

Intalco Responses to Washington Department of Ecology Questions and Comments on the December 1, 2007 BART Analysis

Question 1: Section 4.3: Please document the rationale for using the 1 km dispersion modeling. In addition, include a written discussion of how the met file was produced, along with evaluation metrics on the met file. Ecology's preference is to utilize only the 4 km gridded data, unless there is a valid reason to use a smaller resolution, such as was needed for the Alcoa Wenatchee facility.

Specifically, to utilize the 1 km data, you need to submit a comparison of model performance between the 4 km and 1 km data. This would need to demonstrate that the 4 km output was not producing realistic wind fields. To use the finer grid, there should be performance statistics to persuade us that the 1 km output better describes the wind fields, than the 4 km data.

Because no evaluation was submitted with the report, you need to submit model performance statistics for wind direction and wind speed. The usual ones as supplied by the program, METSTAT, will suffice. They should be calculated for the following observation sites: KBLI, KBVS, KCLM, CYVR, CYYJ, Marblemount (MBMWI), Wells Creek (WCSWI), Smith Island (SISWI), Hurricane Ridge (HUR52), Mt Walker (TWALK), and Sandy Point (C1394).

Clint Bowman, our senior modeler believes the data completeness for these sites is high enough to provide the desired comparison. The statistics should be computed for both the 4 km and the 1 km wind fields. He is open for suggestions of appropriate additional or alternate sites.

Mr. Bowman recognizes that model performance statistics for small grid spacings often do not show the expected degree of improvement and there is a need for additional weight of evidence to be used in the assessment. Therefore, there should be a discussion of the dominant wind fields on selected high impact days, showing the improvement in using the 1 km model output. I recommend that you call or email Clint for further discussion.

RESPONSE

[Joe Scire with TRC is working directly with Clint Bowman to answer this question. The modeling evaluation is not yet complete and the results will be submitted to WDOE under separate cover.](#)

Question 2: Section 5.1, SO₂ controls: Please evaluate ammonia based scrubbing technologies. An ammonia scrubbing technology is reported to exhibit the same removal efficiency as wet limestone scrubbing, and was a 'finalist' for the Centralia Power Plant reasonably available control technology evaluation in 1996/7. It has also been used at the Cominco lead and zinc smelter in Trail BC. It does not seem to have the temperature dependence that lime or limestone scrubbing have.

RESPONSE

There are four major drawbacks associated with once-through ammonia scrubbing: 1) the use of hazardous ammonia, which may not be readily available at most aluminum smelters; 2) the need to provide storage for the product liquor; 3) the necessity of a ready market for the liquid by-product; and 4) the potential for the creation of a blue visible plume of ammonium sulfate salts. In addition to the four drawbacks of once through ammonia scrubbing systems, additional shortcomings are associated with two types of ammonia scrubbing with oxidation/solidification technology: (1) the need to produce crystallized or pelletized ammonium sulfate, (2) the requirement of a costly conversion system for the ammonium sulfate, and (3) the fact that a conversion system would be difficult to justify at the small scale associated with aluminum potlines.

The positive aspects of ammonia scrubbing technology are when it is used with high inlet concentrations of SO₂, (*i.e. up to the 6,000 ppm*) such as those associated with utility boilers, and where high degrees of ammonia control are needed in SCR applications to avoid ammonia slip. These potential advantages are not found in an aluminum potline application.

Also, the 1940s and 1950s technology of ammonia scrubbing with acid regeneration is no longer feasible because it is no longer actively marketed.

The conclusion is that these technologies, while considered technically feasible, were not considered practical or economical for aluminum potlines and was not carried forward in any of Alcoa's BART analyses.

Question 3: Page 5-14 Bake furnace usage of SNCR. Can the ammonia or urea be injected into the bake furnace flues before the exhaust gas has cooled below the reaction temperature? If this is possible, what effects would it have on natural gas usage and emissions in the bake furnace?

RESPONSE

Alcoa does not believe that this emission reduction approach is safe, technologically feasible, or that it would have any affect on emissions, given the structure, configuration, operating requirements and extremely low pollutant concentration that are associated with anode baking furnaces. Neither the third party engineering firm that reviewed the available control technologies nor Alcoa's internal Electrode Area Technical Specialists identified that this emission reduction approach has ever been tried, much less applied to operations of this type.

Discussions provided by USEPA in its May 2004 proposal, (69 FR 25219), instruct facilities with respect to technologies that have not been applied to (or permitted for) full scale operations. The guidance indicates that these types of technologies are not considered as available, and facilities are not expected to either purchase or construct a process or control device that has not already been demonstrated in practice.

In addition to the reasons stated above, major EHS issues were identified with the safe handling and use of ammonia. Baking furnaces are not perfectly sealed thermal devices, such as boilers. Baking furnace burners are physically moved on regular intervals causing a high potential for employee exposure to a hazardous material during the normal operation of the furnace. The potential for personal injury is even more reason for Alcoa to not consider this approach as a reasonably feasible technology for controlling baking furnace SO₂ emissions.

For these technical, regulatory, and safety reasons provided above, adding ammonia or urea in anode baking furnace flues is not considered a feasible approach to controlling baking furnace emissions.

Question 4: Page 5-14: What characteristics of your SO₂ wet scrubber proposal cause it to create extra particulate emissions? Other facilities with more mist eliminator washing equipment do not seem to generate wet scrubber particulate at the rate of your proposal. Table 5-2 indicates an 88% reduction of SO₂, but a 42% increase in PM_{2.5}. Please explain this further.

Question 5: Section 5.2.1, pages 5-17: A quick review of the application of limestone wet scrubbing to coal fired power plants has not indicated a need to increase PM emission limits as a result of scrubber installations. TransAlta's Centralia Power Plant did not have to change its very low PM limit to account for particulate from the wet scrubbers installed on that facility. Please provide reference information on why a well functioning mist eliminator system, cannot continue to meet the current potline primary system PM limitation.

RESPONSE FOR 4 & 5

As with any wet scrubbing device, there will be a certain amount of residual scrubbing liquor that is entrained and released from the emission control device. The scrubbing technology being considered in the Intalco BART analysis results in the scrubbing system being installed downstream of the existing fluoride emission control devices that are equipped with very efficient particulate controls, fabric filtration (*i.e. baghouses*). All of the particulate in the scrubbing liquor is not removed by the mist eliminator, resulting in an increase in particulate emissions.

The particulate emission rates guaranteed by multiple equipment vendors were greater than the inlet concentration serving as the basis for the system design. A review of the vendor quotes revealed that one vendor's guaranteed performance specification included a scrubber system incorporating high efficiency mist eliminators at two levels in the scrubber. Even with two mist eliminators, the outlet particulate emissions rate increased above the inlet concentration. This is why Table 5-2 shows an increase in particulate emissions,

Question 6: Sections 5.2.3 and 5.2.4: NOx reductions: Emission reductions anticipated from use of advanced firing system (20% less fuel and NOx, resulting in 27 tpy less emissions) and/or use of the LoTOx control system (90% control, 122 tpy less emissions) are stated. How were the baseline NOx emission rates established, that the tons per year reduction is based on?

RESPONSE

NOx emissions from the anode bake oven were calculated using the emission factor for pulverized anthracite coal combustion from AP-42, Section 1.2. This emission factor was applied to the 1999-2000 maximum monthly average mass of anode lost during baking (assuming 100% of the loss is pitch) and the average number of anodes baked per day (based on maximum number of anodes per month for 1999-2000). This emission factor was selected to account for emissions that may occur during high-temperature oxidation of the pitch contained in an anode during baking.

A maximum daily emissions factor of 1.2 was then applied to these emissions to convert average emissions to a worst-case day. This factor is the ratio of maximum daily aluminum production to annual average daily aluminum production. In addition, NOx emissions from natural gas combustion in the anode bake oven were included in the calculation of plant-wide natural gas combustion emissions.

Question 7: Section 5.3.4, Page 5-22: The report notes the cost and adverse impacts of using the existing domestic water supply, from implementation of the wet scrubbing system. As an alternative to using water from the existing potable system, is it possible for the company to develop a separate non-potable system, exclusively for the emissions control system? If so, what might development of a new water supply for the wet scrubber use only cost? Can the company get a credit from not having to purchase water from the domestic supply?

RESPONSE

Section 5.3.4 notes an increase in water demand of approximately 9% that would be needed to effectively operate the wet scrubbing system if installed. Intalco receives all of its water directly from the Public Utility District (PUD) from the Nooksack River. At this time there are no additional water rights available from the PUD to increase water usage at the facility, and in addition, the facility entered into a contractual agreement with the PUD and the neighboring refinery (BP) in 2003 to relinquish approximately 3 million gallons/day (MGD) of its current water rights to support water conservation and use in the area. If water usage rates were to be increased at the site, additional sources of water would have to be sought that could include groundwater sources and/or additional PUD water rights that are currently unavailable. Intalco does not utilize potable water for emission control. Given the above constraints Intalco believes it would be much more costly if not impossible for the company to develop a separate non-potable and/or other water system/source to be used exclusively for the emission control systems other than what is currently in place.

Question 8: Page 5-23: Not to disregard the small degree of visibility improvement projected by use of either combustion controls or the LoTOx system on the anode bake furnace, and the fact that a scrubber is not proposed, what is the estimated capital cost and cost effectiveness in \$/ton removed, for these systems? Ecology recognizes that on page 5-21 it was stated that cost data for the LoTOx system was not readily available, but still would like to get some idea of the magnitude of costs and the cost effectiveness of a LoTOx installation.

RESPONSE

There is limited available information on LoTOx costs. We did find that LoTOx costs were evaluated as part of an assessment of NOx control options for cement kilns prepared for the Texas Commission on Environmental Quality (TCEQ).¹ Costs were evaluated for several cement kilns with uncontrolled NOx emissions ranging from 121 tons/yr to 2,222 tons/yr. The cost effectiveness of LoTOx for these cement kilns ranged from \$2,300/ton NOx removed (for the source with the highest emissions) to \$11,000/ton NOx removed (for the source with the lowest emissions). It is important to note that the sources with the lowest cost effectiveness had higher emissions and were already equipped with a wet scrubber, which is required for use of LoTOx.

The baseline NOx emission rate for the anode bake furnace is 136 tpy, as presented in Table 5-2 of the BART determination. This emission rate is comparable to the NOx emission rate for the cement kiln with the lowest uncontrolled emissions evaluated by TCEQ. This cement kiln did not have an existing wet scrubber and the cost effectiveness of the LoTOx system plus a scrubber was \$11,000/ton. Given similar uncontrolled NOx emissions and the lack of a downstream scrubber, a similar cost effectiveness value is expected for the anode bake furnace. Therefore, LoTOx is not considered to be cost effective for the anode bake furnace at Intalco.

General Questions

G1: We would like to have an electronic copy of as much of the application as possible. Word is preferred, but pdf is acceptable as long as it allows cut and pasting of all materials into a Word document and in Word format, not bitmapped.

RESPONSE

A pdf version of the files used to create the BART determination has been provided to WDOE. This includes the text, tables, and appendices.

G2: We need copies of all spread sheets or other documents, related to quantifying the baseline emissions to each emission point listed in Tables 3-1 and 4-1 through 4-4. Based on footnote 2 to Table 2-6 of the Nov. 28, 2007 Site-Specific Modeling Report for BART analysis at Alcoa Inc-Intalco Facility, Ferndale, Washington, (Appendix A) this information was submitted to TRC Environmental Corp. by Mike Palazzolo of Alcoa.

¹ ERG, Inc. 2006. *Assessment of NO_x Emissions Reduction Strategies for Cement Kilns – Ellis County: Final Report*. TCEQ Contract No. 582-04-65589. July 14.

RESPONSE

The emission calculations are detailed in a file called “Maximum daily emissions FINAL.” This file will be provided in pdf format to WDOE.

G3: We need the same information for the proposed emissions, reflecting the potential BART controls that were evaluated by modeling.

RESPONSE

The emission calculations are detailed in the file described in the response to question G2, which will be provided to WDOE.

G4: Appendices C and D: Why are the SO₂ control costs different in the Hatch report than in Environ’s cost analysis? (71 million versus 80 million for the potline scrubber and 8.9 million versus 10 million for the anode bake furnace scrubber). The body of the report indicates that Environ’s costs were based on the Hatch report results, but the connection is not made between these 2 appendices.

RESPONSE

As discussed in Section 5.3.1.1 of the BART report, Alcoa received two separate vendor quotes for installation of limestone forced-air oxidation wet scrubbing systems for the Alcoa, TN facility. These two quotes were supposed to have been included with other confidential information in Appendix B of the BART report. The omitted vendor quotes are being provided in a separate submission, as confidential information, along with the appropriate confidentiality designation documents required by WDOE

Alcoa contracted Hatch specifically to provide 1) a methodology for scaling equipment costs for the TN vendor quotes to the higher gas flow to be treated at Intalco and 2) to estimate consumable rates (reagent and utility requirements) for an Intalco scrubber. As discussed in Section 5.3.1.1, Hatch scaled equipment costs for only one of the two vendor quotes. This scaling resulted in an equipment cost of \$71 million for the potline scrubber and \$8.9 million for the anode bake scrubber, which is shown in the Hatch Report (Appendix C).

In preparing the BART document, Environ used both (two) vendor quotes along with the scaling procedure developed by Hatch. The costs in Table 5-3 and the equipment cost of \$80 million for the potline scrubber in and \$10 million for the anode bake furnace in Appendix D are based on the average of the two FGD vendor quotes available for the Alcoa, TN. One TN quote was \$65 million and the other was \$82 million. Scaling the average of these two quotes (\$73.5 million) to the Intalco flow rates provides equipment costs of \$80 million and \$10 million for the potline and anode bake furnace scrubbers, respectively. The scaling procedure used was identical to that applied in Appendix C by Hatch.

G5: Did Hatch evaluate the installation of three absorber vessels sized at 50% capacity each, rather than 2 vessels sized at 100% capacity? Having 3 absorber vessels would allow for one

absorber to be out of service, while still maintaining full scrubbing capacity and the goal of a centralized potline SO₂ control system, of a bake furnace control system. Wouldn't the capital costs be reduced if, instead of 2 absorber vessels and support equipment sized at 100% capacity, you were to build 3 absorber vessels with 50% capacity each? How much of a cost difference would this change make?

RESPONSE

Hatch did not evaluate the installation of three 50% absorber vessels. However, one of the two vendors providing quotes for the Alcoa TN facility (Alstom Power) evaluated costs for three 50% absorbers. The quoted cost for three 50% absorber vessels was 15% higher than the cost for two 100% vessels. This difference is primarily attributable to the additional steel required for three vessels.

G6: Appendix D Please indicate the basis for increasing the handling and erection multiplier to 80% from the EPA default of 40%. An increase due to retrofitting is understandable, but doubling the costs of handling and erection needs to be justified. Any specific site characteristics and access issues, related to installation of new ducting over the existing potlines, to the central treatment center for the potline emissions, needs to be explained. Similarly, what constraints justify the increase in handling and erection multiplier for the bake furnace?

RESPONSE

The increased multiplier for handling and erection is necessary and appropriate to account for the retrofit considerations discussed in Section 5.3.1.1 of the BART Determination Report:

1) Gases must be collected from multiple individual baghouse stacks. The facility has six baghouse scrubbing centers located in courtyards between the six potrooms. Each A-Line center has 6 baghouse cells for a total of 12 stacks, each B-Line center has 26 baghouse cells for a total 52 stacks and each C-Line center has 22 baghouse cells for a total of 44 stacks. The existing stacks in each center would all have to be combined to a single duct and ducts from each center would ultimately need to be combined to a single inlet to the wet scrubber. Without further engineering evaluation, it is unknown whether the existing condition of these stacks, and possibly the baghouse tops/tube sheets, would allow these stacks to be combined without modifying or replacing existing equipment. The exact means for supporting the ductwork on or among or the existing control devices and structures is also uncertain.

2) The system must simultaneously maintain balanced flow from the existing potline control devices. This requirement will increase equipment costs compared to a typical greenfield flue gas desulfurization system to treat emissions from a utility boiler.

3) The system installation would require transport and installation of new components into the narrow courtyards between the potrooms where production personnel and vehicles travel on a 24 hour, 7 day a week basis. This would require extensive coordination of the equipment delivery with the daily work schedule of potline operations to ensure a safe control system installation

process. Equipment laydown areas would also be restricted and cause inefficiencies compared to a greenfield installation.

Scrubber installation at the anode bake furnace would be less complicated because the existing dry scrubber has a single stack and there is less congestion in the area where a wet scrubber would be installed. However, the costs impacts associated with retrofit vs. greenfield installation for the anode bake furnace have not been fully evaluated and use of the 80% factor provides additional contingency. Alternatively, use of an 80% multiplier vs. the EPA default 40% multiplier may slightly overestimate the cost of scrubber installation for the bake furnace. In this case, use of the EPA default factor would reduce the overall cost effectiveness from \$36,400 per ton of SO₂ removed to \$32,300 per ton.

Several technical references support the use of a higher factor for installed capital costs of a scrubber in a retrofit scenario, as compared to installation on a new unit. First, two reports prepared for the National Lime Association in 2003 and 2007 contained a detailed estimate of the capital and operating costs of a wet scrubber for a 500 MW coal-fired boiler.^{2,3} A boiler of this size would have an exhaust flowrate and SO₂ emissions similar to the potlines at Intalco. Based on experience with installations at actual facilities, these reports cited installed capital costs on average 20% higher for scrubbers retrofit for existing units as opposed to installations at new units.

In addition, USEPA has developed a spreadsheet model for estimating air pollution control costs for coal-fired boilers (the Coal Utility Environmental Cost model, or CUECost).⁴ This model estimates capital and operating costs for various air pollution control devices for large (>100 MW) coal-fired boilers, including wet scrubbers. In this model, a retrofit markup for installed capital costs of 1.3 is recommended for typical retrofits, and a factor of 1.6 is recommended for difficult retrofits. Increasing the handling and erection factor from 40% to 80% would have the effect of increasing installed capital costs by approximately 20%. This is less than the factor estimated by the National Lime Association or the USEPA CUECost model for retrofits of scrubbers of a similar size.

G7: Appendix D, control cost analyses. Please justify the need for 4 new maintenance personnel that work one shift per day, 5 days per week, in addition to, one new maintenance person for other shifts simply to maintain the scrubber system. Are maintenance personnel not shared with other process units?

Similarly, one operator per shift, just to operate the wet scrubbing system, is more than the other facilities I am familiar with. In those facilities, plant operators control overall plant operation

² Sargent & Lundy LLC. 2003. *Wet Flue Gas Desulfurization Technology Evaluation*. Prepared for National Lime Association. January.

³ Sargent & Lundy LLC. 2007. *Flue Gas Desulfurization Technology Evaluation, Dry Lime vs. Wet Limestone FGD*. Prepared for National Lime Association. March.

⁴ Keith, R. and Blagg, R. et al. 1999. *Coal Utility Environmental Cost (CUECost) Workbook User's Manual, Version 1.0*, EPA-600/R-99-056, June.

from a central control room. Only a couple of facilities have separate control rooms, covering subsets of the whole plant's operations and these still coordinate with the main control room.

RESPONSE

The installation and operation of a wet scrubber on the potlines at Intalco would be a major undertaking, requiring the use of a scrubber comparable to in size to what might be required for a large utility boiler (approximately 570 MW). Currently, the plant is staffed very lean to minimize overall operating expenses. So, additional personnel would have to be added to operate and maintain a new wet scrubbing system.

The estimates provided in the Intalco BART document for additional operating and maintenance labor may actually be conservatively low. As described above, USEPA has developed the CUECost model for use in estimating the capital and operating costs of controls of the size that would be required at Intalco. This model assumes that 28 operators, each working 40 hours/week, are required. This does not include labor required for maintenance, since the CUECost model does not specify number of maintenance personnel required. Instead, this model includes maintenance labor and material costs as a percentage of capital costs.

In addition, the two National Lime Association reports cited above also contain specific estimates of additional labor requirements for a scrubber of the size that would be required at Intalco. These reports estimate that 8 additional operators would be required for a wet scrubber at a new unit, while 12 additional operators would be required for a retrofit application. In both cases, each new operator is assumed to work 40 hours/week in the cost analysis. Again, this does not include the additional requirements for maintenance labor.

In comparison to both the CUECost and National Lime Association examples, the estimates of additional operator and maintenance labor required for a potline wet scrubber at Intalco appear to be conservative.

G7 continued: Potline maintenance material costs, seem to be referenced to a low sulfur boiler system, rated at 1.3 million BTU/hr heat input. Why is this, the right reference for maintenance materials?

RESPONSE

We are not sure where the reference to 1.3 million BTU/hr heat input comes from in this question. The potline maintenance material costs were used as reported in the National Lime Association report that is cited above. This report evaluated the use of a limestone scrubber on a 500 MW coal fired boiler rated at 5,000 million Btu/hr, as stated in Table 3.1-1 of the report.⁵

⁵ Please note that Table 3.1-1 lists the boiler evaluated as having a heat input rate of 5,000 MBtu/hr. We believe that MBtu/hr is intended to mean million Btu/hr and not thousand Btu/hr, for a few reasons. First, the power output of the boiler is listed as 500 MW, which would equate to a unit with a heat input close to 5,000 million Btu/hr. Also, an evaluation of the SO₂ emission rates would support this conclusion. These emission rates are listed in units of lb/MBtu, which in this case appears to mean lb per million Btu, based on the listed higher heating value and sulfur content of the fuel.

The boiler referenced in this document had a flow rate of 1.7 macfm inlet/1.5 macfm outlet, which is smaller than the potline system with 2.2 macfm inlet/2.0 macfm outlet. So, we believe the maintenance materials costs listed in this report should be comparable to those required for the potlines at Intalco. These costs should also be conservatively low since they were estimated for a system with a slightly smaller exhaust flow rate.