

8.7 BART Determination and Modeling for Alcoa

8.7.1 Summary of Alcoa BART Analysis

Alcoa, located in Newburgh, Warrick County, Indiana, is subject to BART. The source submitted a BART analysis in December 2008, in which it developed BART and alternative BART control strategies.

NPS: According to IDEM, the alternative achieves a visibility improvement equal to 0.46 dv and an overall improvement in visibility equal to 75% over the baseline and achieves significantly higher reductions in SO₂, equal to approximately 21,600 tons. However, it is likely that the majority of the emission reductions cited by IDEM were the result of efforts by Alcoa to increase the capacities of Boilers 1, 2, and 3 while avoiding review under the Prevention of Significant Deterioration (PSD) regulations. In order to do so, Alcoa installed wet scrubbers to reduce SO₂ emissions from these units, as well as installing Selective Catalytic Reduction on Boiler #4 to offset NO_x emission increases from Boilers 1, 2, and 3. Therefore, we question whether it is valid to take credit as a BART Alternative for reductions made for other purposes, as we shall discuss later.

8.7.2 BART-eligible units at Alcoa

Alcoa identified 18 ingot furnaces, three boilers (Boilers 2, 3, and 4), and five aluminum refining furnaces (Potlines 2-6) as meeting the BART-eligibility criteria. Boilers 2 and 3 are classified as industrial boilers. Boiler 4 is classified as an Electric Generating Unit (EGU). Alcoa, in its December analysis addressed PM, SO₂, and NO_x for all its BART-eligible units including Boiler 4. According to the Indiana BART rule, 326 IAC 26-1-5, participation of this boiler in the Clean Air Interstate Rule (CAIR) satisfies the SO₂ and NO_x requirements. The BART analysis will therefore address PM only for this boiler.

Boilers 2, 3, and 4 are dry bottom, pulverized coal-fired units. Boiler 2 came online in January 1964, Boiler 3 came online in October 1965, and the construction of Boiler 4 started on March 16, 1968. Boilers 2 and 3 each had a nominal heat input capacity of 1,357 MMBtu/hr prior to a recent upgrade to a nominal heat input capacity of 1,589 MMBtu/hr. Boiler 4 has a nominal heat input capacity of 2,958 MMBtu/hr. Each boiler is equipped with an electrostatic precipitator (ESP) for PM control. Boiler 2 was equipped with a low NO_x burner (LNB) and overfire air (OFA) in 2004, Boiler 3 was equipped with LNB and OFA in 2002, and Boiler 4 was equipped with a LNB in 1998 and a selective catalytic reduction (SCR) system in 2004. Wet flue gas desulfurization (FGD) scrubbers were installed on all boilers in 2008.

Emissions from potlines are captured and controlled with primary controls. Any uncaptured emissions escape through the roof monitors atop the potline buildings. The primary controls consist of a gas treatment system followed by a fabric filtration system. The total fluoride and particulate removal efficiencies of the control systems are estimated to exceed 99%.

Ingot furnace emissions are uncontrolled. There are several material handling operations at the facility that meet the criteria for beginning operation between 1962 and 1977. However, the BART Guidelines require that only those operations at primary aluminum ore reduction plants that meet the NSPS applicability criteria for this source category should be considered for BART controls. These operations are the potroom groups and anode bake plants. IDEM also identified three (3) ingot furnaces in the Alcoa Title V permit that meet the 1962-1977 timeline criteria but were not included in the analysis. According to Alcoa, one of these furnaces has been physically removed and the other two furnaces did not operate in the baseline years. IDEM considers the impact of the other 18- furnaces to be negligible.

8.7.3 BART Analysis

The initial screening model projected the highest visibility impact at Mammoth Cave National Park (MCNP). Other Class I areas screened included Mingo Wilderness Area, Sipsey Wilderness Area, Great Smoky Mountains National Park, Joyce Kilmer – Slick Rock Wilderness Area, Cohutta Wilderness Area, and Shining Rock Wilderness Area. The impact at MCNP exceeded 0.5 dv. Since the visibility impact was highest at MCNP, the BART analysis was solely based on the impact at MCNP.

8.7.4 Control Strategy

IDEM: Alcoa proposed an alternative to BART which requires less emissions reductions on some units for technical or economic reasons. However, it proposes to control emissions from Boiler 1 which is not a BART-eligible unit. For example, Alcoa determined SO₂ BART for Boilers 2 and 3 as 92% reduction, but it proposes to control SO₂ emissions from these boilers by 90% as an alternative. Alcoa currently limits sulfur in the anode grade coke to ≤ 2%. Based on a market study, it has determined that the supply of <3% sulfur coke cannot be ascertained beyond 2013. Therefore, it proposes BART as ≤ 3% sulfur coke and the alternative as ≤ 3.5% sulfur coke. In the alternative, the source proposes to control SO₂ emissions from Boiler 1 by 91% and NO_x emissions at 0.38 lb/MMBtu.

NPS: We do not believe that it is valid to use reductions that are required by permit to avoid PSD¹ and/or meet New Source Performance Standards (NSPS) at Boiler #1 to also satisfy BART for the BART sources. Construction began in 2005 and the FGDs went on-line in 2008 with the start-up of each re-rated unit. The upgraded boilers had to meet NSPS (since they were modified after Feb. 28, 2005) for large boilers (1, 2, and 3). 90% is the requirement for NSPS and Boiler 1 is used to offset the difference with 2 and 3. **Because Boiler #1 was required by NSPS to reduce SO₂ emissions by 90%, we understand that Alcoa can take credit for only the difference between the required 90% reduction at Boiler #1 and the proposed 91% reduction at Boiler #1 in its BART Alternative.**

IDEM Table 26 Summary of Visibility Modeling Analysis

Modeling scenario	Average impact (dv)
1. Baseline, BART-eligible units only	1.849

¹ Limits on overall emissions of PM, NO_x, and H₂SO₄ to avoid PSD were part of the permit.

2. BART, BART-eligible units only	0.382
Average improvement	1.467
3. Baseline, BART-eligible units and Boiler 1	2.545
4. Alternative BART	0.581

IDEM Table 27 Summary of emissions impact of various control scenarios

Emissions (tons)		
	Baseline units only	BART
NO _x	9,786.35	4,935.68
SO ₂	60,268.69	10,062.80
PM	5,717.84	2,680.84

NPS: The majority of the emission reductions and visibility improvement cited by IDEM were the result of efforts by Alcoa to increase the capacities of Boilers 1, 2, and 3 while avoiding PSD. The only emission reductions attributable to BART are due to the 91% SO₂ control on Boiler 1 versus the 90% control required by NSPS. Otherwise, Alcoa/IDEM are proposing to increase SO₂ and PM emissions above current levels.

1. Highest Contributors to Visibility Impairment

IDEM: Boilers 2 and 3 are the highest contributors to visibility impairment. In the year of maximum impact, Boilers 2 and 3 contribute approximately 95%, followed by potlines 3%, followed by Boiler 4 equal to 2%, and the contribution from ingot furnaces is zero. Sulfates and nitrates from Boilers 2 and 3 account for 73% and 25% of the impacts, respectively.

2. Boilers 2 and 3 - SO₂

NPS: Alcoa has underestimated the effectiveness of wet scrubbing on its high sulfur coal. Although Alcoa cites “Typical removal efficiencies are 80–95%,” for SO₂ scrubbers, Alcoa/IDEM determined BART as wet limestone flue gas desulfurization (FGD) for these boilers at control efficiency equal to 92%. Alcoa appears to have decided that **Best Available Retrofit Technology** is merely the **average** performance level (91.8%) of the scrubbers it found in the RBLC.² Presumptive BART for coal-fired boilers³ is 95% SO₂ control or 0.15 lb/mmBtu,

² Twenty-four units were identified in the RBLC database that could be consider similar to the boiler units at Alcoa. Of these 24 units, approximately half utilized a form of dry flue gas desulfurization to control SO₂ emissions, seven used wet scrubbing to control SO₂ emissions, and the remaining units used other means such as low sulfur coal and good combustion practices. Of the 24 units in the database, 10 listed an SO₂ removal efficiency in the range of 90% to 95% with an average of 91.8%.

Based on the RBLC database analysis, which indicated an average control efficiency of 91.8% was BACT for SO₂ from industrial boilers, and Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units (40 CFR 60 Subpart Db) requires a 92% removal efficiency for this type of source, if reconstructed, it was determined that 92% efficiency would be reasonable for units 2 and 3.

³ Even though Boilers 2 and 3 are not subject to presumptive BART, it can be presumed that the technology assumed to achieve the presumptive limits for coal-fired EGUs greater than 200 MW can achieve similar results on the smaller coal-fired Alcoa boilers. We note that IDEM has referred to the presumptive BART limits for coal-fired EGUs greater than 200 MW in its review of NO_x BART.

neither of which was evaluated by Alcoa. BART for these boilers should be at least 95% SO₂ control.

While the BART Guidelines allow special consideration for existing scrubbers achieving greater than 50% SO₂ control, we do not believe that the Alcoa scrubbers were in existence at the time of their July 6, 2005 publication. Although we could not find a clear definition of an “existing scrubber” in the BART Guidelines, we suggest that the same reasoning provided by the BART Guidelines for determining if a source is “in existence”⁴ would logically apply to a scrubber.

The only record we could find regarding permitting of the Alcoa scrubbers is an IDEM “Notice of Decision” dated December 29, 2005, five months after publication of the BART Guidelines:

On November 17, 2005, the Office of Air Quality (OAQ) received an interim significant source modification petition from Alcoa Power Generating Inc. (APGI) - Warrick Power Plant located at 4700 Darlington Road, Newburgh, Indiana for construction of wet scrubbers for sulfur dioxide reduction and for the accompanying construction of material handling facilities and modifications to the coal pulverizers and the boilers identified as Units 1, 2, 3, and 4.

We conclude that the Alcoa scrubbers were not “existing” at the time the BART Guidelines were published, and BART for Boilers 1 and 2 must be analyzed as if the scrubbers are not “existing.” If BART is determined to be greater than the 92% control proposed by Alcoa/IDEM, then it is likely that Alcoa would need to either demonstrate that they will achieve the higher BART level or upgrade them to do so.

3. Boilers 2 and 3 - NO_x

IDEM: Alcoa proposes low NO_x Burners (LNB) and OFA with an emission limit equal to 0.38 lb/MMBtu as BART and as alternative BART for these boilers. U.S.EPA’s presumptive BART limit for these boiler types is equal to 0.39 lb/MMBtu. Baseline modeling without these controls shows the highest visibility impact due to these boilers equal to 0.458 dv, which is projected to decrease to 0.064 dv with the above controls. Alcoa identified Selective Non-catalytic Reduction (SNCRs) and SCRs as feasible technologies to control NO_x from these boilers; however, it did not perform visibility impact analysis with these technologies. The capital and annual costs of SNCR controls on these boilers are estimated at \$3 million and \$2.8 million respectively. The capital and annual costs of SCRs are estimated at \$70 million and \$13 million. Additional controls on these boilers are likely to yield visibility improvement at a very high cost/benefit (\$/dv improvement).

NPS: Alcoa has underestimated the effectiveness of SCR. Although Alcoa notes that "SCR is capable of NO_x reduction efficiencies in the range of 70–90%," it assumed 78% control in its cost analyses. It is generally assumed that a properly designed and operated SCR can achieve at least 90% control.

⁴ The visibility regulations define "in existence" in 40 CFR 51.301. Under these regulations, promulgated in 1980, “in existence” means that the owner or operator has obtained all necessary preconstruction approvals or permits . . . and either has (1) begun, or caused to begin, a continuous program of physical on-site construction of the facility or (2) entered into binding agreements or contractual obligations.

NPS: Alcoa did not perform a five-step BART analysis for SNCR and SCR for Boilers 2 and 3 because it did not perform visibility impact analysis with these technologies. The NO_x controls proposed as BART are already required.

4. Potlines

IDEM: The maximum impact from these sources is 0.231 dv. This includes contributions due to vents and primary controls. Sulfates are the main contributors, at approximately 0.188 dv. Contributions due to other species are less than 0.01 dv. Therefore, any add-on controls for these pollutants will result in insignificant improvements in visibility. Due to insignificant impact from vents (0.013 dv), Alcoa did not perform the 5-step analysis for these sources. Further, these sources are subject to 40 CFR 63, Subpart LL, Maximum Achievable Control Technology (MACT). In order to comply with these standards, Alcoa follows work practices which minimize emissions escaping roof vents.

Sulfur dioxide from potlines can be controlled by lowering sulfur content in the anode grade coke and/or by installing wet scrubbers. Alcoa presently limits sulfur at $\leq 2\%$. From a market study, Alcoa has concluded that a supply of coke below 3% sulfur cannot be ensured beyond 2013, the year when the BART controls will be needed. Therefore it proposes $\leq 3\%$ sulfur coke as BART and $\leq 3.5\%$ sulfur coke as alternative BART. The 3.5% sulfur limit in the coke translates into 2.919% sulfur in the baked anode composite, the practice Alcoa follows to measure the sulfur content.

The installed and annual costs of wet scrubbers on potlines are estimated at \$300 million and \$55 million respectively. Modeling shows that SO₂ scrubbers on potlines can improve visibility by 0.138 dv. This improvement will be achieved at a cost/benefit ratio equal to \$398 million/dv. Also, there are severe space and access limitations at the facility that would complicate the installation.

NPS: Alcoa is proposing to increase SO₂ emissions by 75% from this operation.

5. Boilers 2, 3 and 4 - PM

IDEM: The maximum baseline impact due to filterable PM emissions from these sources is 0.035 dv. Alcoa proposes ESPs with an emission limit equal to 0.03 lb/MMBtu as BART controls for Boilers 2 and 3. Alcoa determined BART for Boiler 4 as 0.015 lb/MMBtu, but it proposes alternative BART for this boiler as 0.1 lb/MMBtu. This boiler has a LNB and SCR for NO_x control. Alcoa has noticed excessive conversion of SO₂ to SO₃ in the SCR due to the addition of an extra catalyst layer. To reduce SO₃, which has the potential to adversely affect the downstream equipment and in order to comply with the sulfuric acid limit in its permit, Alcoa has applied for a permit to install a dry reagent injection system between the SCR and ESP. This system will remove SO₃ from the gas stream, but it is expected to adversely affect the performance of the downstream ESP. The impact of this system on the ESP performance is not yet known. To account for this uncertainty, Alcoa proposes 0.1 lb/MMBtu as the alternative BART limit. A recent test, after the startup of the SO₂ scrubber on this boiler, measured an emission rate equal to 0.05 lb/MMBtu which includes PM and sulfuric acid.

The above limits are projected to lower the contribution from Boilers 2, 3, and 4 to approximately 0.005 dv. Alcoa identified fabric filters as feasible control technology for these boilers. However, estimating that these controls will not significantly improve visibility, it did not perform cost and visibility impact analyses with these controls. It roughly estimated the cost of fabric filters on these boilers at \$97.18 million. This estimate is based on the cost of a fabric filter installed on a utility boiler. Alcoa estimates that installation of fabric filters on these boilers will improve visibility by 0.024 dv at a cost/benefit ratio equal to \$445 million/dv.

NPS: Alcoa did not perform a five-step BART analysis for PM for Boiler 4. (For example, Alcoa should have investigated low-oxidation catalysts, fabric filtration, and wet ESPs.) Instead, **Alcoa is proposing to increase PM emissions from this unit.**

6. Ingot furnaces

IDEM: The maximum baseline impact from these sources is 0.003 dv. Due to insignificant impact from these sources, Alcoa did not perform a 5-step BART analysis for these sources.

Conclusions & Recommendations

According to IDEM, the proposed BART Alternative achieves a visibility improvement equal to 0.46 dv and an overall improvement in visibility equal to 75% over the baseline and achieves significantly higher reductions in SO₂, equal to approximately 21,600 tons. While we recognize the emission reductions and visibility improvements that result from Alcoa's compliance with New Source Review and NSPS requirements, we believe that the proposed BART Alternative improperly relies upon SO₂ emission reductions that are already required by NSPS.

Instead, it appears that Alcoa is proposing to increase PM emissions from Boiler #4 and SO₂ emissions from the potlines, which is contrary to the fundamental premise of BART, unless it can at least be shown that the additional reductions of SO₂ from Boiler #1—reductions beyond the 90% required by NSPS—result in more visibility improvement than the 1.5 dv that would be achieved if Alcoa met its proposed BART. (If BART is determined to be more stringent than proposed by Alcoa, then additional visibility improvements would be needed.) For example, it may be necessary to model the following scenarios:

1. Baseline, BART-eligible units and Boiler #1 @ 90% SO₂ control
2. BART, BART-eligible units and Boiler #1 @ 90% SO₂ control
3. Alternative BART

If Scenario #3 achieves greater visibility improvement than Scenario #2, then the Alternative BART would be acceptable.

