Wingra Engineering, S.C.
Environmental Engineering Consultants

January 27, 2021

National Parks Conservation Association
Clean Air and Climate Program
Attn: Stephanie Kodish, Senior Director & Counsel
777 6th Street NW, Suite 700
Washington, DC 20001-3723

Subject: Four-Factor Reasonable Progress Analysis
Ardagh Glass, Inc.
Seattle, Washington

Dear Ms. Kodish:

The National Parks Conservation Association requested the preparation of a Four-Factor Reasonable Progress Analysis for Ardagh Glass, Inc. in Seattle, Washington. This analysis evaluates the feasibility of installing emission control equipment for air pollutants which are precursors to regional haze. The enclosed report describes the procedures and results of this analysis.

Should you have further questions, please contact me at (608) 255-5030.

Sincerely,

Wingra Engineering, S.C.

Steven Klafka, P.E., BCEE
Environmental Engineer

Enclosure

303 South Paterson Street, Madison, WI 53703, (608) 255-5030, (fax) 255-5042, www.wingraengineering.com

Ardagh Glass, Inc.

Seattle, Washington

Four-Factor Reasonable Progress Analysis

January 27, 2021

Prepared by:

Steven Klafka, P.E., BCEE

Wingra Engineering, S.C.

Madison, Wisconsin

1.0 INTRODUCTION

In 2010, Washington Department of Ecology (DOE/WDOE) updated its regional haze state implement plan to improve visibility in certain national parks and wilderness areas in the state.[1] These are referred to as Class I areas for implementation of air pollution protection regulations and include the following:

- Alpine Lakes Wilderness
- Glacier Peak Wilderness
- Goat Rocks Wilderness
- Mt. Adams Wilderness
- Mt. Rainier National Park
- North Cascades National Park
- Olympic National Park
- Pasayten Wilderness

Figure 1 is a WDOE map showing the location of these areas.[2]

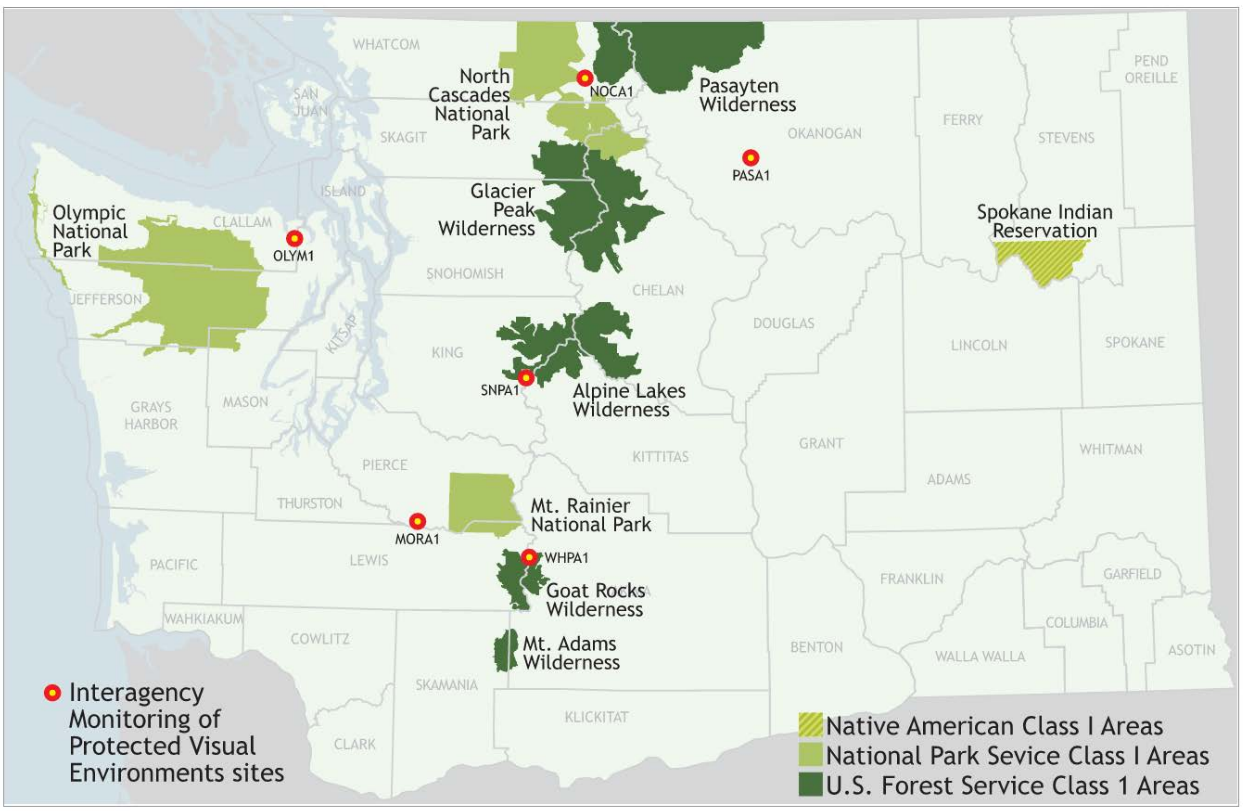

Figure 1 - Washington State Class I Areas

---

[1] Department of Ecology, State of Washington, Regional Haze, State Implementation Plan, Final December 2010

[2] https://ecology.wa.gov/Air-Climate/Air-quality/Air-quality-targets/Regional-haze

The DOE regional haze state implementation plan is evaluating the retrofit of emission control technology at large industrial sources to make reasonable progress toward natural conditions in Class 1 areas. To determine the effectiveness of retrofitting emissions control technology, USEPA requires states to use a Four-Factor Reasonable Progress Analysis (FFA). In its background document for this analysis, WDOE states:

Consider the costs of compliance, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance, and the remaining useful life of any potentially affected sources, and include a demonstration showing how these factors were taken into consideration in selecting the goal (40 CFR 51.308(d)(1)(i)(A)). This four factor analysis is used to identify controls necessary to meet the reasonable progress goals for each mandatory Class 1 area (CIA).

Therefore, the four statutory factors are:

- Costs of compliance
- Time necessary for compliance
- Energy and non-air quality impacts of compliance
- Remaining useful life of any potentially affected sources

This report presents an FFA for Ardagh Glass, Inc. located in Seattle, Washington. DOE has identified this industrial facility has potentially having impacts on regional haze at surrounding Class I areas.

2.0 FACILITY DESCRIPTION

Ardagh Glass, Inc. is located at 5801 East Marginal Way S. in Seattle, King County, Washington. It manufactures glass containers. It was issued Air Operating Permit No. 11656 on June 6, 2007. Specifications for the air pollution sources at the plant are taken from this operating permit and the Statement of Basis for Administrative Amendment 5-31-17 (SOB) which provides a description of activities and a compliance history for the plant. Both documents were obtained from the Puget Sound Clean Air Agency.[3]

The closest Class I areas to Ardagh include the following:

- Olympic National Park
- Alpine Lakes Wilderness
- Mount Rainier National Park
- Glacier Peak Wilderness
- Goat Rocks Wilderness

[3] https://www.pscleanair.gov/182/List-of-Approved-Permits

In its regional haze plan, DOE modeled facilities that were within 300 km of Class I areas to determine if they had a significant impact these areas. The closest Class I area to Ardagh is the Alpine Lakes Wilderness at 53.5 km. All of the Class I areas are within the 300 km distance from Ardagh.

While there are numerous air pollution sources at glass manufacturing plants, the largest sources are the fossil fuel-fired furnaces which melt glass. At the Ardagh plant, there are five furnaces. No. 1 is an all-electric furnace; No. 2, No. 3 and No. 5 furnaces are oxy-fuel fired; and, No. 4 is an end-port regenerative furnace.

For the No. 1 glass furnace, DOE states that the company does not have any reported emissions from this electric furnace and it vents through the roof and normally has no visible emissions, but is capable of emitting visible emissions from the furnace during upset conditions. It will be assumed for this analysis that there are no significant emissions from this furnace and its emissions will not be considered.

Specifications for the remaining furnaces are provided in Table 1. The actual daily production melt rates are taken from the Puget Sound Clean Air Agency SOB and come from 1994 source tests. Current emission inventory reports only provide annual production rates. If 1994 are the last source tests, it is recommended that DOE require new stack tests to verify current actual emission rates.

The full production capacity of each furnace provided by the SOB is also summarized in Table 1.

Table 1 - Ardagh Glass Furnace Specifications

Glass Melting Furnace	Tested Melt Rate	Capacity Melt Rate
	(tons per day)	(tons per day)
No. 2	144.6	195
No. 3	166.8	160
No. 4	131.3	430
No. 5	130.7	205
Total	573.4	990

Table 2 provides the annual actual emissions from the Ardagh plant as reported in its emissions inventory submitted to DOE.[4] The air pollutants evaluated include nitrogen oxides (NO_x), sulfur dioxide (SO_2) and particulate matter (PM). The actual emissions can be used to estimate the cost effectiveness of emission control equipment in an FFA.

[4] Department of Ecology, State of Washington, Air emissions inventory summaries, https://ecology.wa.gov/Air-limate/Air-quality/Air-quality-targets/Air-emissions-inventory

Furnaces Nos. 2, 3 and 5 are oxy-fuel fired. This combustion technique would reduce the formation of NO_x. It is assumed that any NO_x emission reductions due to this technique are already incorporated into the reported actual emissions summarized in Table 2. The DOE SOB indicates Furnace No. 5 was equipped with a Tri-Mer Cloud Mist Scrubber in approximately 2009. This scrubber would capture the SO_2 and PM emissions. It is assumed that the reported actual emissions incorporate any emission reductions due to the use of the mist scrubber.

Table 2 - Ardagh Actual Emissions

Reporting	NO_x	SO_2	PM_{10}	Total
2012	227.1	61.4	75.2	363.7
2013	166.5	73.3	92.8	332.6
2014	172.1	105.9	73.2	351.2
2016	153.7	98.7	95.3	347.6
2017	153.3	98.7	88.2	340.2
2018	167.6	89.9	82.2	339.7
Maximum	-	-	-	351.2

Table 3 provides the annual potential, legally enforceable emissions from the Ardagh plant. It is a common practice in air pollution control, especially for a Best Available Control Technology analysis following the federal Prevention of Significant Deterioration regulations, to estimate the cost effectiveness of air pollution control equipment based on 100% capacity and the potential emissions. As shown in Table 2, actual annual emissions vary with annual production. Looking at historical emission inventory reports, total emissions have been as high as 700.7 tpy in 2008. Based on the Ardagh air quality operating permit, there is no limitation on annual production. Actual emissions are approved as long as they remain below the potential emissions approved by the operating permit. Potential emissions, in addition to actual emissions, can be used to estimate the cost effectiveness of emission control equipment in an FFA.

Table 3 - Ardagh Potential Emissions

Glass Melting Furnace	Capacity (tons per day)	Air Pollutant	Limitation (lbs/ton)	Limitation (tpy)
No. 2	195	NO_x	3.8	135
		SO_2	1.6	57
		PM	1.0	36
No. 3	160	NO_x	3.8	111
		SO_2	1.6	47
		PM	1.0	29
No. 4	430	NO_x	3.8	298
		SO_2	1.6	126
		PM	1.0	78
No. 5	205	NO_x	3.8	142
		SO_2	1.6	60
		PM	1.0	37
Total	990	NO_x	-	687
		SO_2	-	289
		PM	-	181
		All	-	1,156

3.0 FOUR-FACTOR ANALYSIS

The four factors included in this analysis are:

- Costs of compliance
- Time necessary for compliance
- Energy and non-air quality impacts of compliance
- Remaining useful life of any potentially affected sources

Each of these factors are evaluated for the Ardagh plant.

3.1 Costs of Compliance

The emissions from the Ardagh furnaces which need to be controlled are NO_x, SO_2 and PM. Historically, these pollutants were controlled using separate air pollution control systems due to their physical and chemical properties. NO_x emission control requires changes in the combustion conditions that form NO_x from N_2 at high temperatures, or use ammonia or urea injection to react with the NO_x to form N_2 as the reaction product. SO_2 emissions require wet or dry injection of a chemical to react with and neutralize this pollutant. PM emissions are solids which requires capture by filtering or agglomeration into larger particles using water sprays.

Furnace No. 1 at the Ardagh plant is electrically heated. Puget Sound concluded there were no emissions from this furnace except during upsets. If this is true, then changing the other four furnaces from fossil fuel-fired to electrically heated is an emission control option that DOE should evaluate. Glass furnaces are rebuilt every 10 to 20 years. The next rebuilt would be an appropriate time to change the heating method.

A common resource to determine the latest control methods for an industry is the *BACT Clearinghouse* operating by the United States Environmental Protection Agency (USEPA).[5] This website lists the most recent results of Best Available Control Technology analyses for air pollution permits issued to major source under the Prevention of Significant Determination. For glass manufacturing, the website provides only two entries during the past 10 years. These include the 700 ton per day flat glass plant approved for Cardinal FG Company in Winlock, Washington. As BACT, the glass furnace was equipped with a spray drier scrubber for SO_2 control, ESP to capture PM, and use of the *3R Process* combustion modifications to reduce NO_x emissions. The second project was 18 furnaces for the production of high purity glass at the Corning Incorporated plant in Canton, New York. BACT for NO_x emissions was determined to be the use of oxygen-fired combustion to minimize the formation of NO_x.

There have been additional emission control projects in the U.S. which have not been subject to the PSD regulations so are not documented in the BACT Clearinghouse. These also provide insight into demonstrated emission control methods.

In 2010, USEPA reached a settlement with Saint Gobain Containers Inc. over violations of the Clean Air Act at their container glass plants.[6] The settlement required the installation of new emission control systems for NO_x including the use of an Oxyfuel Furnace, Oxygen Enriched Air Staging (OEAS) and Selective Catalytic Reduction (SCR); new emission control systems for SO_2 including semi-dry scrubbers, dry scrubbers, cloud chamber scrubber systems and process controls; and, new emission control systems for PM including cloud chamber scrubber systems, electrostatic precipitators, or process controls. Ardagh Glass Inc. later purchased some of the Saint Gobain plants included in the USEPA settlement. These plants included the Seattle facility. In the settlement, this plant was required to use oxyfuel to reduce NO_x emissions from Furnaces No. 3 and 5 and install a cloud chamber scrubber system to reduce SO_2 and PM emissions from Furnace No. 5.

In 2015, USEPA reached a settlement with Guardian Industries Corporation over violations of the Clean Air Act at their flat glass plants.[7] Guardian was required to install new emission controls for NO_x, SO_2 and PM including selective catalytic reduction, dry scrubbing and dust capture

[5] https://www.epa.gov/catc/ractbactlaer-clearinghouse-rblc-basic-information
[6] https://www.epa.gov/enforcement/saint-gobain-containers-inc-clean-air-act-settlement
[7] https://www.epa.gov/enforcement/guardian-industries-corp-clean-air-act-settlement

equipment. For some plants, Guardian chose to use a new emission control technology which has been demonstrated to simultaneously control NO_x, SO_2 and PM emissions from glass plants. This technology uses catalytic ceramic filters in combination with ammonia injection for NO_x control and reagent injection for SO_2 control. PM is captured on the surface of the ceramic filters.

In 2015, Cardinal FG Company began a voluntarily program to install additional control equipment to reduce it flat glass plant emissions. At three existing flat glass plants already equipped with spray drier – ESP control systems for SO_2 and PM control, an additional Selective Catalytic Reduction or SCR system for NO_x control would be installed. At two existing flat glass plants using the *3R Process* for NO_x control, the new catalytic ceramic filter control system has been installed. Compliance testing of catalytic ceramic filter systems show they are achieving the lowest emission levels for NO_x, SO_2 and PM combined at existing glass plants. Based on the system quotation used for this analysis, the guaranteed control efficiencies for these air pollutants are 90%, 75% and 95.8%, respectively.

The two catalytic ceramic filter installations at Cardinal FG were manufactured by the Tri-Mer Corporation. Table 4 summarizes glass plant installations of the catalytic ceramic control system by Tri-Mer. It is noteworthy that one of the installations is the Ardagh Glass container plant in Dolton, Illinois. This makes this type of system an excellent option to consider for controlling the emission of these pollutants from the Ardagh plant in Seattle. Based on the success of the catalytic ceramic filter systems at existing glass plants, it will be used for the FFA for the Ardagh plant in Seattle.

Table 4 - Tri-Mer Filter Projects in U.S.

Company	Location	Glass Type
Durand	Millville, NJ	Tableware
Anchor	Monaca, PA	Mixed
AGC	Church Hill, TN	Flat
Gallo	Modesto, CA	Container
AGC	Hill, KS	Flat
Adagh	Dolton, IL	Container
Kohler	Kohler, WI	Specialty
Guardian	Carleton, MI	Flat
PG Corporation	L.A. Basin	Specialty
Cardinal FG	Mooresville, NC	Flat
Cardinal FG	Durant, OK	Flat

For typical BACT analyses, order-of-magnitude cost estimates are typically generated.[8] The cost estimate is improved if it incorporates actual vendor quotations for the required equipment. A prior quotation for a catalytic ceramic filter system was available for one of the Cardinal FG plants. Like the Ardagh plant, the cost estimate reflects the retrofit of a new control system at an existing

[8] USEPA, Air Pollution Control Manual, Sixth Edition, EPA/452/B-02-001 January 2002.

industrial facility. These capital, installation and operating costs were adjusted to reflect the differences between the Cardinal and Ardagh plants. The development of this cost estimate is provided in the supporting calculations of Appendix A.

As previously noted, BACT analyses are typically based on full capacity and potential emissions. For Ardagh, cost estimates were developed for both actual and potential production and emissions. The actual cost estimate is based on reported emissions and incorporates any existing air pollution control measures on the four glass furnaces at Ardagh. The potential cost estimate reflects the production capacity and emissions approved for the four glass furnaces.

Table 5 presents a summary of the cost estimate for the Ardagh plant. Because the catalytic ceramic filter system is a multi-pollutant control technology, cost effectiveness was calculated based on the total expected emission reductions in NO_x, SO_2, and PM emissions. The cost effectiveness for actual conditions is $4,766 per ton of total air pollutants removed and for potential conditions is $2,238 per ton of total air pollutants removed. Both of these values are well within the cost effectiveness level considered reasonable in prior BACT and control equipment analyses by regulatory agencies. It is not unusual for $10,000 per ton of pollutant removed to be considered acceptable. In correspondence with DOE staff on this topic, they provided reasonable cost example values for actual and potential emissions of $5,250 and 4,000 per ton, respectively.[9] The estimates for Ardagh are within these values. It is concluded that the installation of a catalytic ceramic filter system at the Ardagh plant in Seattle would be considered a reasonable expense.

This analysis is more accurate than one based on order-of-magnitude cost estimates. However, it would be improved if a budget quotation were obtained for the plant.

3.2 Time necessary for compliance

Based on prior projects, the time frame to obtain a quotation for a catalytic ceramic filter, issue a purchase order, complete engineering, construct and install the equipment is 12 months. Furnace No. 5 at the Seattle plant is equipped with a Cloud Mist Scrubber manufactured by Tri-Mer. Additionally, the plant in Dolton, Illinois is equipped with a catalytic ceramic filter system manufactured by Tri-Mer. The familiarity of Ardagh staff with Tri-Mer products would improve the ability to obtain a quotation and installation of a new control system at the Seattle plant.

[9] Email, P. Gent – WDOE to S. Klafka – Wingra Engineering, Regional haze four-factor analysis for Ardagh Glass, Inc., January 19, 2021.

Table 5 - Cost Estimate for Catalytic Ceramic Filter System to Control Actual and Potential Emissions from Ardagh Glass, Inc.

Basis	Actual	Potential
Capacity (tpd)	573.4	990
Capital Costs	$11,866,967	$16,468,204
Annual Capital Costs	$816,210	$1,132,683
Annual Operating Costs	$330,980	$700,622
Annual Capital and Operating Costs	$1,147,190	$1,833,305
Inlet NO_x (tpy)	172	687
Inlet SO_2 (tpy)	106	289
Inlet PM (tpy)	73	181
Inlet Total NO_x, SO_2 and PM (tpy)	351	1,156
Outlet NO_x (tpy)	17	69
Outlet SO_2 (tpy)	26	72
Outlet PM (tpy)	3	8
Outlet Total NO_x, SO_2 and PM (tpy)	47	148
Removed NO_x (tpy)	155	618
Removed SO_2 (tpy)	79	217
Removed PM (tpy)	70	173
Removed Total NO_x, SO_2 and PM (tpy)	304	1,008
Cost Effectiveness ($ per Total Ton removed)	$3,768	$1,819

3.3 Energy and non-air quality impacts of compliance

Significant operating costs in order of magnitude include electricity, ammonia reagent, hydrated lime reagent and labor. These costs are taken into account in the enclosed cost estimates. The cost estimates provided in this report incorporate electricity usage for control system fans.

The cost estimates adjust ammonia reagent consumption rates based on the anticipated actual and potential emissions. The ammonia selected for the control of NO_x emissions is 19% aqueous ammonia. This is a less concentrated and safer alternative to anhydrous ammonia. This type of ammonia has no federal requirement to evaluate the potential impacts of an accidental release.

The cost estimates adjust hydrated lime consumption rates based on the anticipated actual and potential emissions. The calcium sulfate formed by the reaction of hydrated lime with SO_2 will be captured as dust by the ceramic filters. Calcium sulfate is a raw material in glass making and it is common practice to recycle the captured dust to the glass furnace. The cost estimates provided with this report includes the cost of a recycling system for 100% of the dust. This system avoids waste disposal impacts and costs.

3.4 Remaining useful life of any potentially affected sources

It is common practice in the glass industry to rebuild glass furnaces after their refractory has completed its useful life. This may last 10 to 20 years. It is not clear from the available DOE background documents how long a glass factory has been in the location of Ardagh. A history of glass container manufacturing suggests there has been a Ardagh connected plant in Seattle since 1931.[10] This would suggest there have been numerous new and rebuilt furnaces, and a new control system at the Ardagh plant would continue to operate for its entire useful life. As previously discussed with available emission control options, the time when a glass furnace is rebuilt would be an appropriate time to consider changing from a fossil fuel-fired furnace to one that is electrically heated and eliminating the emissions associated with regional haze.

4.0 CONCLUSIONS

It is technically feasible to add additional emission controls to the Ardagh Glass Inc. plant in Seattle and further reduce its air pollution emissions of NO_x, SO_2 and PM which contribute to regional haze. The catalytic ceramic control system evaluated in the enclosed FFA has been installed on other glass plants, including Ardagh's own plant in Illinois.

The existing Seattle plant does have some control measures in place. Furnace Nos. 2, 3 and 5 are oxy-fuel fired to reduce their NO_x emissions and Furnace Nos. 3 and 5 are equipped with a cloud mist control system to reduce SO_2 and PM emissions. Nevertheless, the residual emissions can be controlled further by the use of the catalytic ceramic control system.

Based on actual and potential emissions, the enclosed cost estimates show that the new control system would have a cost effectiveness of $3,768 and $1,819 per ton of total air pollutants removed, respectively. Both of these values represent a reasonable expenditure for the reduction of NO_x, SO_2 and PM emissions.

[10] https://glassbottlemarks.com/ball-bros-glass-company/

Appendix A

Supporting Cost Calculations

	Reference	Original	Reference	Original	Reference	Ardagh	Reference	Ardagh
Basis		Potential		Potential		Actual		Potential
Capacity (tpd)	Quotation	700		700	2017 DOE SOB	573.4	2017 DOE SOB	990
Inlet NOx (lbs/ton)	Quotation	18.0		18.0			2017 DOE SOB	3.8
Inlet SO2 (lbs/ton)	Quotation	4.0		4.0			2017 DOE SOB	1.6
Inlet PM (lbs/ton)	Quotation	1.2		1.2			2017 DOE SOB	1
Inlet NOx (tpy)	Calculated	2,299.5		2,299.5	2014 Inventory	172.1	Calculated	686.6
Inlet SO2 (tpy)	Calculated	511.0		511.0	2014 Inventory	105.9	Calculated	289.1
Inlet PM (tpy)	Calculated	153.3		153.3	2014 Inventory	73.2	Calculated	180.7
NOx Removal (%)	IN vs OUT	90.0%		90.0%	Same as Original	90.0%	Same as Original	90.0%
SO2 Removal (%)	IN vs OUT	75.0%		75.0%	Same as Original	75.0%	Same as Original	75.0%
PM Removal (%)	IN vs OUT	95.8%		95.8%	Same as Original	95.8%	Same as Original	95.8%
Outlet NOx (lbs/ton)	Quotation	1.8		1.8			Calculated	0.38
Outlet SO2 (lbs/ton)	Quotation	1.0		1.0			Calculated	0.40
Outlet PM (lbs/ton)	Quotation	0.1		0.1			Calculated	0.04
Outlet NOx (tpy)	Calculated	230.0		230.0	Calculated	17.2	Calculated	68.7
Outlet SO2 (tpy)	Calculated	127.8		127.8	Calculated	26.5	Calculated	72.3
Outlet PM (tpy)	Calculated	6.4		6.4	Calculated	3.1	Calculated	7.5
Removed NOx (tpy)	Calculated	2,069.6		2,069.6	Calculated	154.9	Calculated	617.9
Removed SO2 (tpy)	Calculated	383.3		383.3	Calculated	79.4	Calculated	216.8
Removed PM (tpy)	Calculated	146.9		146.9	Calculated	70.2	Calculated	173.1
Removed NOx, SO2 and PM (tpy)	Calculated	2,599.7		2,599.7	Calculated	304.5	Calculated	1,007.9
Capital Costs		Original (2015)	Inflation	Original (2020)	Adjustment Method	Actual Basis	Adjustment Method	Potential Basis
Complete System Equipment and Installation		$12,159,935	1.10	$13,375,929	Six-Tenths by Capacity	$11,866,967	Six-Tenths by Capacity	$16,468,204
Capital Recovery Factor (CRF)	CRF (20 yrs, 3.25%)	0.06878	CRF (20 yrs, 3.25%)		CRF (20 yrs, 3.25%)	0.06878	CRF (20 yrs, 3.25%)	0.06878
		$836,360				$816,210		$1,132,683
Operating Costs								
Electricity		188953	1.10	$207,848	Ratio by Capacity	$170,257	Ratio by Capacity	$293,957
19% Aqueous Ammonia		665665	1.10	$732,232	Ratio by Inlet NOx	$54,802	Ratio by Inlet NOx	$218,623
Hydrated Lime		361,810	1.10	$397,991	Ratio by Inlet SO2	$29,787	Ratio by Inlet SO2	$118,829
Labor for Operation and Maintenance		69,213	1.10	$76,134	No Change	76,134	No Change	69,213
Annual Operating Costs		1,285,641				330,980		700,622
Capital Costs		$12,159,935				$11,866,967		$16,468,204
Annual Capital Costs		$836,360				$816,210		$1,132,683
Annual Operating Costs		$1,285,641				$330,980		$700,622
Annual Capital and Operating Costs		$2,122,001				$1,147,190		$1,833,305
Inlet NOx (tpy)		2,300				172		687
Inlet SO2 (tpy)		511				106		289
Inlet PM (tpy)		153				73		181
Inlet NOx, SO2 and PM (tpy)		2,964				351		1,156
Outlet NOx (tpy)		230				17		69
Outlet SO2 (tpy)		128				26		72
Outlet PM (tpy)		6				3		8
Outlet NOx, SO2 and PM (tpy)		364				47		148
Removed NOx (tpy)		2,070				155		618
Removed SO2 (tpy)		383				79		217
Removed PM (tpy)		147				70		173
Removed NOx, SO2 and PM (tpy)		2,600				304		1,008
Cost Effectiveness ($ per ton removed)		$816				$3,768		$1,819

Notes:

Complete System Equipment and Installation includes: emission control system, controls, infrastructure, engineering design and project management, installation, services, batch recycle system, ammonia tank shelter.

Inflation multiplier from November 2015 to December 2020 = 1.10 - https://www.bls.gov/data/inflation_calculator.htm

Capital Recover Factor based on lifetime of operation and % interest from DOE, Four-Factor Analysis, https://ecology.wa.gov/Air-Climate/Air-quality/Air-quality-targets/Regional-haze

Last Page