporting, and recordkeeping requirements; and a demonstration, to the satisfaction of the Division, that the proposed monitoring frequency is sufficient to represent control device operating conditions; and [40 CFR 63.846(d)(2)(vi)(B)]
 - 7) A demonstration that compliance with each of the applicable emission limit(s) will be achieved under representative operating conditions. [40 CFR 63.846(d)(2)(vii)]
 - iii. Upon receipt, the Division will review and approve or disapprove the plan or permit application according to the following criteria: [40 CFR 63.846(d)(3)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- 1) Whether the content of the plan includes all of the information specified in 40 CFR 63.846(d)(2); and [40 CFR 63.846(d)(3)(i)]
- 2) Whether the plan or permit application presents sufficient information to determine that compliance will be achieved and maintained. [40 CFR 63.846(d)(3)(ii)]
- iv. The Division will not approve an implementation plan or permit application containing any of the following provisions: [40 CFR 63.846(d)(4)]
 - 1) Any averaging between emissions of differing pollutants or between differing sources. Emission averaging shall not be allowed between TF, POM and/or PM, and emission averaging shall not be allowed between potlines and anode bake furnaces; [40 CFR 63.846(d)(4)(i)]
 - 2) The inclusion of any emission source other than an existing potline or existing anode bake furnace or the inclusion of any potline or anode bake furnace not subject to the same operating permit; or [40 CFR 63.846(d)(4)(ii)]
 - 3) The inclusion of any potline or anode bake furnace while it is shut down, in the emission calculations. [40 CFR 63.846(d)(4)(iii)]
- v. Following review, the Division will approve the plan or permit application, request changes, or request additional information. Once the Division receives any additional information requested, the Division will approve or disapprove the plan or permit application within 120 days. [40 CFR 63.846(d)(5)]
 - 1) The Division will approve the plan for the term of the operating permit; [40 CFR 63.846(d)(5)(i)]
 - 2) To revise the plan prior to the end of the permit term, the permittee shall submit a request to the Division; and [40 CFR 63.846(d)(5)(ii)]
 - 3) The permittee may submit a request to the Division to implement emission averaging after the applicable compliance date. [40 CFR 63.846(d)(5)(iii)]
- vi. While operating under an approved implementation plan, the permittee shall monitor the operating parameters of each control system, keep records, and submit periodic reports as required for each source subject to 40 CFR 63, Subpart LL. [40 CFR 63.846(d)(6)]
- b. The permittee shall submit recommended accuracy requirements to the Division for review and approval. All monitoring devices required by 40 CFR 63.848 must be certified by the permittee to meet the accuracy requirements and must be calibrated in accordance with the manufacturer's instructions. [40 CFR 63.848(k)]
- c. The permittee shall develop and submit to the Division, if requested, an engineering plan that describes the techniques that will be used to address the capture efficiency of the reduction cells for gaseous hazardous air pollutants in compliance with the emission limits in 40 CFR 63.843, 63.844, and 63.846; and [40 CFR 63.850(a)(8)]
- d. One-time notification of startup of an existing potline or potroom group that was shut down for a long period and subsequently restarted. The permittee must provide written notice to the Administrator at least 30 days before the startup. [40 CFR 63.850(a)(9)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- e. Within 60 days after the date of completing each performance test (as defined in 40 CFR 63.2) required by 40 CFR 63, Subpart LL, the permittee shall submit the results of the performance tests following the procedure specified in either 40 CFR 63.850(b)(1) or (b)(2). [40 CFR 63.850(b)]
- f. In addition to the information required under 40 CFR 63.10 of the General Provisions, the permittee shall provide semiannual reports containing the information specified in 40 CFR 63.850(d)(1) and (2) to the Division. [40 CFR 63.850(d)]
 - i. Excess emissions report. As required by 40 CFR 63.10(e)(3), the permittee shall submit a report (or a summary report) if measured emissions are in excess of the applicable standard. The report shall contain the information specified in 40 CFR 63.10(e)(3)(v) and be submitted quarterly. [40 CFR 63.850(d)(1)]
 - ii. If there was a malfunction during the reporting period, the permittee shall submit a report that includes the number, duration and a brief description for each type of malfunction which occurred during the reporting period and which caused or may have caused any applicable emission limitation to be exceeded. The report shall also include a description of actions taken by the permittee during a malfunction of an affected source to minimize emissions in accordance with 40 CFR 63.843(f) and 63.844(f), including actions taken to correct a malfunction. [40 CFR 63.850(d)(2)]
- g. All reports required by 40 CFR 63, Subpart LL not subject to the requirements in 40 CFR 63.850(b) or (c) shall be sent to the Administrator at the appropriate address listed in 40 CFR 63.13. If acceptable to both the Administrator and the permittee, these reports may be submitted on electronic media. The Administrator retains the right to require submittal of reports subject to 40 CFR 63.850(b) in paper format. [40 CFR 63.850(f)]
- h. The Division will notify the permittee in writing of the need for additional time to review the submissions in 40 CFR 63.851(a)(1) through (a)(5) or of approval or intent to deny approval of the submissions in 40 CFR 63.851(a)(1) through (a)(5) within 60 calendar days after receipt of sufficient information to evaluate the submission. The 60-day period begins after the permittee has been notified that the submission is complete. [40 CFR 63.851(a)]
 - i. The test plan in 40 CFR 63.847(b); [40 CFR 63.851(a)(1)]
 - ii. Request to change limits for operating parameters in 40 CFR 63.847(h)(3); [40 CFR 63.851(a)(2)]
 - iii. Request for similar potline monitoring in 40 CFR 63.848(d)(5); [40 CFR 63.851(a)(3)]
 - iv. Request for an alternative method in 40 CFR 63.849(e)(2). [40 CFR 63.851(a)(5)]
- i. The Division will notify the permittee in writing whether the submission is complete within 30 calendar days of receipt of the original submission or within 30 days of receipt of any supplementary information that is submitted. When a submission is incomplete, the Division will specify the information needed to complete the submission and will give the permittee 30 calendar days after receipt of the notification to provide the information. [40 CFR 63.851(b)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- j. The permittee shall submit to the Division quarterly ambient monitoring data reports. If the maximum 24-hour average primary standard or any of the secondary standards for HF as defined in 401 KAR 53:010, Appendix A, are exceeded more than once annually, than any subsequent exceedance is a violation. Any exceedance of the secondary standards for TF as defined in 401 KAR 53:010, Appendix A, is a violation. Refer to **SECTION D**. [401 KAR 61:165]
- k. For Potlines 1-3:
 - i. On and after the date specified in 40 CFR 64.7(a) by which the permittee must use monitoring that meets the requirements of 40 CFR 64, the permittee shall submit monitoring reports to the Division in accordance with **SECTION F**. [40 CFR 64.9(a)(1)]
 - ii. Refer to Appendix A for reporting requirements under 40 CFR 64.
- l. Refer to **SECTION F**.

7. Specific Control Equipment Operating Conditions:

- a. The permittee shall install, operate, calibrate, and maintain a continuous parameter monitoring system for each emission control device. The permittee shall submit for approval by the Division a description of the parameter(s) to be monitored, the operating limits, and the monitoring frequency to ensure that the control device is being properly operated and maintained. An explanation of the criteria used for selection of the parameter(s), the operating limits, and the monitoring frequency, including how these relate to emission control also shall be submitted to the Division. Except as provided in 40 CFR 63.848(l), the following monitoring devices shall be installed: [40 CFR 63.848(f)]
 - i. For dry alumina scrubbers, devices for the measurement of alumina flow and air flow; [40 CFR 63.848(f)(1)]
- b. The owner or operator of an existing affected source that is equipped with a control device and is subject to a PM limit shall: [40 CFR 63.848(g)]
 - i. Install and operate a bag leak detection system in accordance with 40 CFR 63.848(f)(6); or [40 CFR 63.848(g)(1)]
 - ii. Install and operate a PM CEMS in accordance with 40 CFR 63.848(f)(7); or [40 CFR 63.848(g)(2)]
 - iii. Visually inspect the exhaust stack(s) using Method 22 on a twice daily basis (at least 4 hours apart) for evidence of any visible emissions indicating abnormal operations and, shall initiate corrective actions within 1 hour of a visible emissions inspection that indicates abnormal operation. Corrective actions shall include, at a minimum, isolating, shutting down and conducting an internal inspection of the compartment that is the source of the visible emissions that indicate abnormal operations. [40 CFR 63.848(g)(3)]
- c. If a monitoring device for a primary control device measures an operating parameter outside the limit(s) established pursuant to 40 CFR 63.847(h) or if visible emissions indicating abnormal operation are observed from the exhaust stack of a control device

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

during a daily inspection, the permittee shall initiate corrective action procedures within 1 hour. Failure to initiate the corrective action procedures within 1 hour or to take the necessary corrective actions to remedy the problem is a violation. [40 CFR 63.848(h)]

- d. If the limit for a given operating parameter associated with monitoring a specific control device is exceeded six times in any semiannual reporting period, then any subsequent exceedance in that reporting period is a violation. For the purpose of determining the number of exceedances, no more than one exceedance shall be attributed in any given 24-hour period. [40 CFR 63.848(i)]
- e. The permittee may monitor alternative control device operating parameters subject to prior written approval by the Division. [40 CFR 63.848(l)]
- f. The permittee shall install, operate, and maintain the dry alumina scrubbers and baghouses in accordance with manufacturer's specifications. [401 KAR 51:017]
- g. The permittee shall continuously monitor the alumina bed differential pressure and the baghouse differential pressure. [401 KAR 51:017]
- h. Refer to **SECTION E**.

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

SUBJECT ITEM 6 REQUIREMENTS: Anode Bake Furnace

EU	Equip. Desig.	Cons. Date	Description	Controls	Material	Capacity
Emission Group IV: Anode Bake Furnace						
N2	(EE)	8/4/1972; Refurbished 2007	Anode Bake Furnace ("261 Furnace")	A-446 Dry Scrubber/ Baghouse System	Green Anodes; Natural Gas	17.74 tons/hr*; 51.0 MMBtu/hr

*Based on an annual average

APPLICABLE REGULATIONS:

401 KAR 51:017, *Prevention of significant deterioration of air quality*

401 KAR 53:010, *Ambient air quality standards for HF & TF*

401 KAR 59:010, *New process operations*

401 KAR 63:002, Section 2(4)(bb), 40 C.F.R. 63.840 to 63.855, Tables 1 to 4, and Appendix A (Subpart LL), *National Emission Standards for Hazardous Air Pollutants for Primary Aluminum Reduction Plants*, applicable with respect to each existing anode bake furnace associated with primary aluminum production and located at a major source as defined in 40 CFR 63.2.

40 CFR 64, *Compliance Assurance Monitoring*, applicable to the Anode Bake Furnace with respect to PM₁₀. Refer to Appendix A-1.

PRECLUDED REGULATIONS:

401 KAR 51:017, *Prevention of significant deterioration of air quality*

1. Operating Limitations:

- At all times, the permittee shall operate and maintain any affected source, including associated air pollution control equipment and monitoring equipment, in a manner consistent with safety and good air pollution control practices for minimizing emissions. Determination of whether such operation and maintenance procedures are being used will be based on information available to the Division which may include, but is not limited to, monitoring results, review of operation and maintenance procedures, review of operation and maintenance records and inspection of the source. [40 CFR 63.843(f) and 63.844(f)]
- The permittee shall install and operate an advanced furnace firing and control system to minimize natural gas usage per unit of baked anode production and thus, CO emissions. [401 KAR 51:017]
- Refer to **SECTION D**.

2. Emission Limitations:

- The permittee shall not discharge or cause to be discharged into the atmosphere any emissions of TF, POM, PM or mercury in excess of the limits in 40 CFR 63.843(c)(1) through (4). [40 CFR 63.843(c)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- i. Emissions of TF shall not exceed 0.20 lb/ton (0.10 kg/Mg) of green anode; [40 CFR 63.843(c)(1)]
- ii. Emissions of POM shall not exceed 0.18 lb/ton (0.09 kg/Mg) of green anode; [40 CFR 63.843(c)(2)]
- iii. Emissions of PM shall not exceed 0.20 lb/ton (0.10 kg/Mg) of green anode; and [40 CFR 63.843(c)(3)]
- iv. Emissions of mercury shall not exceed 1.7 µg/dscm. [40 CFR 63.843(c)(4)]

Compliance Demonstration:

- 1. The permittee shall determine compliance with the applicable TF, POM, PM or Hg emission limits using the following equations and procedures: [40 CFR 63.847(e)]
 - A. Compute the emission rate (E_b) of TF, POM or PM from each anode bake furnace using the following equation: [40 CFR 63.847(e)(3)]

$$E_b = \frac{(C_s \times Q_{sd})}{(P_b \times K)}$$

Where:

E_b = emission rate of TF, POM or PM, lb/ton (kg/mg) of green anodes;

C_s = concentration of TF, POM or PM, mg/dscf (mg/dscm);

Q_{sd} = volumetric flow rate of effluent gas, dscf/hr (dscm/hr);

P_b = quantity of green anode material placed in the furnace, ton/hr (mg/hr); and

K = conversion factor, 453,600 mg/lb (106 mg/kg).

- B. Compliance with the anode bake furnace Hg emission standard is demonstrated if the Hg concentration of the exhaust from the anode bake furnace control device is equal to or less than the applicable concentration standard in 40 CFR 63.843(c)(4). [40 CFR 63.847(e)(4)]
 - C. Determine the weight of the green anode material placed in the anode bake furnace using the monitoring devices required in 40 CFR 63.848(j). [40 CFR 63.847(e)(5)]
 - D. Determine the rate of green anode material introduced into the furnace by dividing the number of operating hours in the calendar month into the weight of green anode material used during the calendar month in which the performance test was conducted. [40 CFR 63.847(e)(7)]
 - 2. Refer to **3. Testing Requirements (e)** and **(f)** and **7. Specific Control Equipment Operating Conditions (b)**.
- b. The permittee shall not cause, suffer, allow or permit any continuous emission into the open air from a control device or stack associated with any affected facility which is equal to or greater than twenty (20) percent opacity. [401 KAR 59:010, Section 3(1)(a)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

Compliance Demonstration:

Refer to 5. Specific Recordkeeping Requirements and 7. Specific Control Equipment Operating Conditions.

- c. For all emission units listed above: For emissions from a control device or stack the permittee shall not cause, suffer, allow or permit the emission into the open air of particulate matter from any affected facility which is in excess of the quantity specified in 401 KAR 59:010, Appendix A: [401 KAR 59:010, Section 3(2)]
- For process weights < 0.5 tons/hour: 2.34 lbs/hr
 - For process weights < 30 tons/hour: $E = 3.59P^{0.62}$
- Where
 E = rate of emission in lb/hr; and
 P = process weight rate in tons/hr.

Compliance Demonstration:

Compliance with the hourly particulate emission limits described above shall be determined by comparing the allowable rate to the actual rate as calculated below:

$$E_{PMij} = \frac{P_{ij} \times EF_{PMj}}{h_{ij}} \times (1 - CE_j)$$

Where:

i = month;

j = unit;

E_{PMij} = actual average hourly particulate emission rate from unit j during month i (pounds/hour);

P_{ij} = actual specific operating parameter for month i (units/month);

EF_{PMj} = overall uncontrolled particulate emission factor as determined from the most recent performance test or approved by the Division for unit j (pounds/unit);

h_{ij} = actual total hours of operation for unit j during month i (hours/month)

CE_j = overall control efficiency (%) of any air pollution control equipment associated with unit j .

- d. The permittee shall not allow PM/PM₁₀ emissions from the Anode Bake Furnace to exceed 5.14 lbs/hr based on a 3-hour average. [To preclude 401 KAR 51:017]

Compliance Demonstration:

Refer to 3. Testing Requirements (k) and 4. Specific Monitoring Requirements (d).

- e. For SO₂ standards, refer to SECTION D 3.

3. Testing Requirements:

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- a. The permittee shall prepare a site-specific test plan prior to the initial performance test according to the requirements of 40 CFR 63.7(c). The test plan shall include procedures for conducting the initial performance test and for subsequent performance tests required in 40 CFR 63.848 for emission monitoring. In addition to the information required by 40 CFR 63.7, the test plan shall include: [40 CFR 63.847(b)]
 - i. Procedures to ensure a minimum of three runs are performed annually for the primary control system for each source; [40 CFR 63.847(b)(1)]
 - ii. For a source with a single control device exhausted through multiple stacks, procedures to ensure that at least three runs are performed annually by a representative sample of the stacks satisfactory to the Division; [40 CFR 63.847(b)(2)]
 - iii. Procedures for sampling single stacks associated with multiple anode bake furnaces; [40 CFR 63.847(b)(4)]
- b. The permittee shall conduct the performance test: For an existing anode bake furnace that was shut down at the time compliance would have otherwise been required and is subsequently restarted, by the 45th day from the start of the second anode bake cycle (but no later than the 180th day from the startup of the anode bake furnace). [40 CFR 63.847(c)(3)(ii)]
- c. All performance tests shall be conducted in accordance with the applicable requirements of the general provisions in 40 CFR 63, Subpart A, the approved test plan, and the procedures in 40 CFR 63.847. Performance tests shall be conducted under such conditions as the Division specifies to the permittee based on representative performance of the affected source for the period being tested. Upon request, the permittee shall make available to the Division such records as may be necessary to determine the conditions of performance tests. [40 CFR 63.847(d)]
- d. If the permittee has performed more than one test of primary emission control device(s) for a bake furnace during the previous consecutive 12 months, the average of all runs performed in the previous 12-month period shall be used to determine the contribution from the primary emission control system. [40 CFR 63.847(d)(3)]
- e. For each anode bake furnace, the permittee shall measure and record the emission rate of TF, POM, PM and Hg exiting the exhaust stacks(s) of the primary emission control system. In accordance with 40 CFR 63.847(e)(3) and (4), the permittee shall compute and record the average of at least three runs each year to determine compliance with the applicable emission limits for TF, POM, PM and Hg. Compliance is demonstrated when the emission rates of TF, POM, PM and Hg are equal to or less than the applicable TF, POM, PM and Hg emission limits in 40 CFR 63.843. [40 CFR 63.847(d)(4)]
- f. Using the procedures in 40 CFR 63.847 and in the approved test plan, the permittee shall determine TF, PM, Hg and POM emissions from each anode bake furnace on an annual basis. The permittee shall compute and record the annual average of TF, PM, Hg and POM emissions from at least three runs to determine compliance with the applicable emission

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

limits. A minimum of four dscm per run must be collected for monitoring of Hg emissions. The owner or operator must include all valid runs in the annual average. [40 CFR 63.848(c)]

- g. The permittee shall use the following reference methods to determine compliance with the applicable emission limits for TF, POM, PM, and conduct visible emissions observations: [40 CFR 63.849(a)]
 - i. Method 1 in 40 CFR 60, Appendix A for sample and velocity traverses; [40 CFR 63.849(a)(1)]
 - ii. Method 2 in 40 CFR 60, Appendix A for velocity and volumetric flow rate; [40 CFR 63.849(a)(2)]
 - iii. Method 3 in 40 CFR 60, Appendix A for gas analysis; [40 CFR 63.849(a)(3)]
 - iv. Method 13A or Method 13B in 40 CFR 60, Appendix A, or an approved alternative, for the concentration of TF where stack or duct emissions are sampled; [40 CFR 63.849(a)(4)]
 - v. Method 315 in 40 CFR 63, Appendix A or an approved alternative method for the concentration of POM where stack or duct emissions are sampled; [40 CFR 63.849(a)(6)]
 - vi. Method 5 in 40 CFR 60, Appendix A or an approved alternative method for the concentration of PM where stack or duct emissions are sampled; [40 CFR 63.849(a)(8)]
 - vii. Method 29 in 40 CFR 60, Appendix A or an approved alternative method for the concentration of mercury, nickel and arsenic where stack or duct emissions are sampled; [40 CFR 63.849(a)(10)]
 - viii. Method 22 in 40 CFR 60, Appendix A or an approved alternative method for determination of visual emissions; [40 CFR 63.849(a)(12)]
- h. The permittee may use an alternative test method for TF or POM emissions providing: [40 CFR 63.849(e)]
 - i. The permittee has already demonstrated the equivalency of the alternative method for a specific plant and has received previous approval from the U.S. EPA or the Division for TF or POM measurements using the alternative method; or [40 CFR 63.849(e)(1)]
 - ii. The permittee demonstrates to the satisfaction of the Division that the results from the alternative method meet the criteria specified in 40 CFR 63.848(d)(1) and (d)(3) through (d)(6). The results from the alternative method shall be based on simultaneous sampling using the alternative method and the following reference methods: [40 CFR 63.849(e)(2)]
 - 1) For TF, Methods 13 and 14 or Method 14A in 40 CFR 60, Appendix A; or [40 CFR 63.849(e)(2)(i)]
 - 2) For POM, Method 315 in 40 CFR 63, Appendix A and Method 14 in 40 CFR 60, Appendix A. [40 CFR 63.849(e)(2)(ii)]

i. Sulfur Content Sampling and Testing:

~~iii. A sample of green anode and bake anode shall be tested monthly for sulfur content.~~

Commented [PS2]: This new set of sulfur content sampling conditions are being proposed as part of the enhanced compliance determination method for the SO₂ emission limits in Section D and for cross reference by the SO₂ calculation methodology documented in a new proposed Appendix B of the permit.

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- i. A sample of green anode paste (normally from the conveyor downstream of the mixers and upstream of the anode press block) shall be collected at least once daily on days the Paste Plant is operating, except in the case of equipment malfunction.
 - 1) The green anode paste samples shall be analyzed using ASTM Method D6376 or an approved alternative method to determine the sulfur content.
 - 2) On days when samples cannot be obtained or analyzed due to a malfunction, the sulfur content for that day shall be set to the average of the values from the most recent day and next following day samples are obtained.
- ii. Core samples shall be extracted from baked anode blocks removed from the Anode Bake Furnace at least once per day on days the Furnace is in operation, except in the case of equipment malfunction.
 - 1) The daily core samples shall be extracted from a distribution of no less than four baked anodes and the sulfur content averages shall be attributed to anodes for the day the blocks were removed from the Furnace.
 - 2) The samples shall be analyzed using ASTM Method D6376 or an approved alternative method to determine the sulfur content.
 - 3) On days when core samples cannot be obtained due to a malfunction or other situation in which the core drilling sampling equipment is inoperable, the sulfur content for that day shall be set to the average of the values from the most recent day and next following day samples are obtained.
- ~~iv.iii.~~ A sample of packing coke used in the Anode Bake Furnace as cover material shall be collected and analyzed at least once per month using ASTM Method D6376 or an approved alternative method to determine the sulfur content. If raw petroleum coke as received is used for packing coke, the permittee may alternatively use the average of sulfur content from certificate of analysis data provided by the supplier for shipments received in the prior month in lieu of conducting on-site analyses.
- ~~i. A sample of packing coke shall be tested quarterly for sulfur content.~~
- j. The following compliance tests shall be performed to demonstrate compliance with the emission limitations listed above and to develop emission factors:
 - i. The permittee shall perform testing according to Reference Method 10 for CO emissions once within the 5 year permit term of permit V-19-010.
 - ii. The permittee shall perform testing according to Reference Method 6 for SO₂ emissions once within the 5 year permit term of permit V-19-010. The test shall be performed within 180 days of the issuance of permit V-19-010.
 - iii. The permittee shall conduct a performance test for particulate emissions (filterable PM, PM₁₀, PM_{2.5} and Condensable Particulate) from each stack once during the within the 5 year permit term of permit V-19-010. The tests shall be performed according to Reference Method 5 and Reference Method 201A/202 for particulate emissions (filterable PM, PM₁₀, PM_{2.5} and Condensable Particulate).
 - iv. The permittee may use other test methods as approved by the Division.

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- k. Pursuant to 401 KAR 59:005, Section 2(2) and 401 KAR 50:045, Section 1, performance testing using the reference methods specified in 401 KAR 50:015 shall be conducted as required by the Division.

4. Specific Monitoring Requirements:

- a. The permittee shall determine the operating limits and monitoring frequency for each control device that is to be monitored as required in 40 CFR 63.848(f). [40 CFR 63.847(h)]
 - i. For anode bake furnaces, the permittee shall determine upper and/or lower operating limits, as appropriate, for each monitoring device for the emission control system from the values recorded during each of the runs performed during the initial performance test and from historical data from previous performance tests conducted by the methods specified in 40 CFR 63, Subpart LL. [40 CFR 63.847(h)(1)]
 - ii. The permittee may redetermine the upper and/or lower operating limits, as appropriate, based on historical data or other information and submit an application to the Division to change the applicable limit(s). The redetermined limits shall become effective upon approval by the Division. [40 CFR 63.847(h)(3)]
- b. The permittee shall install, operate, and maintain a monitoring device to determine the daily weight of green anode material placed in the anode bake furnace. The weight of green anode material may be determined by monitoring the weight of all anodes or by monitoring the number of anodes placed in the furnace and determining an average weight from measurements of a representative sample of anodes. [40 CFR 63.848(j)]
- c. The permittee shall monitor the following: [401 KAR 52:020, Section 10]
 - i. Monthly hours of operation;
 - ii. Monthly material processed;
 - iii. Hourly PM emissions, calculated monthly.
- d. For the Anode Bake Furnace, refer to Appendix A for CAM requirements pursuant to 40 CFR 64.
- e. Refer to **SECTION F**.

5. Specific Recordkeeping Requirements:

- a. The permittee shall develop a written startup plan as described in 40 CFR 63.847(l)(1) through (4), to be followed during startup periods of bake furnaces. Compliance with the startup plan will be demonstrated through site inspection(s) and review of site records by the Division. The written startup plan must contain specific procedures to be followed during startup periods of anode bake furnaces, including the following: [40 CFR 63.847(l)]
 - i. A requirement to develop an anode bake furnace startup schedule. [40 CFR 63.847(l)(1)]
 - ii. Records of time, date, duration of anode bake furnace startup and any nonroutine actions taken during startup of the furnaces. [40 CFR 63.847(l)(2)]
 - iii. A requirement that the associated emission control system be operating within normal parametric limits prior to startup of the anode bake furnace. [40 CFR 63.847(l)(3)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- iv. A requirement to take immediate actions to stop the startup process as soon as practicable and continue to comply with 40 CFR 63.843(f) if the associated emission control system is off line at any time during startup. The anode bake furnace restart may resume once the associated emission control system is back on line and operating within normal parametric limits. [40 CFR 63.847(l)(4)]
- b. The permittee shall maintain files of all information (including all reports and notifications) required by 40 CFR 63.10(b) and by 40 CFR 63, Subpart LL. [40 CFR 63.850(e)]
- c. The permittee shall retain each record for at least 5 years following the date of each occurrence, measurement, maintenance, corrective action, report, or record. The most recent 2 years of records must be retained at the facility. The remaining 3 years of records may be retained offsite; [40 CFR 63.850(e)(1)]
- d. The permittee may retain records on microfilm, on a computer, on computer disks, on magnetic tape, or on microfiche; [40 CFR 63.850(e)(2)]
- e. The permittee may report required information on paper or on a labeled computer disc using commonly available and compatible computer software; and [40 CFR 63.850(e)(3)]
- f. In addition to the general records required by 40 CFR 63.10(b), the permittee shall maintain records of the following information: [40 CFR 63.850(e)(4)]
 - i. Daily production rate of green anode material placed in the anode bake furnace; [40 CFR 63.850(e)(4)(ii)]
 - ii. Records, such as a checklist or the equivalent, demonstrating that the daily visual inspection of the exhaust stack for each control device has been performed as required in 40 CFR 63.848(g), including the results of each inspection; [40 CFR 63.850(e)(4)(xi)]
 - iii. Records documenting the corrective actions taken when the limit(s) for an operating parameter established under 40 CFR 63.847(h) were exceeded or when visible emissions indicating abnormal operation were observed from a control device stack during a daily inspection required under 40 CFR 63.848(g). [40 CFR 63.850(e)(4)(xiii)]
 - iv. Records documenting the portion of TF that is measured as particulate matter and the portion that is measured as gaseous when the particulate and gaseous fractions are quantified separately using an approved test method; [40 CFR 63.850(e)(4)(xv)]
 - v. Records of the occurrence and duration of each malfunction of operation (i.e. process equipment) or the air pollution control equipment and monitoring equipment; and [40 CFR 63.850(e)(4)(xvi)]
 - vi. Records of actions taken during periods of malfunction to minimize emissions in accordance with 40 CFR 63.843(f) and 63.844(f), including corrective actions to restore malfunctioning process and air pollution control and monitoring equipment to its normal or usual manner of operation. [40 CFR 63.850(e)(4)(xvii)]
- g. The permittee shall maintain the following records:

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- i. Monthly hours of operation;
- ii. **Number of green anodes and total mass of green anodes (tons) placed in the anode bake furnace per month.**~~Monthly material processed;~~
- iii. **Number of baked anodes and total mass of baked anodes (tons) removed from the anode bake furnace per month, including baked anodes or baked anode pieces scrapped for quality or other reasons.**
- ~~iv.~~ **Mass of packing coke (tons) added to anode bake furnace per month.**
- v. Records of sulfur content measurements of green anode **pastes**, baked anodes, and packing coke used in quantifying SO₂ emissions using the **methodology documented in Appendix B of the permit**~~Century Aluminum SO₂ Calculation Engine.~~
- ~~vi.~~ **Records of the occurrence, duration, and corrective actions taken for malfunctions of the green and baked anode sampling equipment.**

h. For the Anode Bake Furnace:

- i. The permittee shall comply with the recordkeeping requirements specified in **SECTION F**. The permittee shall maintain records of monitoring data, monitor performance data, corrective actions taken, any written quality improvement plan required pursuant to 40 CFR 64.8 and any activities undertaken to implement a quality improvement plan, and other supporting information required to be maintained under 40 CFR 64 (such as data used to document the adequacy of monitoring, or records of monitoring maintenance or corrective actions). [40 CFR 64.9(b)(1)]
- ii. Instead of paper records, the permittee may maintain records on alternative media, such as microfilm, computer files, magnetic tape disks, or microfiche, provided that the use of such alternative media allows for expeditious inspection and review, and does not conflict with other applicable recordkeeping requirements. [40 CFR 64.9(b)(1)]

i. Refer to **SECTION F**.**6. Specific Reporting Requirements:**

- a. The permittee shall submit recommended accuracy requirements to the Division for review and approval. All monitoring devices required by 40 CFR 63.848 must be certified by the permittee to meet the accuracy requirements and must be calibrated in accordance with the manufacturer's instructions. [40 CFR 63.848(k)]
- b. One-time notification of startup of an existing anode bake furnace that was shut down for a long period and subsequently restarted. The permittee must provide written notice to the Administrator at least 30 days before the startup. [40 CFR 63.850(a)(9)]
- c. Within 60 days after the date of completing each performance test (as defined in 40 CFR 63.2) required by 40 CFR 63, Subpart LL, the permittee shall submit the results of the performance tests following the procedure specified in either 40 CFR 63.850(b)(1) or (b)(2). [40 CFR 63.850(b)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- d. In addition to the information required under 40 CFR 63.10 of the General Provisions, the permittee shall provide semiannual reports containing the information specified in 40 CFR 63.850(d)(1) and (2) to the Division. [40 CFR 63.850(d)]
 - i. Excess emissions report. As required by 40 CFR 63.10(e)(3), the permittee shall submit a report (or a summary report) if measured emissions are in excess of the applicable standard. The report shall contain the information specified in 40 CFR 63.10(e)(3)(v) and be submitted quarterly. [40 CFR 63.850(d)(1)]
 - ii. If there was a malfunction during the reporting period, the permittee shall submit a report that includes the number, duration and a brief description for each type of malfunction which occurred during the reporting period and which caused or may have caused any applicable emission limitation to be exceeded. The report shall also include a description of actions taken by the permittee during a malfunction of an affected source to minimize emissions in accordance with 40 CFR 63.843(f) and 63.844(f), including actions taken to correct a malfunction. [40 CFR 63.850(d)(2)]
- e. All reports required by 40 CFR 63, Subpart LL not subject to the requirements in 40 CFR 63.850(b) or (c) shall be sent to the Administrator at the appropriate address listed in 40 CFR 63.13. If acceptable to both the Administrator and the permittee, these reports may be submitted on electronic media. The Administrator retains the right to require submittal of reports subject to 40 CFR 63.850(b) in paper format. [40 CFR 63.850(f)]
- f. The Division will notify the permittee in writing of the need for additional time to review the submissions in 40 CFR 63.851(a)(1) through (a)(5) or of approval or intent to deny approval of the submissions in 40 CFR 63.851(a)(1) through (a)(5) within 60 calendar days after receipt of sufficient information to evaluate the submission. The 60-day period begins after the permittee has been notified that the submission is complete. [40 CFR 63.851(a)]
 - i. The test plan in 40 CFR 63.847(b); [40 CFR 63.851(a)(1)]
 - ii. Request to change limits for operating parameters in 40 CFR 63.847(h)(3); [40 CFR 63.851(a)(2)]
 - iii. Request for an alternative method in 40 CFR 63.849(e)(2). [40 CFR 63.851(a)(5)]
- g. The Division will notify the permittee in writing whether the submission is complete within 30 calendar days of receipt of the original submission or within 30 days of receipt of any supplementary information that is submitted. When a submission is incomplete, the Division will specify the information needed to complete the submission and will give the permittee 30 calendar days after receipt of the notification to provide the information. [40 CFR 63.851(b)]
- h. For the Anode Bake Furnace:
 - i. On and after the date specified in 40 CFR 64.7(a) by which the permittee must use monitoring that meets the requirements of 40 CFR 64, the permittee shall submit monitoring reports to the Division in accordance with **SECTION F**. [40 CFR 64.9(a)(1)]
 - ii. Refer to Appendix A for reporting requirements under 40 CFR 64.

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- i. Refer to **SECTION F**.

7. Specific Control Equipment Operating Conditions:

- a. The permittee shall install, operate, calibrate, and maintain a continuous parameter monitoring system for each emission control device. The permittee shall submit for approval by the Division a description of the parameter(s) to be monitored, the operating limits, and the monitoring frequency to ensure that the control device is being properly operated and maintained. An explanation of the criteria used for selection of the parameter(s), the operating limits, and the monitoring frequency, including how these relate to emission control also shall be submitted to the Division. Except as provided in 40 CFR 63.848(l), the following monitoring devices shall be installed: [40 CFR 63.848(f)]
 - i. For dry alumina scrubbers, devices for the measurement of alumina flow and air flow; [40 CFR 63.848(f)(1)]
 - ii. For emission sources control device exhaust streams for which the permittee chooses to demonstrate continuous compliance through bag leak detection systems the permittee shall install and operate a bag leak detection system according to the requirements in 40 CFR 63.848(o), and the permittee shall set the operating limit such that the sum of the durations of bag leak detection system alarms does not exceed 5 percent of the process operating time during a 6-month period. [40 CFR 63.848(f)(6)]
 - iii. For emission sources control device exhaust streams for which the permittee chooses to demonstrate continuous compliance through a PM CEMS, the permittee shall install and operate a PM CEMS according to the requirements in 40 CFR 63.848(p). The permittee shall determine continuous compliance averaged on a rolling 30 operating day basis, updated at the end of each new operating day. All valid hours of data from 30 successive operating days shall be included in the arithmetic average. Compliance is demonstrated when the 30 operating day PM emissions are equal to or less than the applicable emission limits in 40 CFR 63.843. [40 CFR 63.848(f)(7)]
- b. The owner or operator of an existing affected source that is equipped with a control device and is subject to a PM limit shall: [40 CFR 63.848(g)]
 - i. Install and operate a bag leak detection system in accordance with 40 CFR 63.848(f)(6); or [40 CFR 63.848(g)(1)]
 - ii. Install and operate a PM CEMS in accordance with 40 CFR 63.848(f)(7); or [40 CFR 63.848(g)(2)]
 - iii. Visually inspect the exhaust stack(s) using Method 22 on a twice daily basis (at least 4 hours apart) for evidence of any visible emissions indicating abnormal operations and, shall initiate corrective actions within 1 hour of a visible emissions inspection that indicates abnormal operation. Corrective actions shall include, at a minimum, isolating, shutting down and conducting an internal inspection of the compartment that is the source of the visible emissions that indicate abnormal operations. [40 CFR 63.848(g)(3)]

SECTION B - EMISSION UNITS, EMISSION POINTS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

- c. If a monitoring device for a primary control device measures an operating parameter outside the limit(s) established pursuant to 40 CFR 63.847(h) or if visible emissions indicating abnormal operation are observed from the exhaust stack of a control device during a daily inspection, the permittee shall initiate corrective action procedures within 1 hour. Failure to initiate the corrective action procedures within 1 hour or to take the necessary corrective actions to remedy the problem is a violation. [40 CFR 63.848(h)]
- d. If the limit for a given operating parameter associated with monitoring a specific control device is exceeded six times in any semiannual reporting period, then any subsequent exceedance in that reporting period is a violation. For the purpose of determining the number of exceedances, no more than one exceedance shall be attributed in any given 24-hour period. [40 CFR 63.848(i)]
- e. The permittee may monitor alternative control device operating parameters subject to prior written approval by the Division. [40 CFR 63.848(l)]

f. Refer to **SECTION E**.

g. Refer to **SECTION I** for requirements associated with the construction of a new stack for the Anode Bake Furnace.

SECTION D - SOURCE EMISSION LIMITATIONS AND TESTING REQUIREMENTS

1. As required by Section 1b of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26; compliance with annual emissions and processing limitations contained in this permit, shall be based on emissions and processing rates for any twelve (12) consecutive months.
2. CO, COS, D/F, HCl, HF, Mercury, NO_x, PM, PM₁₀, PM_{2.5}, POM, SO₂, and TF emissions, measured by applicable reference methods, or an equivalent or alternative method specified in 40 C.F.R. Chapter I, or by a test method specified in the state implementation plan shall not exceed the respective limitations specified herein.

3. Sulfur Dioxide Emissions:

- a. Sulfur dioxide (SO₂) emissions shall not exceed 5,853 total tons per year, on a rolling 12-month basis, from the production of primary aluminum by electrolysis (potline operations) and anode bake furnace operations. [401 KAR 51:017]
- b. **Monthly average SO₂ emissions shall not exceed 1,129 lb/hr in any calendar month from the potline operations and anode bake furnace operations combined. [401 KAR 53:010]**
- c. **Monthly average SO₂ emissions shall not exceed 237 lb/hr in any calendar month from the anode bake furnace operations. [401 KAR 53:010]**
- ~~a-d.~~ **Monthly average SO₂ emissions shall not exceed 1,018 lb/hr in any calendar month from the production of primary aluminum by electrolysis (potlines operations). [401 KAR 53:010]**

Compliance Demonstration: Compliance with the ~~annual~~ SO₂ emission limits shall be determined by computing the **monthly average SO₂ emission rates (lb/hr) from the anode bake furnace operations and the potline operations via the mass balance methodology documented in Appendix B (Sulfur Mass Balance Methodology) of the permit**~~total primary aluminum production SO₂ emissions monthly using the Century Aluminum SO₂ Calculation Engine (an example of the form can be found in the Kentucky Division for Air Quality tracking system "TEMPO"); and calculating a rolling 12-month SO₂ emission total for the primary aluminum process (potlines and anode baking furnaces).~~

- ~~3-4.~~ **Source-wide gaseous fluorides** shall not exceed the amounts that violate, or interfere with the attainment or maintenance of, ambient air quality standards as specified in 401 KAR 53:010 and the following concentrations: [401 KAR 53:005, Section 1(3)]

Primary Standards:	Annual Average:	400 µg/m ³ (0.5 ppm)
	Maximum 24 Hour Average:	800 µg/m ³ (1.0 ppm)
Secondary Standards:	Maximum monthly average:	0.82 µg/m ³ (1.0 ppb)
	Maximum weekly average:	1.64 µg/m ³ (2.0 ppb)

Commented [PS3]: This legacy BACT limit condition from the V-05-088 R2 permit action is now subsumed by the new proposed combined SO₂ emission limit of 1,129 lb/hr (equivalent to an annual potential to emit of 4,946 tpy). If possible, it therefore can be removed. Or, if it has to be retained because of the tie to a past PSD permit action, it is of no consequence.

SECTION D - SOURCE EMISSION LIMITATIONS AND TESTING REQUIREMENTS (CONTINUED)Maximum 24-hour average: 2.86 µg/m³ (3.5 ppb)Maximum 12-hour average: 3.68 µg/m³ (4.5 ppb)**Gaseous Fluoride (HF) Compliance Demonstration:**

To provide reasonable assurance that HF emission limits are being met, the source shall demonstrate compliance by the following methods or other Division approved method:

- A. The permittee shall comply with the terms in 401 KAR 61:165, in addition to **SECTION B, Subject Item 4, 1. Operating Limitations (e), 4. Specific Monitoring Requirements (d), 5. Specific Recordkeeping Requirements (g), and 6. Specific Reporting Requirements (j).**
 - B. The permittee shall submit to the Division quarterly ambient monitoring data reports. If either the maximum 24-hour average primary standard or any of the secondary standards for HF listed above and defined in 401 KAR 53:010, Appendix A, are exceeded more than once annually, than any subsequent exceedance is a violation. The reports shall clearly identify any exceedances of the ambient standards.
 - C. Ambient air modeling for HF shall be performed at the time of each renewal, and based on the modeled maximum impact area and in consideration of common siting criteria (e.g., Appendix E to 40 CFR 58, Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring), the Division may require relocation of the ambient air monitoring equipment as provided for in **SECTION B, Subject Item 4, 4. Specific Monitoring Requirements (d).**
 - D. In the event of a recorded violation of the HF standard as listed above and defined in 401 KAR 53:010, Appendix A, the Division shall require that remedial measures be initiated from the source(s) responsible for causing said violation. [401 KAR 61:165, Section 4(2)] This includes, but is not limited to:
 - i. A corrective action plan, identifying possible causes for the exceedances and remedies initiated; and
 - ii. A follow-up testing plan to ensure that the exceedance of the standard has been remedied.
 - E. Major modifications triggering a significant permit revision under 401 KAR 52:020, or changes that can increase emissions of HF above the projected emission rate that exceeds the Kentucky Ambient Air Quality Standard for HF, will require additional air dispersion modeling be completed with the revision application.
- 4.5. Source-wide total fluorides emissions shall not exceed the amounts that violate, or interfere with the attainment or maintenance of, ambient air quality standards as specified in 401 KAR 53:010 and the following concentrations: [401 KAR 53:005, Section 1(3)]

Dry weight basis (as fluoride ion) in and on forage for consumption by grazing ruminants:

SECTION D - SOURCE EMISSION LIMITATIONS AND TESTING REQUIREMENTS (CONTINUED)

Secondary Standards:	Growing Season:	40 ppm
	Two-Month Average:	60 ppm
	One-month average:	80 ppm

Total Fluoride (TF) Compliance Demonstration:

To provide reasonable assurance that TF emission limits are being met, the source shall demonstrate compliance by the following methods or other Division approved method:

- A. The permittee shall comply with the terms in 401 KAR 61:165, in addition to **SECTION B, Subject Item 4, 1. Operating Limitations (e), 4. Specific Monitoring Requirements (d), 5. Recordkeeping Requirements (g), and 6. Specific Reporting Requirements (j).**
- B. Major modifications triggering a significant permit revision under 401 KAR 52:020, or changes that can increase emissions of TF above the projected emission rate that exceeds the Kentucky Ambient Air Quality Standard for TF, will require additional air dispersion modeling be completed with the revision application. Continued compliance for TF is demonstrated if the model shows compliance with the primary standards for gaseous fluorides.

~~5.6. The permittee shall, within 1 year of the final issuance of permit V-19-010, relocate the ambient air monitor required by 401 KAR 61:165 and **SECTION B, Subject Item 4, 1. Operating Limitations (e).** The monitor shall be located at the location proposed in the plan for relocation submitted to the Division on December 8, 2016 (Across from the DRR SO₂ monitoring location). Refer to **SECTION I** for the relocation schedule and steps.~~

Commented [PS4]: This permit condition can be removed from the permit since the relocation of the ambient monitoring station was completed in 2021.

SECTION I - COMPLIANCE SCHEDULE

This section contains compliance schedule requirements as specified by Section 1c of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26. Progress reports on this schedule must be submitted at least semiannually, or at more frequent intervals if required in the specific conditions outlined below. Reports shall include the following items: (a) Dates scheduled for achieving each milestone, and the actual date that compliance is achieved; and (b) An explanation of why dates in the schedule of compliance were not or will not be met, and preventive or corrective measures adopted to ensure that compliance with future items will be brought back on schedule. Compliance certifications shall be mailed to the addresses listed in General Condition F.9

~~Regarding the relocation of the HF Ambient Air Monitor required by 401 KAR 61:165, Section 6(3), the following steps will be completed within 12 months after the final issuance of renewal permit, V-19-010.~~

- ~~1. The permittee shall prepare the new approved site in terms of mowing, ground clearing, drive access improvements (if needed), shelter procurement and set up (including leveling via block, poured concrete, or other foundation or site leveling), set up of security measures (install a surrounding security fencing with a lock and key for the gated entryway as well as the door of the structure), and electrical supply hookup. The electrical supply hookup will include internal shelter installation of ample amperage, outlets, lighting, and controls. The permittee shall also install a combined heating and cooling unit appropriate for the size of the shelter with required electrical supply and outlet.~~
- ~~2. The permittee shall prepare all internal space, electrical, probe set up, and access arrangements at the approved HF monitoring site. The probe for sampling will be installed in accordance with 40 CFR 58, Appendix E, Probe and Monitor Path Siting Criteria for Ambient Air Quality Monitoring.~~
- ~~3. After steps 1 and 2 are complete, the permittee shall contact the Division for Air Quality Technical Services Branch to request a site meeting to review and verify that the new area inside and outside the monitoring structure, ports, and other infrastructure aspects are properly configured and ready to have HF monitoring equipment installed. The site will be considered ready for installation upon final approval by the Division.~~
- ~~4. The permittee shall refurbish, clean, and calibrate the HF sampler and analyzer components as necessary consistent with the manufacturer's operating instructions. As part of this process, the permittee shall determine whether any of the existing HF monitoring equipment will need to be replaced and upgraded or whether the existing monitoring instrumentation is still usable and up to current HF monitoring specifications and can be relocated and reused at the new site. If the permittee purchases new instrumentation, the permittee shall submit notification describing the new equipment to the Division for approval.~~
- ~~5. The permittee shall pack up all serviceable components of the existing HF ambient monitoring system at the existing site and, along with any new purchased equipment, carefully transport to the approved new site location. The equipment will be installed consistent with all manufacturer recommended instructions.~~
- ~~6. The permittee shall field test the overall system consisting of the sampling probe, analyzer, data logger, and other miscellaneous instrumentation. Field testing will include any flow~~

SECTION I - COMPLIANCE SCHEDULE (CONTINUED)

~~calibrations required as well as testing of the timer and its control of the tape movement and opacity measurements of the tape system.~~

~~7. Steps 4-6 shall not take longer than 1 month, during which time the monitor will be unable to gather data.~~

~~8. Immediately following the transportation, installation, and field test of the ambient HF monitoring system at the approved new location, the monitor will begin ambient air sampling and measurements on the same schedule as the existing monitor, with monitoring taking place at least every eighth day (e.g. Monday of the first week, Tuesday of the second week, Wednesday of the third week, etc.) Two individual 12-hour samples will be collected each sample day. These measurements will be logged by a data logger and averaged to obtain a 24-hour sample. As additional data is available, weekly, monthly and annual averages will be obtained with the data to compare against the respective KYAAQS for gaseous fluorides. All data will be summarized and submitted to the Division quarterly. The reports shall clearly identify any exceedances of the ambient standards.~~

~~9.1. After steps 1-6 are complete, the permittee shall arrange for a site meeting with Division personnel to review and verify the operation and data collection procedures of the newly relocated HF ambient monitoring system. Prior to this meeting, a facility SOP shall be prepared for the operation, maintenance, and data collection (QA/QC) procedures to be followed by facility personnel. The SOP shall be submitted for to the Division for review prior to the meeting.~~

1. Regarding the construction/erection of a new stack for the exhaust from the A-446 Dry Scrubber/Baghouse serving the Anode Bake Furnace (EU N2) as required to support the SO₂ Nonattainment Modeling Demonstration (August 2024), the following actions shall be completed: [401 KAR 53:010]

- a. The stack shall be located southeast of the existing bank of the A-446 dry alumina scrubber system within 100 meters of coordinate 456,089.60 m East, 4,168,045.80 m North (UTM Zone 16), or other approved alternative site.
- b. The discharge height of the new stack shall be not less than 213.2 ft from ground-level.
- c. The permittee shall complete design and onsite erection of the stack, and the construction of tie-in ductwork and all associated components necessary to redirect exhaust gases from the A-446 scrubber system to the new stack, and commence use of the new stack as soon as practically feasible, but in no case later than December 31, 2025 or 12 months following issuance of Final Permit V-19-010 R3, whichever is later.

2. Regarding the construction/erection of new permanent fence sections on the western and southern property boundary, the following actions shall be completed: [401 KAR 53:010]

- a. Erect a permanent fence between the main plan entrance and the southwest tip of the property boundary allowing controlled access openings as needed for the existing Big Rivers coal road.
- b. Erect a permanent fence along the southern property boundary from the southwest tip to the Green River, allowing controlled access openings for existing railroad and road crossings.
- c. At a minimum, the erected fence sections shall possess the following characteristics:

Commented [P55]: These conditions should be removed from the permit since the relocation of the ambient fluoride monitoring station was completed in 2021.

SECTION I - COMPLIANCE SCHEDULE (CONTINUED)

- 1) The fence must be a permanent continuous physical structure approximately 5 feet tall that prevents easy access to the property.
- 2) The fence shall be comprised of durable materials that can withstand weather conditions and attempts at entry (e.g., chain link, barbed wire, metal, wood, etc.).
- 3) The fence should be clearly visible and recognizable as a boundary with appropriate signage (e.g., “No Trespassing” or “Private Property”) at regular intervals along the fence.
- d. The permittee shall complete the installation of the new fence as soon as practically feasible, not later than November 30, 2024 or within 3 months following issuance of Final Permit V-19-010 R3, whichever is later.

APPENDIX B

SO₂ Mass Balance Emissions Calculation Methodology To Be Used for Demonstrating Compliance with SO₂ Emission Limits

Commented [P56]: Placeholder for adding new proposed Appendix B to the Title V permit. Refer to Attachment 3 of the permit application.

APPENDIX L

AEROMOD Files

**Accessible as
Compressed File Folder
*"Modeling Files"***

APPENDIX M

Public Notice and Statement of Consideration

**KENTUCKY DIVISION FOR AIR QUALITY
PUBLIC NOTICE FOR PROPOSED KENTUCKY STATE IMPLEMENTATION PLAN
REVISION ATTAINMENT DEMONSTRATION FOR THE PARTIAL COUNTIES OF
HENDERSON AND WEBSTER LOCATED WITHIN THE KENTUCKY
2010 1-HOUR SULFUR DIOXIDE NONATTAINMENT AREA**

The Kentucky Energy and Environment Cabinet (Cabinet) is requesting EPA's approval that the proposed State Implementation Plan (SIP) revision satisfies the attainment demonstration requirements for the Henderson-Webster County, Kentucky 2010 1-hour SO₂ nonattainment area. The draft SIP revision includes a projected attainment year emissions inventory for all sources of SO₂ within the nonattainment area, an air dispersion modeling demonstration, reasonably available control measures (RACT)/ reasonably available control technology (RACM), reasonable further progress, conformity, and contingency measures.

In accordance with 40 CFR 51.102, the Cabinet is making this proposed plan available for public inspection and provides the opportunity for public comment concerning Kentucky's attainment demonstration for the Henderson-Webster County, KY nonattainment area. The proposed plan can be found at <https://eec.ky.gov/Environmental-Protection/Air/Pages/Public-Notices.aspx>. The public comment period will be open from August 15, 2024 through September 20, 2024. Comments should be submitted in writing to the contact person by either mail or email.

The Cabinet will conduct a virtual public hearing on September 20, 2024, at 10:00 a.m. (Eastern Time). This hearing will be held to receive comments on the proposed SIP revision. This hearing is open to the public and all interested persons will be given the opportunity to present testimony. To assure that all comments are accurately recorded, the Division requests that oral comments presented at the hearing are also provided in written form, if possible. It is not necessary that the hearing be held or attended in order for persons to comment on the proposed administrative regulation. If no request for a public hearing is received by September 13, 2024, the hearing will be cancelled, and notice of the cancellation will be posted at <https://eec.ky.gov/Environmental-Protection/Air/Pages/Public-Notices.aspx>. Written comments should be sent to the contact person and must be received by September 20, 2024, to be considered part of the public record.

Please note that registration is required to participate in this hearing. You must either email your name and mailing address to claire.oyler@ky.gov or mail this information to Claire Oyler, Division for Air Quality, 300 Sower Building, 2nd Floor, Frankfort, KY 40601. Please put "Registration for comment on the 2010 SO₂ attainment demonstration for the partial counties of Henderson and Webster public hearing" as the subject line, and state in the body of the message if you plan to speak during the hearing.

CONTACT PERSON: Claire Oyler, Environmental Scientist III, Evaluation Section, Division for Air Quality, 300 Sower Boulevard, Frankfort, Kentucky 40601. Phone: (502) 782-3930; Email: claire.oyler@ky.gov

The Energy and Environment Cabinet does not discriminate on the basis of race, color, national origin, sex, age, religion or disability and provides, upon request, reasonable accommodation including auxiliary aids and services necessary to afford an individual with a disability an equal opportunity to participate in all services, programs and activities.

APPENDIX M

STATEMENT OF CONSIDERATION

Relating to the Proposed
Attainment Demonstration
for the Partial Counties of
Henderson and Webster
Located within the Kentucky
2010 1-Hour Sulfur Dioxide
NAAQS Nonattainment Area

Energy and Environment Cabinet
Kentucky Department for Environmental Protection

Division for Air Quality

Public Comments and Response Summary

From August 15, 2024, until September 20, 2024, the Kentucky Division for Air Quality (Division) provided an opportunity for comments on the proposed State Implementation Plan (SIP) revision regarding the “Attainment Demonstration for the Partial Counties of Henderson and Webster for the 2010 1-Hour Sulfur Dioxide (SO₂) National Ambient Air Quality Standard (NAAQS) Nonattainment Area” (the Attainment Demonstration). The public notice announcing the comment period included an opportunity to request a virtual public hearing. No request for the September 16, 2024 public hearing was received and the public hearing was canceled in accordance with 40 CFR 51.102. Written comments were received during the comment period.

The Division appreciates the time and participation of members of the public, non-governmental organizations, and the United States Environmental Protection Agency (EPA) Region 4 during this public review process. The Division carefully considered the feedback received during the public comment period and made modifications accordingly. Specifically, the following non-substantive changes were made to the Attainment Demonstration:

1. The Division requested additional information from Century Aluminum (Century) on several of the topics addressed in this Statement of Consideration. The response from Century has been included in Appendix H of the final submission of the Attainment Demonstration. This additional information was used to make the following changes:
 - a. An analysis of wet scrubbing feasibility has been added to the Reasonably Available Control Technology (RACT) section on page 12.
 - b. Expected completion date for construction of the stack on the anode bake furnace potline has been added to page 13.
2. Additional modeling files have been added to Appendix L.
3. Century Aluminum Sebree’s permit application has been added as Appendix K, which includes enforceable measures to bring the Area into attainment.
4. Additional data years were provided in Tables and Figures to present a more up-to-date picture of SO₂ in the Area. Emissions were provided through 2024 and monitoring data through 2025. The Projected Year Emissions Inventory remains unchanged, as it would be unduly burdensome to rerun all projections at this stage in the SIP process.

The Division commits to providing the final permit for Century Aluminum, Sebree in a supplemental submission for inclusion in the Attainment Demonstration.

In addition to input from public commentators, the Division maintained contact with Century to

draft the final Attainment Demonstration. Century is a primary aluminum smelter that owns two of the four remaining operational primary aluminum facilities in the country. Century's facility in Sebree, KY, produced 216,333 metric tons of aluminum in 2024, accounting for approximately one-third of the United States' output. US aluminum production has fallen to 0.9% of global production, compared to 33% in 1980. As demonstrated by the COVID-19 pandemic, the United States needs the ability to produce raw materials to ensure a stable domestic supply chain. The Division has kept national security in mind when considering various control measures and their impact on Century's ability to remain in operation.

Statement of Consideration

The Division received four comment letters and organized the comments into eleven topics. Because of the volume of comments, the Division paraphrased them; Appendix M contains the full text of comments received. The table below identifies each commentor and the corresponding response topic.

Commenter	Topic of Concern
Anonymous Commenter	Topic 1: Control Measures (A) Topic 3: Permitting at Century Aluminum (A)
John and Nancy Guy	Topic 1: Control Measures (B) Topic 3: Permitting at Century Aluminum (H) Topic 4: Modeling Demonstration (A, B) Topic 5: Modeling Adjustments (A) Topic 7: Weight-of-Evidence (A) Topic 8: Monitoring Data (A) Topic 11: Miscellaneous (B)
Unified comments submitted by Kentucky Resources Council, the Environmental Integrity Project, and the Sierra Club	Topic 1: Control Measures (A, B, E, F) Topic 2: RACT/RACM at Century Aluminum (A-D) Topic 3: Permitting at Century Aluminum (C, E-H, J-L) Topic 4: Modeling Demonstration (A, C, D) Topic 5: Modeling Adjustments (D) Topic 6: Modeling Parameters (A, C-E) Topic 7: Weight-of-Evidence (A) Topic 8: Monitoring Data (D) Topic 9: Emissions Inventory (A, B) Topic 10: Contingency Measures (A, B) Topic 11: Miscellaneous (C)
EPA Region 4	Topic 1: Control Measures (C, D) Topic 2: RACT/RACM at Century Aluminum (A) Topic 3: Permitting at Century Aluminum (B-D, G-I, M) Topic 4: Modeling Demonstration (A, C) Topic 5: Modeling Adjustments (B, C) Topic 6: Modeling Parameters (B, C) Topic 7: Weight-of-Evidence (A) Topic 8: Monitoring Data (B, C) Topic 9: Emissions Inventory (C, D) Topic 11: Miscellaneous (A)

Topic 1: Control Measures

A. Century Aluminum must implement the use of low-sulfur coke.

The Division acknowledges this comment. The use of low-sulfur coke was evaluated as a potential control strategy. In Century's current operating permit, the coke sulfur content is required to be less than three percent for the production of anodes. This requirement will be carried over into the revised operating permit being drafted by the Division. The following response is a paraphrase of the analysis provided by Century in Appendix H.

A 2025 analysis estimated the cost of 2.5 percent low-sulfur coke at approximately \$6,300/ton. Cost alone, however, does not determine an appropriate control. Aluminum trades in a commodity market, where global supply and demand set prices, and Century cannot raise its product price to offset increases in low-sulfur coke costs. Because this market is volatile, Century must maintain stable operations to remain competitive.

Long-term availability of low-sulfur coke is uncertain, and market analyses indicate that petroleum coke sulfur content is trending upward. Decreased supply will raise the cost of low-sulfur coke, in turn increasing the facility's operational costs. Requiring low-sulfur coke, which has an unreliable supply, would limit Century's ability to control costs and maintain operational stability.

Low-sulfur coke can also adversely affect anode quality and, in turn, potline performance and overall emissions. Using anodes with low sulfur levels increases anode reactivity. Sulfur in the anodes helps reduce sodium compounds originating in the electrolyte bath from migrating into the anodes, which at lower sulfur levels would increase reactivity. The increased reactivity leads to higher carbon dust in the pots, which can reduce aluminum production efficiency and increase power consumption, leading to higher CO₂ emissions from the process.

For the aforementioned reasons, this measure was not included in the chosen control strategy for the Area, consistent with Clean Air Act (CAA) requirements to consider both cost and feasibility when identifying RACT and Reasonably Available Control Measures (RACM). The Division also recognizes Century's unique position as one of only four aluminum smelters still operating in the United States. Thus, the Division acknowledges the need for this facility to maintain reasonable operational costs as a matter of national security. Further, the Division notes that not requiring the use of low-sulfur coke does not prohibit Century from using it at any point in time that it is available and economically feasible.

B. Cost should not be a primary decision-making factor when choosing control measures.

The Division acknowledges this comment. The Division must ensure that sources implement all RACT and RACM necessary to attain the NAAQS as expeditiously as practicable. However, the CAA does not require additional measures if the Division and the sources demonstrate that the selected controls will achieve attainment by the applicable deadline, and if other measures are not cost-effective or would not meaningfully advance the attainment date. Although cost was not the sole factor in selecting control measures, the Division may properly consider cost in determining which measures are reasonably available.

C. Please include a compliance schedule for implementation for enforceable control measures and mechanisms to demonstrate compliance within a reasonable timeframe.

The Division acknowledges this comment. The status of the anode bake furnace (ABF) stack has been added to page 13 of the Attainment Demonstration. The stack is expected to be operational in August of 2026.

D. Please include an assessment of expected air quality improvements in the Nonattainment Area from the proposed stack increase and provide detail of the engineering, control, and compliance strategy for the anode bake furnace and potlines at Century Aluminum.

The Division acknowledges this comment. The modeling demonstration and weight-of-evidence analysis provide details on the expected air quality improvements in the Area. The details on the engineering, control, and compliance schedule will be provided in the final permit. The final permit will be included in a supplemental SIP submittal once available. The Division does not currently have a draft permit available for public review. Century has submitted a permit revision application, which is provided in Appendix K. The final permit will be no less stringent than the permit application.

E. The Division must require the implementation of wet-scrubbing technology at Century Aluminum and evaluate the cost effectiveness of this option.

The Division acknowledges this comment. In 2022, Washington State Department of Ecology submitted an Attainment Demonstration SIP for a primary aluminum smelter, Alcoa Intalco, requiring the installation of a wet scrubber.¹ However, before the EPA acted on the Washington SIP, Alcoa Intalco announced the permanent closure of its facility. The need for significant capital expenditures and rising power costs made reopening the facility

¹ Washington State Department of Ecology. (November 2022). *Intalco Sulfur Dioxide Attainment Plan Washington's Air Quality State Implementation Plan Revision*. <https://apps.ecology.wa.gov/publications/documents/2202035.pdf>.

economically infeasible.² The Division does not require control measures that are economically infeasible.

Additional analysis has been provided by Century and Trinity Consultants regarding the cost-effectiveness of implementing a wet-scrubbing technology (Appendix H). Wet-scrubbing technology would require constructing a wastewater treatment plant and obtaining the required additional permits from the Kentucky Division of Water. This process would delay efforts to bring the Area into attainment as expeditiously as practicable. Additional information has been added to page 12 of the final document.

The Division cannot require a facility to choose one control measure over another if alternative options are available to bring the Area into attainment. As demonstrated in the updated RACT/RACM analysis, the construction and operation of a wet-scrubbing system is not economically feasible for the facility.

F. Dispersion is not an effective control technique for facilities with emissions over 5,000 tpy and the Division has not yet implemented an enforceable limit under this amount.

The Division acknowledges this comment. Century has not emitted more than 5,000 tpy of SO₂ in any year since the Area was designated nonattainment. Additionally, the cumulative sources in the Area are expected to generate less than 5,000 tpy of SO₂ for the attainment year and all succeeding years. Century is also taking an enforceable SO₂ limit of 4,946 tpy, as referenced in the permit application provided in Appendix K.

² The Bellingham Herald. (March 16, 2023). *Idled Whatcom County Intalco smelter closure announced by Alcoa*. <https://www.bellinghamherald.com/news/local/article273243680.html>

Topic 2: RACT/RACM Analysis at Century Aluminum

- A. The Division must consider other control options for Century Aluminum and whether they would allow for more expeditious attainment of the standard.

The Division acknowledges this comment. As part of their prevention of significant deterioration (PSD) and Title V Permit revision process, Century (then operating as Rio Tinto Alcan) submitted a best available control technology (BACT) analysis on March 10, 2009. As a result of this BACT analysis, the Division set a limit on the petroleum coke used for green anodes at a maximum sulfur content of three percent. This limit will continue to be part of the facility's operating permit, which will be submitted as a supplement upon completion of this Attainment Demonstration. The feasibility of procuring lower sulfur coke has been addressed in comment 1A above.

The Division's Attainment Demonstration is required to provide a RACT analysis.³ RACT analyses are not required to be as stringent as BACT, and can only require controls that are technologically and economically feasible. In addition to the already approved BACT option of controlling sulfur content, the facility is undergoing a substantial capital investment to increase the stack height serving the ABF, one of the two primary sources of SO₂ emissions at the facility.

Trinity Consultants consulted the RACT/BACT/LAER (Lowest Achievable Emission Rate) Clearinghouse in September 2025 and found no new available technology advancements for primary aluminum smelters since 2009.⁴ Century has provided updated cost estimates from the 2009 BACT analysis, which are found in Appendix H. Additionally, the 2009 BACT analysis has been added as Appendix I of the final Attainment Demonstration. These cost estimates reaffirm the findings from the 2009 assessment. Given the lack of new control technologies, the updated pricing still shows economic infeasibility of existing options, and the Division considers this an adequate consideration of RACT.

- B. The Division must conduct an independent evaluation of control options.

The Division acknowledges this comment. After independently evaluating the information provided by Century and Trinity Consultants, the Division determined that the selected control strategy represents the most effective approach to bring the Area into attainment as expeditiously as practicable.

³ 42 USC § 7502(c)(1).

⁴ The RACT/BACT/LAER Clearinghouse provides a database of air pollution control technology strategies. To access the database: <https://www.epa.gov/catc/ractbactlaer-clearinghouse-rblc-basic-information>.

- C. The Division's method for determining infeasibility of control options, rather than focusing on the level of emissions controls needed, leads to a flawed modeling process and a pre-ordained outcome.

The Division acknowledges this comment. The Division does not predetermine outcomes. Instead, it evaluates and excludes technically or economically impracticable controls in accordance with EPA guidance that treats feasibility as a prerequisite for SIP inclusion.⁵ An approach that evaluates control levels without considering feasibility would result in unrealistic modeling and would undermine the integrity of the SIP process.

- D. The control measure chosen for Century Aluminum must provide for attainment of the NAAQS. The chosen limit for Century Aluminum in combination with changes in emissions characteristics is ineffective and does not result in a demonstration of attainment within the Area and therefore cannot be considered RACT.

The Division acknowledges this comment. After considering the weight-of-evidence approach outlined by Century, the Division asserts that the chosen control strategy is effective and can be expected to achieve attainment of the NAAQS in the Area. If raising the primary stack height does not lead to attainment of the NAAQS, the Division is committed to implementing the contingency measures outlined in the final submittal until attainment is achieved.

⁵ US EPA. (June 19, 1985). *Criteria for Determining RACT in Region IV*. <https://www.epa.gov/ground-level-ozone-pollution/ract-information>.

Topic 3: Permitting at Century Aluminum

- A. Century Aluminum Sebree has violated its operating permit using anodes from Century Aluminum Hawesville.

The Division acknowledges this comment. Century recycled anodes from its Hawesville plant, originally believing it was more environmentally beneficial overall. However, as referenced in Appendix H, "Century originally sought to recover additional material from the Hawesville Plant, the processing of recycled anode material ceased in June 2023."

- B. The Division is requested to include Big Rivers Electric Company Green (BREC - Green) station permit V-19-020 R2 in this SIP submittal to ensure that all conditions within are permanent and enforceable.

The Division maintains that Century continues to be the primary contributor to SO₂ exceedances in the Area. This conclusion was initially based on modeling, and later confirmed when BREC - Green completed conversion to natural gas, significantly reducing its SO₂ emissions, and the Area was still unable to reach attainment. Therefore, the Division maintains that control strategies at Century are necessary to bring the area into attainment.

The Division has included the BREC - Green permit for informational purposes only in Appendix E to show that the facility can only burn natural gas. BREC - Green would have to undergo a permit modification in order to switch the fuel source. The permitting process, including Nonattainment New Source Review (NNSR), is designed to foster attainment and maintenance of the NAAQS and, thus, the permit is not necessary for inclusion into this Attainment Demonstration.

- C. The Division is requested to include Century Aluminum's final permit action, with increased stack height, into the SIP.

The Division acknowledges this comment. The Division is actively coordinating with Century to complete the permitting process as expeditiously as practicable. The Division will submit the final permit to EPA as a supplemental submission upon completion. The permit application is included in Appendix K.

- D. The Division is requested to have all permitting actions complete within the 5-year time frame for an April 2026 attainment date.

The Division acknowledges this comment. The Division is working as expeditiously as possible on making the draft permit available for public review. It is currently expected in 2026.

- E. The Division cannot rely on proposed permitting measures that it has not committed to adopt. The Draft SIP does not include any of the terms of a proposed limit.

The Division acknowledges this comment. Century's permit application includes the 4,946 tpy

SO₂ limit. The final permitted SO₂ limit will be no less stringent than the application and will be submitted to EPA upon completion of the required public comment period and revision processes. The Division is committed to adopting all measures included in the final permit into the Attainment Demonstration SIP, which includes the Division submitting a supplemental SIP revision to EPA (depending upon the timing of the permitting action).

- F. The Draft SIP does not state that Century Aluminum has agreed to the new annual SO₂ limit or provide a date by which the Division expects to issue a final permit revision for incorporation into the SIP.

The Division acknowledges this comment. Due to the extensive review process the Division is undergoing to finalize Century's permit, the Division cannot commit to a timeline for it to be completed. Because the permitting process often proceeds in tandem with the SIP process, the Division is moving forward to submit the final Attainment Demonstration SIP. Given the uncertainty of when the permit will be finalized, the Division will not be able to include the final permit with this submission. However, Century's final permit revision will be incorporated into this Attainment Demonstration SIP via a supplemental SIP revision so that the SIP can be deemed complete and approved by EPA, making the new annual SO₂ limit permanent and enforceable. The updated annual SO₂ limit is included in their permit application.

- G. The Draft SIP does not discuss continuous emissions reduction technology, work practice standards, recordkeeping/reporting requirements, or compliance/enforcement strategies to determine how compliance will be determined in practice. The Division should include incorporation of these factors to the SIP via the operating permit.

The Division acknowledges this comment. The final permit will be included in a supplemental SIP revision as soon as it is finalized. The permit will include all the referenced strategies and will be made available for public review as required by the permitting process.

- H. The Division is requested to describe how the allowable SO₂ emission limit was derived and what the change will be for the facility.

The Division acknowledges this comment. The Division is committed to establishing SO₂ emission limits that are both protective of air quality and consistent with regulatory and technical standards. In this instance, permitting staff evaluated the facility's operations, emission characteristics, and applicable control technologies to ensure that limits were set at appropriate levels and with suitable averaging periods that reflect the nature of the emissions and support enforceability. This process aligns with EPA guidance and ensures that the set limits are neither arbitrarily stringent nor overly lenient but instead account for practical implementation considerations. Century's SO₂ yearly limit will decrease from the current 5,853 tpy to an expected 4,946 tpy, so that dispersion is an acceptable control technology. The calculations used to derive the 4,946 tpy limit are provided in Appendix K, in the "Magnitude

and Form of SO₂ Emission Limits” section.

- I. The Division is recommended to establish individual limits for the anode bake furnace and potlines in addition to a combined 30-day average limit for both units.

The Division acknowledges this comment. As part of the permitting process, the Division will assess the feasibility of establishing individual SO₂ emission limits upon the anode bake furnaces and potlines, in addition to determining the most appropriate averaging time.

- J. The promise of an anticipated future emission limit does not constitute the necessary commitment for conditional approval under § 110(k)(4).

The Division acknowledges this comment. CAA § 110(k)(4) states that, “the Administrator may approve a plan revision based on a commitment of the State to adopt specific enforceable measures by a certain date.” The Division believes that seeking conditional approval by providing the final permit for Century in a supplemental submission is a circumstance in which this CAA section is applicable. The permitting process cannot be expected to align perfectly with SIP deadlines, and the Division commits to submitting the final within the required timeframe.

- K. The Division must set limits for the facility at an appropriate level and averaging period. The use of an annual limit for a 1-hour standard at Century Aluminum is improper and not federally and practically enforceable. The Division must make a shorter-term, 1-hour, averaging limit. The modeling demonstration states that each potline operates in a “continuous, steady-state manner.” There is no practical reason why a 1-hour averaging time would not be appropriate, if short-term variability in SO₂ emissions is indeed low enough that it does not need to be accounted for in the model.

The Division acknowledges this comment. The Division affirms its commitment to establishing SO₂ emission limits that are both protective of air quality and consistent with regulatory and technical standards. Permitting staff evaluated the facility's operations, emission characteristics, and applicable control technologies to ensure that SO₂ emission limits were set at appropriate levels and with suitable averaging periods that reflect the nature of the emissions and support enforceability. While finalizing Century’s pending permit application, the feasibility of the enforcement limit timeframes will be reviewed to ensure the permit operating standards are both feasible and do not result in NAAQS exceedances.

- L. Continuous emissions monitoring systems should be required on each stack, for both the potlines and the anode bake furnace to ensure practical enforceability of 1-hour averaging limit. If the Division disagrees, additional limits, such as emissions per unit heat input, must be required on an equally appropriate short-term basis.

The Division acknowledges this comment. The Division believes that the 4,946 tpy SO₂ limit,

enforceable under the current mass balance approach, in conjunction with the increased stack height, will ensure that the facility operates in compliance with the SO₂ NAAQS. The evaluation of continuous emissions monitoring systems (CEMS) as a control option is more appropriate during the permit review process. The review for Century's current permit application will assess the feasibility and effectiveness of using CEMS on emission points within the facility. The draft permit will include a public review period to allow public comment.

M. The Division establishes no enforceable limits preventing the use of high sulfur recycled anodes in the future.

The Division acknowledges this comment. Within Century's operating permit, the maximum sulfur content for coke allowed is three percent. The availability and sourcing of anode materials are subject to global market fluctuations, and restricting their use further could unnecessarily constrain the facility's operations, particularly during periods of limited supply. Instead, the Division focuses on establishing enforceable SO₂ emission limits that ensure compliance with the SO₂ NAAQS. This approach maintains environmental protection while allowing the facility the operational flexibility needed to adapt to market conditions.

Topic 4: Modeling Demonstration

- A. The Draft SIP modeling under the chosen control technology does not demonstrate that the area is meeting or will meet the NAAQS.

The Division acknowledges this comment. The weight-of-evidence analysis justifies why the modeling outcomes are not representative of actual emissions in the Area. The Division believes that the chosen control measure will bring the Area into attainment as expeditiously as practicable. The Division and Century acknowledge that if attainment is not achieved, the contingency measures in the Attainment Demonstration will be implemented to attain the NAAQS.

The 2010 SO₂ NAAQS is met when the design value is under the standard. Design values are calculated by taking the 3-year average of the annual 99th percentile (the fourth high) of daily maximums. Meaning that a single exceedance of the standard does not result in nonattainment. The 2025 fourth high value for the Area is below the standard of 75 ppb at 71.2 ppb. The Area could record a 2026 fourth high value of up to 75 ppb and achieve a three-year design value (2024-2026) under the standard. This scenario is possible if Century maintains the status quo and does not implement any control measures. While air modeling is highly effective at predicting data, there is nothing more certain than monitored values in the Area. Therefore, the Division believes that, with the increased stack height, attainment of the standard is not only likely but almost certain.

- B. The Division acknowledges a drop in emissions due to the COVID-19 pandemic; despite using affected data years the Area is still unable to model attainment with the NAAQS.

The Division acknowledges this comment. In the modeling demonstration, 2021-2023 were used as they were the most recent complete data years at the time the Attainment Demonstration was submitted. At the time of the final submittal, 2023 has the highest yearly 99th percentile of the one-hour daily maximum value over the last six years. Despite lower emissions in 2021, the inclusion of 2023 ensures that the 2021-2023 design value remains an acceptable approximation of the average design value at the Sebree monitor. As seen in the weight-of-evidence analysis, the model does show attainment after appropriate considerations are taken into account.

- C. The Division must provide modeling that follows federal rules and guidance and demonstrate attainment with the NAAQS. Appendix A of EPA's 2014 document Guidance for 1-Hour SO₂ Nonattainment SIP Submissions lays out a Modeling Framework. If a modeling demonstration is not able to model attainment, steps 6 through 8 of the Modeling Framework states that additional control options should be evaluated until there are no longer modeled violations.

The Division acknowledges this comment. However, the Division believes that the weight-of-evidence analysis provides sufficient justification for deviation from EPA's 2014 Guidance for 1-Hour Sulfur Dioxide Nonattainment Area State Implementation Plans Submissions (SO₂ Attainment Guidance) and demonstrates that attainment will be reached and maintained.⁶

- D. The modeling demonstration assumed 2% of total potline emissions were emitted as fugitives—which appears low, given the actual emissions for 2017-2019 indicates potline roof vent emissions made up ~3.74% of total potline emissions.

The Division acknowledges this comment. As referenced in Century's response to the request for more information in Appendix H, 98 percent represents the more accurate capture efficiency for the potline's emissions. A 2024 study measured a capture efficiency of 99.2 percent for carbon monoxide. A similar capture efficiency can be assumed for SO₂; therefore, 98 percent is a reasonable estimate.

⁶ US EPA. (April 23, 2014). *Guidance for 1-Hour SO₂ Nonattainment Area SIP Submissions*. <https://www.epa.gov/system/files/documents/2025-09/guidance-for-1-hour-so2-nonattainment-area-sip-submissions.pdf>.

Topic 5: Modeling Adjustments

- A. In the provided modeling, the overprediction factor of 1.21 is designed to be conservative and account for real world variability, reducing this factor diminishes the protective nature of the model.

The Division acknowledges this comment. As shown in Table 4-4 of the modeling demonstration, the data corrected impacts in all three scenarios are approximately 6-19 micrograms per cubic meter under the NAAQS. This buffer allows for real world variability, and the Division believes it is sufficiently conservative.

- B. A procedure to adjust the model predicted concentrations using a model-to-monitor ratio is prohibited when using regulatory AERMOD. Section 4.1.f of Appendix W. Model must be revised.

The Division acknowledges this comment. The precise regulatory language states that model calibration shall not be performed. The language does not explicitly prohibit the usage of model-to-monitor ratios. Additionally, this method is not applied to model inputs; rather, it adjusts model outputs to predict monitored values in the area better. Therefore, the Division does not consider this adjustment a calibration of the model and does not believe it is the scenario the regulatory language seeks to prevent.

- C. The use of a relative response factor is not appropriate, and the guidance relied upon in the draft SIP does not apply to SO₂ Attainment Demonstrations.

The Division acknowledges this comment but believes the referenced document, Modeling Guidance for Demonstrating Air Quality Goals for Ozone, PM_{2.5}, and Regional Haze, is applicable in this scenario.⁷ The guidance is not explicitly tailored to SO₂ as the primary pollutant, but SO₂ is a precursor to both ozone and regional haze. The guidance document even states that SO₂ emissions should be modeled to support ozone base year emissions inventories. Additionally, in the first and second rounds of regional haze SIPs, SO₂ was the primary pollutant of concern. If SO₂ must be considered for modeling ozone and regional haze, then logically the same modeling principles should apply and allow the use of a relative response factor.

- D. All three modeling scenarios exceed the 1-hour SO₂ NAAQS.

The Division acknowledges this comment. After considering the weight-of-evidence analysis, which the Division feels is a more accurate prediction for future monitor values, none of the

⁷ US EPA. (November 29, 2018). *Modeling Guidance for Demonstrating Air Quality Goals for Ozone, PM_{2.5} and Regional Haze*. https://www.epa.gov/sites/default/files/2020-10/documents/o3-pm-rh-modeling_guidance-2018.pdf.

modeling scenarios exceed the one-hour SO₂ NAAQS.

Topic 6: Modeling Parameters

- A. The use of an urban land use characterization in AERMOD is inappropriate and results in significant reduction in the modeled design value.

The Division acknowledges this comment. However, the Division disagrees with this conclusion as the urban setting in AERMOD has been used to characterize the impacts of the urban heat island effect in many approved SIPs. As seen in the satellite thermal imagery provided in Section 2.2 of the modeling report (Appendix J), there is a heat island surrounding Century's property.

- B. While an urban option is acceptable in AERMOD, a surrogate population of 2 million is inappropriate for this modeling demonstration. Modeling should be redone using a population in the range of 47,000 to 84,000 to reflect the average urban-rural temperature difference in a range of 7.5 to 8.2 degrees Celsius.

The Division acknowledges this comment. Section 2.2 of the modeling demonstration details the methodology used to arrive at the population of 2,000,000 and temperature difference at 12 degrees Celsius. The empirical formula used has been peer reviewed and is referenced by the EPA on the resource page for Measuring Heat Islands.⁸ The use of these parameters provides conservatively high model output concentrations while remaining realistic when compared to expected monitored values in the Area.

- C. The building profile input program files do not include the new stack for the anode bake furnace, the files that are the basis for the direction specific building dimensions included in AERMOD must be provided. Modeled inputs and outputs, and other key data to evaluate the model are not provided as part of the Draft SIP.

The Division acknowledges this comment. The modeling files have been added to the final submission and can be viewed in Appendix J.

- D. The Division must ensure that the impact of emissions from potline roof vents is adequately accounted for to ensure accuracy of modeling results. Running the model using the increased/combined stack parameter of 3.84 m used by Trinity's model reduced the modeled design value concentration impact from the potline stacks by 81% when compared to modeling each of the potlines with their original diameters of 1.21 m (from 1285 ug/m³ down to 238 ug/m³).

The Division acknowledges this comment. The use of merged plumes from potline roof vents at Century in AERMOD yields results more consistent with monitored values than considering plumes from the potline roof vents separately. In Appendix A of Trinity Consultant's modeling

⁸ US EPA. (March 18, 2025). Measuring Heat Islands. <https://www.epa.gov/heatislands/measuring-heat-islands>.

report, a performance evaluation shows that using merged plumes yields a conservative estimate of the actual monitored values.

- E. The modeling demonstration assumed a buoyancy parameter of $330 \text{ m}^4/\text{s}^3$, which is approximately 10 times higher than the value of $33.5 \text{ m}^4/\text{s}^3$ appropriately calculated using a temperature difference of 12 degrees C and an exit velocity of 0.1 m/s. The use of a much higher buoyancy parameter of $330 \text{ m}^4/\text{s}^3$ results in a 49% reduction of the modeled design value concentration impact from the potline roof vents.

The Division acknowledges this comment. In Appendix H Section 4, Century states that 86 emissions test runs were completed during the 2020-2022 period for the potline roof vents. Results were averaged across the three potlines to yield an exit velocity of 0.84 m/s, an exit temperature of 299.61 K, and a source-ambient temperature difference of 12.28 K. When accounting for these factors, the estimated exit velocity in the modeling files is reasonable.

Topic 7: Weight-of-Evidence

- A. A weight-of-evidence analysis is acceptable for an Attainment Demonstration involving photochemical modeling for PM and ozone; not for 1-hour SO₂. Section 6 of EPA's November 29, 2018, "Modeling Guidance for Demonstrating Air Quality Goals for Ozone, PM_{2.5} and Regional Haze," explains the concept of using supplemental analyses and weight-of-evidence demonstrations for PM_{2.5} and Ozone demonstrations. However, this guidance does not apply to SO₂ Attainment Demonstrations. Appendix A, Section 4 of the 2014 SO₂ Modeling Guidance lists the recommended steps for demonstrating attainment. Step 6 states: "If there are predicted violations of the NAAQS, additional control strategies would need to be implemented on the initially controlled sources and possible controls on additional sources would need to be assessed, which may necessitate re-running the dispersion model." The modeled violations shown in Section 3.1 of the Modeling Report must be resolved by re-modeling with additional emissions reductions or control scenarios demonstrating attainment at all ambient air receptor locations.

The Division acknowledges this comment. The Division has evaluated the SO₂ Attainment Guidance and recognizes that it emphasizes attainment demonstrations based on dispersion modeling and control strategies. At the same time, the Division finds that the use of supplemental analyses, including a weight-of-evidence evaluation, is appropriate to inform and support the modeling results in this case. The CAA and applicable regulations do not prohibit consideration of such information.

The Division relies on the weight-of-evidence analysis here to provide additional context for the modeled results, including comparison to monitored data and evaluation of model performance. This information supports the conclusion that the selected control strategy will achieve attainment. The Division will continue to work with EPA to ensure that the final demonstration satisfies all applicable requirements.

Topic 8: Monitoring Data

- A. The Division should not request for redesignation to attainment when both ambient monitoring data and air dispersion data show continued exceedances of the NAAQS.

The Division acknowledges this comment. This SIP is an Attainment Demonstration outlining the strategies being implemented to bring the Area back into attainment by the attainment date. The Division will not submit a redesignation request SIP until monitoring data shows that the Area has a design value that attains the 2010 SO₂ NAAQS.

- B. Additional info is needed regarding how ambient air was determined for the purpose of receptor placement along the unfenced areas of the ambient air boundary for the facility.

The Division acknowledges this comment. Ambient air was determined to be anything outside of Century's property. Photos of the property boundary are included in Appendix H.

- C. Please confirm whether additional measures are used beyond those described in Section 2.7 of the modeling report to preclude public access along the unfenced areas of Century's property boundary.

The Division acknowledges this comment. Century has added additional fencing and a rolling gate to restrict access from the main roadway. In addition, the facility has placed 'No Trespassing' signage around the perimeter of the property and uses camera footage and periodic vehicle patrols to confirm that the public does not have access. Photos of the fencing, signage, and details of all measures taken to restrict access are listed in Section 3 of Appendix H.

- D. Monitored levels of SO₂ have recently trended back upwards. The highest single max ever monitored at the Sebree monitor occurred in 2024.

The Division acknowledges this comment. The Division notes that the recent upward trend in monitored SO₂ levels occurred in the absence of any newly implemented emission controls. This trend underscores the need for an enforceable control strategy, rather than indicating the ineffectiveness of existing measures. In addition, the increased emissions in 2023 are partially attributable to Century using recycled anode material from its Hawesville facility.

The Division confirms that the highest one-hour SO₂ concentration ever recorded at the Sebree monitor occurred on February 3, 2024. It is important to note that this exceedance took place before the implementation of the control strategy outlined in this Attainment Demonstration. As such, the elevated concentration is consistent with pre-control conditions that led to the Area being designated as nonattainment and further reinforces the need for the timely deployment of the selected emission reduction measures. The Division remains confident that, once fully implemented, the control strategy will effectively reduce SO₂ concentrations in the

Area, improve air quality, and prevent future exceedances of the NAAQS.

Additionally, a single high exceedance day will not violate the NAAQS. SO₂ is a localized pollutant generally originating from one or several sources, so monitored values can exhibit high variability depending on nearby sources. The NAAQS form is designed to allow for this variability by excluding three exceedances above the standard level from the design value calculation. This form design is protective of human health, and the aforementioned day was an outlier at the Sebree monitor, as demonstrated by the fourth highest value in 2024 being approximately 50 ppb lower than the highest value.

Topic 9: Emissions Inventory

- A. Emissions seem likely to trend upward rather than staying steady at Sebree. The Division's projections should be adjusted accordingly, and more fully speciated temporally by release point.

The Division acknowledges this comment. Annual SO₂ emissions from Century have increased from 2018 to 2023. However, Century's 2023 SO₂ emissions are still over 200 tpy less than their 2017 SO₂ emissions. In addition, Century's 2024 SO₂ emissions are over 150 tpy less than their 2023 SO₂ emissions. While annual SO₂ emissions are expected to fluctuate due to market demand and other factors, the reported emissions have trended downward and remained below the facility's permitted maximum allowable SO₂ emissions limit. Century's future year emission projections were calculated using the linear function, detailed in the comment below, and account for all recent data trends. The enforceable SO₂ emissions limit for meeting the standard is facility wide, so emission trends were reported using the facility wide totals.

For further context, a table and graph are included below to illustrate that Century's emissions are not trending upward under linear forecasting. Century did not begin operating the facility until 2013, and that year was omitted from this forecast because the plant was not fully operational throughout the year. Century's SO₂ emissions from the years 2020 and 2021 were also omitted from the emissions inventory to account for impacts from the COVID-19 shutdown. All numbers were obtained from the Division's Emissions Inventory System.

Figure 1: Century Aluminum's SO₂ Emissions (tpy) 2014 - 2024

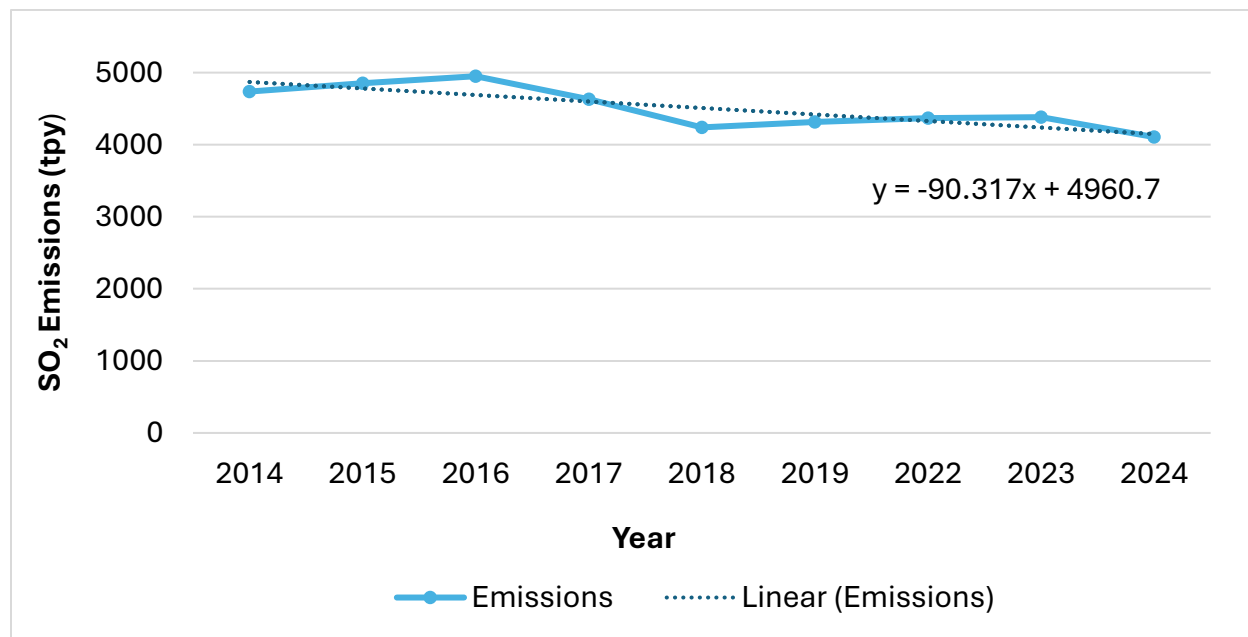


Table 1: Century Aluminum's SO₂ Emissions (tpy) 2014 - 2024

Year	2014	2015	2016	2017	2018	2019	2022	2023	2024
SO ₂ Emissions	4739	4853	4950	4629	4239	4315	4367	4384	4,106

B. The Division's emissions projection methodology is not clear.

The Division acknowledges this comment. As indicated in the Emissions Inventory Excel sheet in Appendix D, the emissions projection for Henderson County was calculated using the linear function in Excel. Looking at the data graphically, it is clear that a linear trendline best fits the available data points. Webster County point sources were projected to maintain 2023 SO₂ emissions values, as all point sources have either shut down completely or switched to natural gas.

The Division used EPA's 2016v2 Emissions Modeling Platform (EMP) to calculate nonpoint and nonroad emissions for both counties for the 2026 attainment year. The EMP files pulled are listed in the Excel sheet, along with their names and associated outputs.

C. Projected emissions inventory for Century is greater than base year by 53 tons. Please clarify any activities relating to the increase in emissions. Note – any final control strategy changes may require adjustments to the projected attainment inventory.

The Division acknowledges this comment. There are no activities; as stated above, the Division made use of the linear function in Excel, and the resulting projected SO₂ emissions show a slight increase from the base year, partially due to the inclusion of 2017 in the data set. Including 2017, the highest emissions year in the data set, ensures that the projected emissions inventory is appropriately conservative. The final control strategy, the increased ABF stack, will not impact emissions as the projected attainment inventory does not need to be updated.

D. Explain how the 2026 projected emission inventory for BREC and Century facilities was determined, including an explanation for how KY applied the Microsoft Excel Linear Forecast Function to project the 2026 SO₂ emissions for both point sources in the Nonattainment Area.

The Division acknowledges this comment. The linear forecast function was used to project 2026 emissions for Century, not for any BREC facilities. As stated in the first tab of the Emissions Inventory Excel sheet provided as Appendix D of the draft document, all Webster County point sources, including all BREC facilities, were projected to have the same emissions in 2026 as in 2023 due to their conversion to natural gas or overall shutdown. The linear

forecast function was applied to Century by selecting the function, entering 2026 as the X value to predict for, entering the years (2017-2023) as known X values, and entering the emissions in tons for each year as the known Y values.

Topic 10: Contingency Measures

- A. The Draft SIP's contingency plan should include at least some measures that will serve to immediately reduce SO₂ emissions.

The Division acknowledges this comment. In the SO₂ Attainment Guidance, EPA states that contingency measures “can mean that the state agency has a comprehensive program to identify sources of violations of the SO₂ NAAQS and to undertake an aggressive follow-up for compliance and enforcement.”⁹ The Division believes that the contingency measures detailed in the draft version of this document satisfactorily reflect the SO₂ Attainment Guidance’s intention.

- B. While meeting the minimum requirements outlined by the SO₂ SIP Guidance, the contingency measures can and should be strengthened.

The Division acknowledges this comment. The Division believes that the contingency measures included in the Attainment Demonstration are sufficient and consistent with the SO₂ Attainment Guidance, as they establish enforceable mechanisms to address potential violations and ensure continued protection of public health. The Division will evaluate whether additional or enhanced contingency measures are warranted in future SIP revisions, including the second ten-year maintenance plan required under 42 U.S.C § 7505a(b), based on updated air quality data and trends.

⁹ *Supra* note 6.

Topic 11: Miscellaneous

A. Attainment SIPs should include reasonable further progress.

The Division acknowledges this comment. As stated in the SO₂ Attainment Guidance, SO₂ concentrations are often dominated by emissions from a limited number of sources, and emissions controls often “yield swift and dramatic improvement in air quality,” and “adherence to an ambitious compliance schedule” would constitute RFP for SO₂.¹⁰ This means that the air agency needs to ensure that sources implement appropriate control measures as expeditiously as practicable. The Division believes the implementation of the increased stack height from the ABF potline constitutes reasonable further progress.

B. The Draft SIP is not protective of public health.

The Division acknowledges this comment. The components of the Attainment Demonstration SIP are an effort to ensure compliance with the NAAQS. Monitoring trends after the control strategy is fully implemented will indicate if the SIP is protective of public health. The Division is confident that the Area will be brought into attainment. However, if the raised stack does not bring the Area into attainment, the Division will implement contingency measures until attainment is reached.

C. The Division must conduct a full, proper public participation process.

The Division acknowledges this comment. The Division affirms that it followed all applicable public participation requirements.¹¹ The public was given the opportunity to review available materials and submit comments during the public notice period of August 15, 2024, through September 20, 2024. The CAA requires only a 30-day public comment period, and the Division provided 37 days. The Division ensured transparency and accessibility throughout the process in accordance with both federal and state regulations. There will be additional opportunities for public comment during the permitting process and when EPA acts on the Division’s final SIP submittal.

¹⁰ *Supra* note 8.

¹¹ 40 CFR 51.102 - Public hearings.