

Appendix C. About Intalco Primary Metals Works Aluminum Smelter

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About Intalco Primary Metals Works Aluminum Smelter

Alcoa, the first American company to produce commercial aluminum, built the Intalco Primary Metals Works aluminum smelter (Intalco) in 1965 in Whatcom County. It began operations in 1966 and currently is the oldest aluminum smelter that is still operating in the United States. Intalco currently employs 703 employees.



Figure 1: A bird's eye view of Intalco looking northeast across the facility toward Lake Terrell (source: <https://nwcitizen.com/>)

Primary Aluminium Production at Intalco

Feedstock for primary, or molten, aluminium is a sedimentary rock called bauxite. It is mined and processed into aluminum oxide, Al_2O_3 , (alumina) near the mining site, typically in Australia, using a caustic process. About four pounds of bauxite result in approximately two pounds of alumina which in turn produces roughly one pound of aluminum.

Alumina does not contain sulfur in significant quantities and is not a source of SO_2 . However, the process of reducing alumina to aluminum is very energy intensive and requires the use of electrical anodes. Intalco makes their own carbon anodes onsite using petroleum coke. The petroleum coke contains up to 3% sulfur by weight, which oxidizes to form the primary source of SO_2 emissions from the facility.

Sulfur dioxide emissions are directly proportional to sulfur content in the carbon anodes. Since the anodes are consumed in the process at a fixed rate, reducing the concentration of sulfur in the anodes results in less sulfur dioxide being generated onsite. Alternately, emissions control devices, such as wet scrubbers, can reduce emissions after they are generated.



Figure 2: Sedimentary rock bauxite and alumina.

Intalco produces molten aluminum in reduction cells (pots) using the Hall-Heroult prebake electrolytic process. The pots are made up of steel shells with two linings, an outer insulating or refractory lining, an inner carbon lining that acts as the cathode of the electrolytic cell, and each cell can hold 18 prebaked anodes. A direct current of 140,000 amperes is fed in series to each pot. The current passes from the cathode through the molten cryolite (bath) and alumina mixture to the anodes. The electrolytic process takes place at temperatures of 940–980° C and breaks the bond between the oxygen and aluminum in the alumina. The oxygen reacts with the anode to form carbon dioxide, carbon monoxide, and sulfur dioxide. The alumina is reduced to molten aluminum at the cathode where it accumulates because it is heavier than the molten bath.

The anodes are used up by the electrolytic process. About 0.6 inches of anode is consumed per day (approximately 0.5 lbs carbon/lb Al). The used anodes (called spent anodes) are removed and replaced with a new anode every 25-28 days. The molten aluminum is tapped from the pots every 34 hours and transferred to the casthouse where it is cast into sows, tees, slabs, and billets.

Intalco has 720 electrolytic pots in which the molten aluminum is produced. The pots are arranged in 3 lines called potlines. The potlines are designated as A, B, and C. Each potline has two buildings (A-1 and A-2, B-1 and B-2, and C-1 and C-2) with 120 pots per building and 240 pots per potline. The operating pots run continuously (24 hours a day, 365 days per year). The average pot is operated for 6 years. After a pot is shut down, a new pot is rebuilt in its place.

Intalco has a production cap of 307,000 tons of aluminum/year. Intalco's January 2020 Air Monitoring Report noted that they were producing 546 tons of aluminum/day (199,290 tons/year) and were operating 524 of their 720 pots (73%).



Figure 3: Aerial views of Intalco facility.

Intalco operations are divided into seven processes.

- Green Carbon (also called the Green Mill and Paste Plant): A mixture of recycled anode, coke, and pitch is made into anode paste and formed into “green” anodes (Figure 4).
- Baked Carbon: The green anodes are baked in two in-ground ring anode bake furnaces.
- Anode Rodding: The baked anodes are prepared for baking and used anodes (spent anodes) are recycled.
- Potlines: Molten aluminum is made in the reduction pots (Figure 5) using the Hall-Heroult prebake electrolytic process.
- Metal Products: Molten aluminum is transferred to holding furnaces where it is alloyed and cast into billets (Figure 6), ingots (Figure 7) and tees (Figure 8)
- Ancillary: Support equipment.
- General Facility: Small emission units.



Figure 3: Green (unbaked anodes) on conveyor being transported to the bake ovens.



Figure 4: Reduction Pot.



Figure 5: Billet.



Figure 6: Ingot.



Figure 7: Tee.

Emissions Controls

Most of the emissions at Intalco are generated by the anode manufacturing processes in the paste plant, the anode baking process in the anode bake ovens, and the aluminum smelting process in the potlines. Intalco's Air Operating Permit (AOP) contains emission limits, monitoring, recordkeeping, and reporting requirements for these pollutants. Intalco is also required to comply with federal requirements for total fluoride (TF), particulate matter (PM), and polycyclic organic matter (POM) that are called "Maximum Achievable Control Technology" (MACT) standards. The MACT standards are more stringent than the respective requirements in Intalco's AOP. Intalco's AOP renewal is currently underway. The MACT standards/requirements will be incorporated into the AOP renewal.

Paste Plant: The processes in Intalco's paste plant generate PM and POM. PM emissions are generated by the crushing and sizing of the materials used to make the "green" (unbaked) anodes. These PM emissions are controlled by four baghouses. POM and PM emissions generated during the mixing of pitch (the binding agent used to help form the anodes) with the crushed/sized anode components are controlled by the Pitch Fume Treatment System (PFTS).

Bake Ovens: The green anodes are baked in the bake ovens. PM, TF, nitrogen oxides (NO_x), POM and sulfur dioxide (SO₂) are generated during the anode baking process. SO₂ is released from the anode bake furnace as pitch is oxidized during the baking process. These emissions are controlled by a dry alumina scrubber and fabric filters called the bake oven baghouse. The gasses/emissions generated during the anode baking process are drawn through the dry scrubbers. In the dry scrubber, the gases are mixed with coke. The coke reacts chemically with PM, TF, NO_x and POM and removes them from the air stream. The coke/gas mixture then flows

to the baghouse where it is filtered to remove the particulate and the treated gas is emitted. The captured particulate is transferred back to the bake ovens as cover material.

Potlines: Baked anodes and cryolite are used in the smelting process in the potlines. PM, TF, POM, SO₂, COS, NO_x, and CO are generated during the smelting process. Sulfur in the anodes is oxidized, releasing SO₂ as the anodes are consumed. These emissions are captured and controlled by two control systems – primary and secondary emission controls.

Primary Emission Control System: Each potline has a primary control system consisting of a dry alumina injection system called a dry scrubber and fabric filters called baghouses. The primary control system captures the gasses/emissions generated inside the pots (called primary emissions). Every pot is enclosed by hoods that are designed to keep the gasses/emissions inside the pot so they can be ducted into the dry scrubbers for treatment. Approximately 90% of gases generated in the pots during the smelting process are drawn through these primary dry scrubbing units. In the dry scrubber, the gases are mixed with a combination of fresh and reacted alumina. The alumina reacts chemically with hydrogen fluoride and removes it from the air stream with very high efficiency. The alumina/gas mixture then flows to a baghouse where it is filtered to remove the particulate, and the treated gas is emitted. The captured particulate containing the fluoride is transferred back to the potlines as feed material. The primary control system has an approximate control efficiency of 98%.

Parts of the primary treatment system in Potlines A and C are illustrated in the **Figure 4** below.

Secondary Emission Control System: Each potline has a secondary emission control system. Secondary emissions are emissions that escape from the primary emission control system through open hoods during the potroom operations (anode changes, tapping molten aluminum, line breaks, and feeding alumina) and through damaged hoods. The gases that escape/leak from the pots are drawn into the overhead Spray Tower Scrubbers (wet scrubbers) on the roofs of the potline building. Each wet scrubber sprays a fine mist of alkaline water in a countercurrent direction to the drafted potroom air. This action removes both hydrogen fluoride and PM from the air stream. Chevron Blade Demisters are used in the top of the wet scrubbers to reduce the quantity of droplets emitted from the scrubbers. The water containing the captured fluoride and PM is routed to the primary wastewater treatment facility. The treated water is recirculated to the wet scrubbers. There are a total of 159 wet scrubbers spaced evenly over the three potlines. Each wet scrubber collects emissions from an average of 4.6 pots. The wet scrubbers are organized into six secondary control groups per potline (located in the north, center, and south sections of Buildings 1 and 2 in each of the three potlines).

The wet scrubbers are less efficient in capturing air pollutants than the dry scrubbers. Approximately 90% of emissions are captured by the dry scrubber system and 10% are captured by the wet scrubbers. Typically, 98% of emissions generated in Intalco's Side-Worked

Prebake (SWPB) pots are captured and ducted to the dry scrubbers and 2% of the emissions are released to the wet scrubbers. The overall capture and control efficiency of the system is 96.9% for fluoride when dry and wet scrubber efficiencies are considered. Fluoride emissions that are not captured by the primary control system (where they are normally recovered and reused) are captured by the roof scrubbers (where they end up in the wet scrubber sludge and are managed as hazardous waste) or are emitted to the ambient air.

The wet scrubber illustrated in **Figure 4** below is one of the 53 wet scrubbers on the roof of Potline A that control secondary emissions from Potline A, and Baghouse Ctr 1 is one of the two primary control system baghouses that control primary emissions from Potline A.

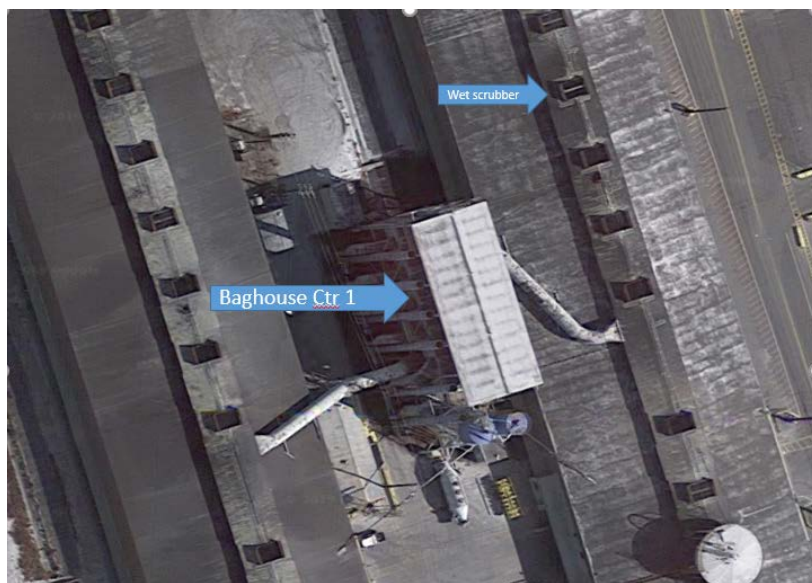


Figure 8: Aerial photo of Parts of the Primary Treatment System in Potlines A and C.

Best Available Retrofit Technology (BART)

The Clean Air Act (CAA) contains requirements that were added in 1977 for the protection of visibility in 156 scenic areas across the United States. States are required to protect and improve visibility in Class I Areas. There are 156 Class I areas, including 47 national parks (under the jurisdiction of the Department of Interior - National Park Service), 108 wilderness areas (under the jurisdiction of the Department of the Interior - Fish and Wildlife Service or the Department of Agriculture - U.S. Forest Service), and one International Park (under the jurisdiction of the Roosevelt Campobello International Park Commission). The Federal Land Managers have regulatory authority over these areas.

Particulate matter (PM) pollution in the air is the major cause of reduced visibility in parts of the United States, including many of our national parks. Visibility is impaired when sunlight encounters tiny pollution particles in the air. Some light is absorbed by particles and other light is scattered away before it reaches an observer. More pollutants mean more absorption and

scattering of light, which reduces the clarity and color of what we see. High concentrations of sulfur dioxide (SO₂) emissions in the air can cause formation of other sulfur oxides (SO_x). SO_x can react with other compounds in the atmosphere to form fine particles. These fine particles scatter more light than other types of particles in the air.

The CAA established a national goal of eliminating man-made visibility impairment from all Class I areas. As part of the plan for achieving this goal, the visibility protection provisions in the CAA mandate that U.S. Environmental Protection Agency (EPA) issue regulations that require states to adopt measures in their State Implementation Plans (SIPs), including long-term strategies, to provide for reasonable progress toward this national goal. The CAA also requires states to coordinate with the Federal Land Managers as they develop their strategies for addressing visibility.

States must require certain existing stationary sources to install best available retrofit technology (BART). The BART provision applies to “major stationary sources” from 26 identified source categories which have the potential to emit 250 tons per year or more of any air pollutant. The BART provision applies to sources that existed on the date the 1977 CAA amendments became effective (August 7, 1977), but had not been in operation as of August 7, 1962.

The CAA required a BART review when any source meeting the criteria above “emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility” in any Class I area. The BART control determination was to consider the costs of compliance, the energy and non-air quality environmental impacts of compliance, any existing pollution control technology in use at the source, the remaining useful life of the source, and the degree of visibility improvement which may reasonably be anticipated from the use of BART.

EPA addressed the visibility in two phases. In 1980, they published regulations (40 CFR 51.300 through 51.307) addressing “reasonably attributable” visibility impairment - the result of emissions from one or few sources that are generally located in close proximity to a specific Class I area. On July 1, 1999, EPA amended those regulations to address the second, more common type of visibility impairment known as “regional haze” – the result of the collective contribution of many sources over a broad region. The regional haze rule slightly modified 40 CFR 51.300 through 51.307, including the addition of a few definitions in § 51.301, and added new sections (51.308 and 51.309). EPA amended the BART requirements (40 CFR 51.308(e)) in 2005. Definitions of terms used in 40 CFR 51.308(e)(1) are found in 40 CFR 51.301.

The regional haze rule codifies and clarifies the BART provisions in the CAA. The rule requires that states identify and list “BART-eligible sources” – sources that fall within the 26 source categories, began operations during the period from 1962 to 1977, and have potential emissions greater than 250 tons per year, determine if those “BART-eligible sources” sources

may “emit any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility.” Under the rule, a source which fits that description is “subject to BART.” States were then required to identify the level of control representing BART for each source subject to BART (40 CFR 51.308(e)(1)(ii)(A)) after considering the best system of continuous emission control technology for each source taking into account the technology available, the costs of compliance, the energy and non-air quality environmental impacts of compliance, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of visibility improvement that may be expected from available control technology.

Intalco, as a Primary Aluminum Ore Reduction facility, falls within one of the 26 source categories subject to BART. A baseline Class I area visibility impact analysis was performed on 100 BART-eligible emission units at Intalco using the CALPUFF model as recommended by the modeling protocol. These sources included Intalco’s three potlines, anode bake furnace, 12 aluminum holding furnaces, various material handling and transfer operations, natural gas, diesel and propane combustion sources, and other small miscellaneous sources. Ecology completed the BART Determination of the Intalco facility in November 2007.

The determination found that Intalco’s emission units, except for the remelt furnace, were subject to BART because they were built between August 7, 1962, and August 7, 1977. Also, Intalco has the potential to emit greater than 250 tons/year of SO₂, NO_x and PM that could contribute to visibility impairment in a Class I area.

The BART Determination found that visibility impacts for the entire facility exceeded the 0.5 deciview (dv) contribution threshold in the following five Class I areas:

- Alpine Lakes Wilderness Area
- Glacier Peak Wilderness Area
- Mount Rainier National Park
- North Cascades National Park
- Olympic National Park (ONP)

The highest modeled facility-wide impact was 1.527 dv in the ONP. The modeled visibility impacts were primarily from the potlines, with a small amount from the anode bake furnace. Other sources contributed negligible amounts.

The visibility impact of the potlines was approximately 1.44 dv in the ONP. The projected impacts in the other, more distant Class I areas were lower. More than 98% of the projected impact from the potlines was attributed to emissions from the potroom primary control devices, with the remainder from the existing potroom wet scrubbers (secondary control

device). More than 96% of the potroom primary control device impact is from emissions of SO₂. Sulfur (from pitch in the anodes) is oxidized, releasing SO₂, as the anodes are consumed during the smelting process.

The guidelines for BART determinations under the Regional Haze Rule recommend consideration of pollution prevention options in addition to add-on controls. The primary opportunity for pollution prevention in the smelting process to minimize SO₂ emissions is through limitations on the sulfur content in the incoming coke. Coke is a major raw material used in the manufacture of green anodes. Green anodes are subsequently baked in a furnace prior to their use in the smelting process.

After a thorough analysis of add on controls and pollution prevention options, Ecology determined that BART for SO₂ was a limit of 3% sulfur in the calcined petroleum coke used to make the anodes. During the BART process, Intalco evaluated the current levels of sulfur in coke used by other aluminum smelters to determine whether a pollution prevention option using lower sulfur content coke would be a feasible BART option. This analysis indicated that certain smelters currently utilize coke with sulfur contents as low as 2%. Given that sulfur contents lower than the current Intalco specification are utilized, Intalco undertook a low sulfur coke availability analysis to determine whether coke at levels below 3% would be available beyond 2013 when BART controls requirements are anticipated.

Based on the market and availability analysis of the future coke supply, Intalco determined that 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 when BART control requirements were anticipated. These same market pressures were expected to force facilities currently using coke with sulfur contents below 3% to begin using higher sulfur content coke in the future. Although coke at sulfur contents below 3% is considered infeasible due to availability concerns, a pollution prevention option that maintains Intalco's current sulfur in coke limit of 3% is considered technically viable or feasible, assuming that sufficient imported lower sulfur coke remains available to allow blending to 3% sulfur content beyond 2013.

BART for the PM and NO_x emitted from the potlines were the existing emission controls. The highest visibility impact was 0.053 dv in ONP, with lower projected impacts in other Class I areas.

Ecology took some limits in Intalco's Title V operating permit into account. Intalco had a number of operational limits that capped allowable emissions of SO₂ from the facility, including: a net potline aluminum production limit of 307,000 ton/yr; a daily potline SO₂ limit of 37,780 pounds per day (lb/day); limits on sulfur in coke and pitch at 3.0% and 0.6%, respectively; and a carbon consumption limit of 0.425 pounds of carbon per pound of aluminum produced.

The visibility impact of anode bake furnaces was 40% (0.02 dv) from SO₂ and 55% (0.03 dv) from NO_x. BART for SO₂ emissions was a limit of 3% sulfur in the coke. BART for NO_x and PM was the existing emission controls.

Additional BART-eligible emission units at the Intalco facility included aluminum holding furnaces, various material handling and transfer operations, natural gas, diesel, and propane combustion, and other small miscellaneous sources that support the primary aluminum ore reduction process. The combined projected impacts from all remaining BART-eligible emission units (sources other than the potlines and anode bake furnace) are less than 0.05 dv in ONP, with lower projected impacts in other Class I areas. Considering the minimal contribution to visibility impairment (less than 0.05 dv) and the existing level of emissions control, these emission sources were excluded from further engineering analysis. BART was determined to be the current controls on those sources.

Ecology determined that:

- BART for SO₂ emissions in the potlines and the anode bake furnaces was the current level of control – a pollution prevention limit of 3% sulfur in the coke used to manufacture anodes.

Use of wet scrubbing technology to reduce potline SO₂ emissions was rejected as BART due to excessive costs: total cost effectiveness of \$7,500 per ton of SO₂ removed, and capital and total annualized costs of \$234.5 million and \$46.8 million per year, respectively. A potline wet scrubber would also have substantial secondary impacts, including increased energy usage of 64,824,000 kWh of electricity per year, added water consumption of 183 million gallons per year, and solid waste generation of 27,000 tons per year.

- BART for PM emissions in the potlines and the anode bake furnaces was the current level of control - use of baghouses to control PM emissions from the alumina dry scrubbers and wet roof scrubbers to control secondary PM emissions from the potroom roofs.
- BART for NO_x emissions from the potlines and the anode bake furnaces - there were no feasible technologies for control of NO_x from the potlines or the anode bake furnaces.

2016 Curtailment

Alcoa split into two companies in 2015, and announced that a full curtailment of the Intalco smelter would begin in February 2016 with only the plant's casthouse continuing to operate. Intalco was scheduled to lay off 465 workers. The curtailment was subsequently postponed until June 2016. On May 2, 2016, Alcoa and the Bonneville Power Administration announced a final power agreement that would allow Intalco to continue to operate through February 2018.

The scheduled curtailment was cancelled on June 19, 2016. However, Intalco had already offered severance packages to their employees when the curtailment was cancelled and this resulted in a significant loss of trained personnel. Intalco has been hiring and training replacement hourly and salary staff since the curtailment was announced. Because of the complexity of Intalco's operations, there is a steep learning curve and Intalco is experiencing high staff turnover. The new staff are not proficient in performing the potline operations which affects pot operation and maintenance and potentially contributes to increases in some emissions. This resulted in a number of permit violations.

The ongoing point feed conversion project will improve facility's greenhouse gas (GHG) emissions but is not expected to reduce SO₂ emissions. The facility is also taking steps to reduce the number of permit violations for other pollutants like PM and TF. Those reductions will not impact SO₂ emission levels.

2020 Curtailment

On April 22, 2020, the Intalco facility announced that it would curtail its operations and stop aluminum production by July 2020, due to the market conditions. Curtailment is different from the facility ceasing operations. A curtailed facility often maintains its permits in order to be able to restart its operations should the market conditions improve. The active permits must comply with the NAAQS and meet other applicable state and federal requirements. However, the facility may exit voluntary agreements.

On April 23, 2020, Ecology received a 30-day written "null and void" notice from the facility about the Agreed Order No. 16449, an agreement to address elevated SO₂ levels recorded near the smelter in recent years. Under the agreement, should EPA designate the area as nonattainment, Intalco was to install a piece of equipment called a wet scrubber in 2022. The scrubber would then capture and remove the SO₂ before it is released into the air. The notice explains that the Intalco facility would not be proceeding with the plan to install new air pollution control equipment to reduce SO₂ emissions due to the curtailment and cites the following language in the Section 4 of the Order, Changed Business Conditions:

"Notwithstanding anything else in this Order, in the event that Intalco announces the closure or curtailment of one of its three potlines (A, B, or C line, or any combination or equivalent measure thereof), then upon thirty days' prior written notice to Ecology, this Order and Intalco's obligations hereunder will become null and void."

As part of the public review process, Ecology collected and responded to the public feedback when the Order was first proposed. The Response to Comments provides additional insights into the SO₂ data and analysis in the area and is included, together with the "null and void" notice, in **Appendix D. Response to Comments. Intalco Aluminum Corporation. Air Quality Agreed Order No. 16499 (PDF)**. The order can also be accessed online .