Chemical Products Corporation

BART-Eligible Source §51.303(a)(2) Exemption Modeling

CALPUFF Modeling Report (4-km Grid)

Cartersville, Georgia (Bartow County)

November 2008 Update

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Chemical Products Corporation
VISTAS BART CALPUFF (4-km) Modeling Report

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1. Introduction

Chemical Products Corporation ("CPC") operates an inorganic chemical manufacturing plant in Cartersville, Georgia and primarily processes barite ore (barium sulfate) and celestite ore (strontium sulfate) into finished products such as barium carbonate, barium chloride, strontium carbonate and strontium nitrate. These chemicals are produced using a number of different types of heated process equipment such as reduction kilns and various types of dryers. CPC also owns a furnace that has been used in the production of sodium silicate glass. Along with the primary products, CPC produces several secondary products such as barium metaborate, elemental sulfur, sodium hydrosulfide, sodium sulfide, ammonium sulfide, dry calcium carbonates and charcoal. CPC is a major source with respect to the Part 70 (Title V) operating permit program and operates under Georgia Title V Permit No. 2819-015-0008-V-02-0, as amended May 1, 2007 (V-02-1).

In 1999, the US EPA published a final rule to address a type of visibility impairment known as "regional haze" (64 FR 35714) in 156 Federally-protected national parks and wilderness areas ("mandatory Class I Federal Areas", or just "Class I Areas"). The Regional Haze Rule requires the evaluation of the best available retrofit technology (BART) for certain major stationary sources defined as "BART-eligible" which are those sources which have the potential-to-emit 250 tons per year (tpy) of one or more visibility-impairing air pollutants, were "in existence" before August 7, 1977 but began operation after August 7, 1962, and whose operations fall within one or more of 26 specific source categories; chemical processing plants are one of the listed source categories, and include process units and support facilities that are considered to be part of major Standard Industrial Classification 28, Chemicals and Allied Products. BART is required for "BART-eligible sources" if is it determined that the source emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility in a Class I Area.

According to US EPA guidelines for BART determinations under the Regional Haze Rule (70 FR 39104), dispersion modeling can be used to determine if an individual source can reasonably be anticipated to cause or contribute to visibility impairment in a Class I area and is thus not subject to BART. A BART-eligible source that is responsible for a 0.5 deciview (dv) change or more from natural background conditions is considered to "contribute" to visibility impairment in a Class I area while a BART-eligible source that is responsible for a 1.0 dv change or more natural background conditions is considered to "cause" a visibility impairment in a Class I area. The Visibility Improvement State and Tribal Association of the Southeast (VISTAS) Regional Planning Organization (RPO) requires the application of the CALPUFF modeling system for carrying out air quality modeling in support of BART determinations using the maximum actual 24-hr emissions rates of NOx, SO2, and PM10. The VISTAS application of CALPUFF for BART determinations uses a two-tier approach: (1) initial exemption modeling using 12-km grid CALMET data and (2) finer resolution exclusion modeling using 4-km grid or smaller CALMET data.

Chemical Products Corporation has six emission units that comprise the BART-eligible source because the units operate at a chemical processing facility, were in existence on August 7, 1977, and began operation after August 7, 1962 and have the potential-to emit greater than 250 tpy of at least one visibility-impairing pollutant. To avoid the requirements of BART, CPC has a federally enforceable permit limitation on SO2 emissions of less than 250 tpy during any 12 consecutive month period from the six BART-eligible emissions units until such time that exemption modeling conducted in accordance with 40 CFR §51.303(a)(2) demonstrates that it cannot be reasonably be anticipated to cause or contribute to visibility impairment in a Class I Area. Periodic monitoring, recordkeeping and reporting requirements required to

demonstrate compliance with the 250 tpy SO2 BART avoidance limitation may be voided if Chemical Products Corporation can demonstrate that it is exempt from the requirements of BART.

Initial 12-km grid BART exemption modeling was conducted on behalf of CPC through funding provided by the Visibility Improvement State and Tribal Association of the Southeast (VISTAS). Now, CPC has now conducted finer 4-km grid BART exclusion modeling on its own, in conjunction with Smith Aldridge, Inc. In addition to the better grid resolution and the introduction of MM5 observational data, several other modeling refinements enhance the accuracy of the finer 4-km grid modeling, including the use of the higher resolution terrain data in defining the terrain fields and application of the ammonia limiting method to repartition NO3/HNO3 in the POSTUTIL post-processor for heavy NOx sources.

1.1. Objectives. The purpose of this report is to (a) document the procedures that were used for the application of the CALPUFF modeling system for finer grid (4-km) BART exclusion modeling for the Chemical Products Corporation BART-eligible source and (b) to report the results of long range transport dispersion modeling conducted to show that the Chemical Products Corporation BART-eligible source does not emit any air pollutants in an amount which may reasonably be anticipated to contribute to a visibility impairment in a Class I Area.

1.2. GA EPD, EPA, and Federal Land Manager Protocol Review Period and Comment. The original Chemical Products Corporation VISTAS BART CALPUFF modeling protocol was submitted to the Georgia Environmental Protection Division (GA EPD) Data and Modeling Unit (DMU) for comment on July 15, 2008. The GA EPD DMU subsequently forwarded the protocol to officials at US EPA Region 4, the US Department of Agriculture Forest Service Air Resources Management Division, and US Department of Interior National Park Service Air Resources Branch on July 24, 2008 to solicit comments. After a 60 day review period, GA EPD DMU provided a full set of state, EPA and FLM comments to Chemical Products Corporation on October 16, 2008 which have been incorporated into this revised protocol.

1.3. Location of Source vs. Relevant Class I Areas. The VISTAS BART Modeling Protocol specifies that all Class I Areas within 300 km of a BART-eligible source must be evaluated to determine whether the source contributes to visibility impairment. Figure 1-1 and Table 1-1 summarize the distances separating the CPC BART-eligible source from mandatory Class I Federal Areas within 300 km, plus Linville Gorge.

Table 1-1 Distances Separating Chemical Products Corporation and Class I Areas within 300 km Radius

Cohutta Wilderness Area	Great Smoky Mountains National Park	Joyce-Kilmer Wilderness Area	Sipsey Wilderness Area	Shining Rock Wilderness Area	Linville Gorge Wilderness Area
78.9 km	167.0 km	153.4 km	237.3 km	217.4 km	321.1 km

Distances determined from Chemical Products Corporation (Latitude 34° 09′ 03″ N, Longitude 84° 46′ 09″ W) to closest receptor in each Class I Area.

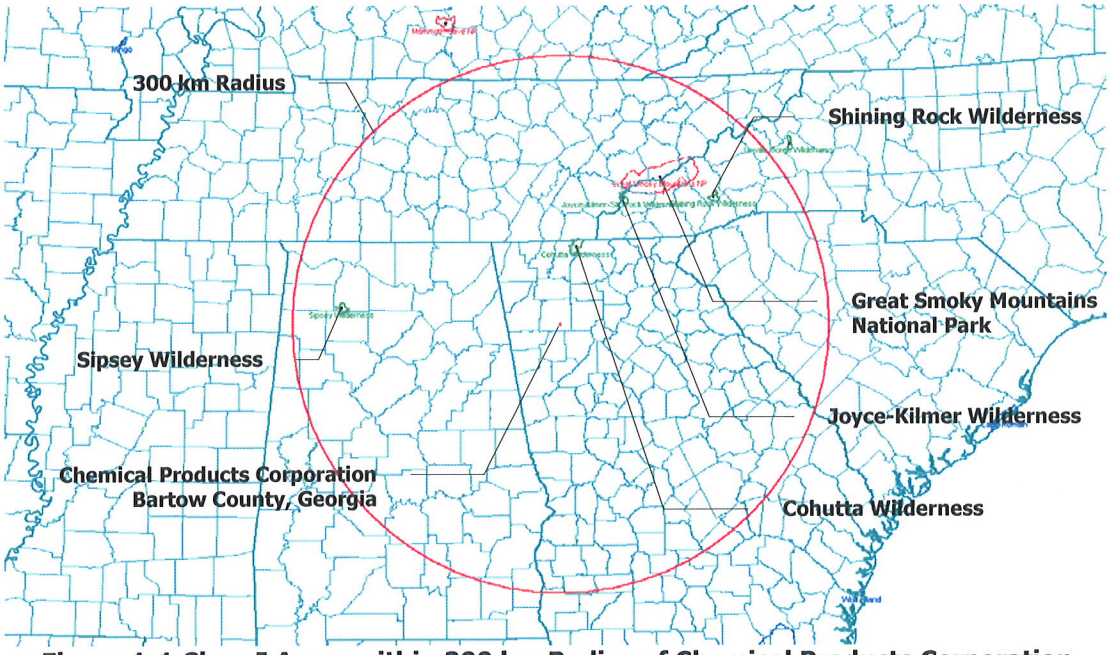

Figure 1-1 Class I Areas within 300 km Radius of Chemical Products Corporation
(Latitude 34° 09′ 03″ N, Longitude 84° 46′ 09″ W)

1.4. Source Impact Evaluation Criteria.

1.4.1. *BART Exclusion Modeling (4-km Grid).* For 4-km grid BART exclusion modeling, a BART-eligible source is considered to cause or contribute to visibility impairment in a Class I Area if the 98th percentile 24-hr average predicted change in the haze index over a three-year period exceeds 0.5 dv from natural background conditions. The 98th percentile 24-hr average predicted impact is the greatest of the three annual highest 8th-high or highest 22nd-high predicted change over the entire three year period, whichever is greater, per EPA BART guidelines and the VISTAS BART common modeling protocol.

Haze is caused 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 reduce the clarity and color of what we see. Some types of particles such as sulfates, scatter more light, particularly during humid conditions. The predicted change in haze is measured by calculating natural light extinction (b_{ext}) which is used to represent the haze index (HI), expressed in dv. The haze index is calculated using the following equation,

$$HI = 10 \ln\left(\frac{b_{ext}}{10}\right),$$

The change in light extinction is affected by various chemical species and the Rayleigh scattering phenomenon and can be calculated using the traditional IMPROVE methodology as shown in the following equation,

$$b_{ext} = \underbrace{3f(RH)[(NH_4)_2SO_4]}_{\text{Ammonium Sulfates}} + \underbrace{3f(RH)[NH_4NO_3]}_{\text{Ammonium Nitrates}} + \underbrace{4[OC]}_{\substack{\text{Condesable}\\ \text{Organic PM}}} + \underbrace{[Soil]}_{\substack{\text{Filterable}\\ \text{Fine PM}\\ PM_{2.5}}} + \underbrace{0.6[PMC]}_{\substack{\text{Filterable}\\ \text{Coarse PM}\\ PM_{10-2.5}}} + \underbrace{10[EC]}_{\substack{\text{Filterable}\\ \text{Elemental}\\ \text{Carbon}}} + \underbrace{b_{ray}}_{\substack{\text{Rayleigh}\\ \text{Scattering}}}$$

The concentrations, in square brackets, are in micrograms per cubic meter (ug/m^3) and b_{ext} is in units of inverse megameters (Mm^{-1}). The Rayleigh scattering term (b_{ray}) has a default value of 10 Mm^{-1}, as recommended in EPA guidance for tracking reasonable progress.

2. Chemical Products Corporation BART-Eligible Source Description

2.1. CPC BART-Eligible Source Emissions Units. Table 2-1 provides a summary of the applicability criteria for the six emissions units that comprise the BART-eligible source at Chemical Products Corporation. Potential emissions for NOx, SO2 and PM10 are determined from permitting emissions limitations (existing and proposed) and data provided in Table A-1 of Attachment A to this document, using AP-42 emissions factors applied to the worst-case fuel for each unit, Georgia Rule (g) for fuel oil sulfur content, and Georgia Rules (d) and (e) for particulate matter.

Table 2-1 CPC BART-Eligible Source Emissions Units BART Applicability Summary

Emissions Unit	Source Code	Construction Date	Latitude Longitude	Potential SO2, (tpy)	Potential NOx, (tpy)	Potential PM10, (tpy)
South Rotary Calciner	BC01	1968	34° 9′ 3.20″N 84° 47′ 9.98 W	278.49	15.69	56.27
Rotary Dryer	BD01	1964	34° 9′ 3.29″N 84° 47′ 9.52 W	103.16	5.81	45.46
South Spray Dryer	BD03	1968	34° 9′ 2.83″N 84° 47′ 10.27 W	67.88	3.82	41.57
Barium Chloride Rotary Dryer	BD04	1976	34° 9′ 3.16″N 84° 47′ 10.56 W	52.22	2.94	37.49
East Rotary Kiln	BK02	1966	34° 9′ 2.33″N 84° 47′ 7.47 W	2831.42	39.00	59.65
B&W Process Steam Boiler	GBX1	1973	34° 9′ 1.84″N 84° 47′ 6.67 W	1539.54	78.45	69.25

2.2. CPC BART-Eligible Source Model Emissions Inventory. An emissions inventory of modeled source parameters is provided in Tables A-2 and A-3 of Attachment A to this document. In the absence of historical continuous emissions monitoring system (CEMS) or facility stack test data for NOx, SO2, and PM10 from all BART-eligible units, the potential-to-emit each visibility-impairing pollutants was modeled in accordance with the priority hierarchy listed in VISTAS BART common modeling protocol. The maximum

hourly emission rates for the 4-km finer grid exclusion modeling for SO2 and NOx were determined based on the maximum hourly fuel consumption rates of natural gas, propane, fuel oil, or used oil, as applicable, with 0.5 percent sulfur, by weight. Emissions factors for NOx and SO2 are those published by US EPA in the most recent version of AP-42, Fifth Edition, Volume I, Chapter 1, External Combustion Sources (http://www.epa.gov/ttn/chief/ap42/ch01/index.html). The maximum hourly emissions rate of NOx from the East Kiln reflects a proposed 8.9 lb/hr NOx from the charcoal process in lieu of the 42 tpy twelve-consecutive month period equipment emissions cap specified in Condition 3.2.1 of TV-02-1. The maximum hourly emission rate of SO2 from the East Rotary Kiln includes an emissions factor derived for the processing of petroleum coke at one ton per hour with a maximum 15.5 percent sulfur content, by weight, using a conversion factor of sulfur to SO2 of two, based on the ratio of molecular weights (64.06/32.06). Particulate matter emissions rates were determined from Georgia Rules (d) and (e), as applicable, and used as a conservative surrogate for PM10. For PM10 speciation, all PM10 was assumed to be condensable organic particulate matter in the submicron particle size categories (PM081 and PM056) consistent with the guidance provided by VISTAS for BART modeling. Table 2-2 summarizes the maximum hourly emissions rates modeled.

Table 2-2 CPC BART-Eligible Source Maximum Hourly Emissions Rates

Emissions Unit	Source Code	SO2 (lb/hr)	NOx (lb/hr)	PM10 (lb/hr)	PM081 (lb/hr)	PM056 (lb/hr)
South Rotary Calciner	BC01	12.716	3.582	12.848	6.424	6.424
Rotary Dryer	BD01	4.710	1.327	10.379	5.190	5.190
South Spray Dryer	BD03	3.100	0.873	9.491	4.745	4.745
Barium Chloride Rotary Dryer	BD04	2.384	0.672	8.560	4.280	4.280
East Rotary Kiln	BK02	624.824	8.900	13.619	6.809	6.809
B&W Process Steam Boiler	GBX1	58.582	17.910	15.811	7.906	7.906

It should be noted that Air Techniques, Inc. conducted a performance test for NOx from the B&W Process Steam Boiler (Source Code GBX1) on September 14, 2000. Emissions of NOx from the boiler were determined to be 9.7 lb/hr (79.7 ppmdv @ 3.1 % O2) when firing natural gas and 13.7 lb/hr (114.7 ppmdv @ 2.7 % O2) when firing propane); the maximum NOx emissions rate modeled is for No. 2 fuel oil (24 lb NOx per 1000 gallons @ 746.27 gallons per hour) using AP-42. Prior to conducting the modeling, Chemical Products Corporation worked closely with GA EPD permit engineering staff the verify that the above emissions rates are expressed as the maximum hourly emissions rates of NOx, SO2, and PM10 for each unit (i.e. potential-to-emit).

2.3. Good Engineering Practice (GEP) Stack Height Evaluation. As specified 40 CFR Part 51 Appendix W, credit for emissions reductions from stack heights in excess of Good

Engineering Practice (GEP) is a dispersion technique that is prohibited. GEP stack height, as measured from the base elevation of a stack, is defined in 40 CFR §51,100(ii) and the US EPA Technical Support Document for Stack Height Regulations (EPA-450/4-80-023R) as the greater of 213 feet (65 meters), or the stack height determined based on the dimensions of "nearby" structures or EPA approved fluid model studies. Since the stack height of each BART-eligible emissions unit is less than 213 feet, the GEP stack height is easily determined to be 213 feet without the use of the Building Profile Input Program (BPIP); BPIP is a software application designed to incorporate the concepts and procedures expressed in EPA-450/4-80-023R. The stack heights and parameters provided in Table A-3 have been confirmed with the facility and are consistent with those found in Georgia Title V Application No. 16069.

2.4. Stack Input Parameters. Input parameters for stack height, stack exit diameter, and exhaust temperature were determined from the data provided by Chemical Products Corporation and are consistent with data provided in the Title V application and information available from the Georgia emissions inventory. Stack exit velocity was calculated based on actual volumetric flow rates determined from the references provided in Table 2-4.

Table 2-4 CPC BART-Eligible Source Maximum Hourly Emissions Rates

Emissions Unit	Source Code	Volumetric Flow Rate (acfm)	Reference Source	Calculated Velocity (fps)
South Rotary Calciner	BC01	12,000	Baghouse Data	49.86 (2.26 ft dia.)
Rotary Dryer	BD01	2,410	Combustion air for fuel oil (Method 19) (F_d-factor 9,190 scf/mmBtu @ 68°F, 3% O2, 8.89 mmBtu/hr, 68°F to 300°F temperature correction, stack moisture fraction 5%)	12.78 (2.00 ft dia.)
South Spray Dryer	BD03	3,000	Baghouse Data	34.93 (1.35 ft dia.)
Barium Chloride Rotary Dryer	BD04	1,500	Baghouse Data	11.41 (1.67 ft dia.)
East Rotary Kiln	BK02	25,000	Baghouse Data	33.16 (4.00 ft dia.)
B&W Process Steam Boiler	GBX1	34,225	Combustion air for fuel oil (Method 19) (F_d-factor 9,190 scf/mmBtu @ 68°F, 3% O2, 100 mmBtu/hr, 68°F to 500°F temperature correction, stack moisture fraction 5%)	80.70 (3.00 ft dia.)

The actual volumetric flow rate (acfm) for the B&W Process Boiler was not measured during the September 14, 2000 performance test. After consultation with the Air Techniques, Inc. Testing and Monitoring group, 5% stack gas moisture content was assumed in calculating actual volumetric flow based on typical stack moisture fractions for combustion of fuel oil in boilers. The same assumption was also made for the Rotary Dryer and the actual volumetric flow rates for these BART-eligible units are calculated using the following equation,

$$Q_{acfm} = \left(F_d \frac{dscf}{mmBtu}\right)\left(\frac{20.9}{(1-M)(20.9-O_2)}\right)\left(\frac{T_{act}+460°F}{T_{std}+460°F}\right)\left(\frac{mmBtu}{hr}\right)\left(\frac{hr}{60\,min}\right)$$

where F_d is the dry fuel factor for oil in EPA Method 19, Table 19-2, M is the stack moisture fraction, O2 is the oxygen concentration on a dry basis, and T_{std} is 68°F.

3. Geophysical and Meteorological Data

3.1. Modeling Domain, Terrain, and Meteorological Data Sets. The VISTAS RPO has developed five sub-regional 4-km CALMET meteorological databases for three years (2001, 2002, and 2003). The sub-regional modeling domains are strategically designed to cover all potential BART eligible sources within VISTAS states and all Class I Areas within 300 km of those sources. The extents of the 4-km sub-regional domains are shown in Figure 3-1.

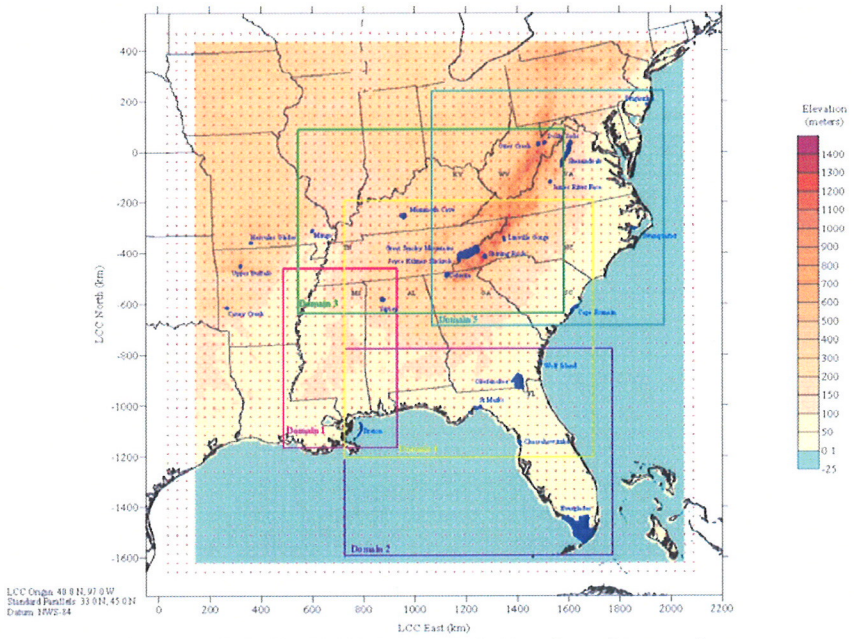

Figure 3-1 VISTAS 4-km Sub-Regional Domains

The meteorological dataset used for the BART-exclusion modeling was developed by VISTAS for sub-regional domain 4, shown in "yellow" in Figure 3-1. The meteorological data was processed by VISTAS using CALMET 5.8 on a 4-km grid scale using MM5 data as the initial guess field with National Weather Service observations to provide local surface refinement. The CALMET data used was preprocessed by VISTAS and obtained from the GA EPD DMU. The meteorological grid is in the Lambert Conic Conformal (LCC) projection with an origin of 40° N latitude and 97° W longitude with matching parallel latitudes of 33° N and 45° N.

USGS 90-meter Digital Elevation Model (DEM) files were used by VISTAS to generate the terrain data at 4-km resolution for input to the 4-km sub-regional CALMET run. Likewise, USGS 90-meter Composite Theme Grid (CTG) files were used by VISTAS to generate the land use data at 4-km resolution for input to the 4-km sub-regional CALMET run.

3.2. Air Quality Database. The CALPUFF model is capable of simulating linear chemical transformation effects by using pseudo-first-order chemical reaction mechanisms for the conversions of SO2 to SO4, and NOx, which consists of nitrogen oxide (NO) and

nitrogen dioxide (NO2), to nitrate (NO3) and nitric acid (HNO3). In this application, chemical transformations involving five species (SO2, SO4, NOx, HNO3, and NO3) were modeled using the MESOPUFF II chemical transformation scheme (MCHEM=1). Ambient concentrations of ozone and ammonia concentrations as represented in the model affect the MESOPUFF II chemical transformation simulation.

3.2.1. *Ozone Concentrations.* Ambient ozone concentrations are used in the CALPUFF "MESOPUFF II" chemical transformation scheme as a surrogate for OH radicals throughout the daylights hours during SO2 and NOx oxidation. Hourly measurements of ozone from all non-urban monitors within and just outside the computational grid were used as input to CALPUFF. The model default of 80 ppb was used for the background ozone concentration in the instances where hourly data was missing for each station. The standard ozone data files for 2001-2003 were provided by the GA EPD DMU.

3.2.2. *Ammonia Concentrations.* For the background ammonia value, a constant background value of 0.5 ppb was used rather than using ammonia data derived from CMAQ model output per recommendation by VISTAS.

3.3. Natural Conditions at Class I Areas. For the Class I Areas within 300 km of the CPC BART-eligible source, Table 3-1 summarizes the default annual average natural background conditions as tabulated in Appendix B of US EPA's Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule (EPA-454/B-03-005). To represent natural background conditions in the absence of anthropogenic sources of sulfates and nitrates, the VISTAS BART Modeling Protocol expresses monthly background extinction coefficients in terms of Rayleigh scattering (default value of 10 Mm^{-1} for Class I Areas) and scattering due to soils (i.e., fine particles) only and is calculated from the tabulated haze index (HI) values from the following equation,

$$b_{back} = 10e^{(HI/10)} = \underbrace{[Soil]}_{\substack{\text{Fiterable}\\ \text{Fine PM}\\ PM_{2.5}}} + \underbrace{b_{ray}}_{\substack{\text{Rayleigh}\\ \text{Scattering}}} = [Soil] + 10\ Mm^{-1}$$

$$[b_{back}]\left(\frac{\mu g}{m^3}\right) = [Soils] = 10e^{(HI/10)} - 10\ Mm^{-1}$$

Table 3-1 Natural Background Conditions for Class I Areas

Class I Area	b_{ext} (Mm^{-1})	Annual Average Haze Index (dv)	20% Best Days Haze Index (dv)	20% Worst Days Haze Index (dv)	Soil b_{back} Annual Avg. (BKSOIL) ($\mu g/m^3$)	Soil b_{back} 20% Best Days Avg. ($\mu g/m^3$)
Cohutta Wilderness Area	21.39	7.60	3.76	11.44	11.38	4.56
Great Smokey Mountains National Park	21.39	7.60	3.76	11.44	11.38	4.56
Joyce-Kilmer Wilderness Area	21.40	7.61	3.77	11.45	11.40	4.58
Sipsey Wilderness Area	21.28	7.55	3.71	11.39	11.28	4.49

Table 3-1 Natural Background Conditions for Class I Areas

Class I Area	b_{ext} (Mm^{-1})	Annual Average Haze Index (dv)	20% Best Days Haze Index (dv)	20% Worst Days Haze Index (dv)	Soil b_{back} Annual Avg. (BKSOIL) ($\mu g/m^3$)	Soil b_{back} 20% Best Days Avg. ($\mu g/m^3$)
Shining Rock Wilderness Area	21.40	7.61	3.77	11.45	11.40	4.58

The effects of relative humidity to amplify the visibility impairment of hygroscopic sulfates and nitrates were characterized using "Method 6," which computes the change in light extinction using a monthly average relative humidity adjustment particular to each Class I Area applied to background and modeled sulfate and nitrate. Table 3-2 summarizes the monthly average humidity values that were applied for the Class I Areas considered in this analysis, as tabulated in Table A-3 of US EPA's Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule (EPA-454/B-03-005).

Table 3-2 Monthly Site-Specific Average *f*(RH) for Class I Areas (RHFAC)

Class I Area	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Cohutta Wilderness Area	3.3	3.1	3.0	2.8	3.4	3.8	4.0	4.2	4.2	3.8	3.4	3.5
Great Smokey Mountains National Park	3.3	3.0	2.9	2.7	3.2	3.9	3.8	4.0	4.2	3.8	3.3	3.4
Joyce-Kilmer Wilderness Area	3.3	3.1	2.9	2.7	3.3	3.8	4.0	4.2	4.2	3.8	3.3	3.5
Sipsey Wilderness Area	3.4	3.1	2.9	2.8	3.3	3.7	3.9	3.9	3.9	3.6	3.3	3.4
Shining Rock Wilderness Area	3.3	3.0	2.9	2.7	3.4	3.9	4.1	4.5	4.4	3.8	3.3	3.4

4. Air Quality Modeling Methodology

4.1. Plume Model Selection. CALPUFF has been adopted by the U.S. EPA as a "Guideline" model for source-receptor distances greater than 50 km (i.e. long range transport), and for use on a case-by-case basis in complex flow situations for near-field applications. CALPUFF is also recommended for Class I impact assessments by FLAG and IWAQM. The final BART guidance recommends CALPUFF as "the best modeling application available for predicting a single source's contribution to visibility impairment." As a result of these recommendations, the VISTAS BART Modeling Protocol is based on the use of CALPUFF modeling system for its BART determinations. Therefore, the most recent EPA-approved version of CALPUFF, Version 5.8 Level 070623, and CALPOST, Version 5.6394 Level 070622, was used for the BART-exclusion modeling and post processing. Meteorological data preprocessed by VISTAS using CALMET, Version 5.8 Level 070623, was obtained from the GA EPD DMU.

4.2. CALPUFF Computational Domain and Receptors. The BART-exclusion modeling computational domain included the entire meteorological sub-regional domain 4. The receptor grid for each Class I Area shall be those receptor locations and elevations

provided by the National Park Service (NPS) Air Resources Division (ARD) available at http://www.nature.nps.gov/air/maps/receptors/index.cfm.

4.3. CALPUFF Modeling Options Selection. The CALPUFF modeling was conducted in accordance with the IWAQM Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts (EPA-454/R-98-019, December 1998), except as modified by the VISTAS BART Modeling Protocol (Section 4.3.3, Revision 3.2, August 2006). The CALPUFF input options were tested to conform to the regulatory model by defining MREG equal to 1.

4.3.1. *Building Downwash*. The requirement to include building downwash was waived since the CPC BART-eligible source is located at a distance greater than 50 km from the nearest Class I Area.

4.3.2. *Ozone Dataset*. The standard ozone data sets used for the BART-exclusion modeling were obtained from the GA EPD DMU and contain hourly observed ozone data extracted from the VISTAS standard ozone data set for years 2001, 2002 and 2003. A default of 80 ppb was used for the background ozone concentration in the instance when hourly data was missing for each station.

4.3.3. *Background Ammonia Concentration*. A constant value of 0.5 ppb was used for background ammonia concentration.

4.3.4. *Vertically Obstructed and Horizontal Stack Discharges*. Vertical discharge to the atmosphere from both the South Rotary Calciner (Source Code BD01) and Rotary Dryer (Source Code BD01) is obstructed by a rain protection device (rain-cap). The South Spray Dryer (Source Code BD03) discharges to the atmosphere by means of a horizontal vent. For these BART-eligible units, the momentum rise associated with actual exit velocity was reduced by setting the vertical momentum flux factor, FMFAC, to zero (default is one).

4.4. POSTUTIL and CALPOST Processing for Light Extinction and Haze Impact Calculations.

4.4.1. *Species Considered*. Species considered include sulfur dioxide, oxides of nitrogen and particulate matter with an aerodynamic diameter less than 10 microns (SO2, NOx, and PM10). Speciation of PM10 was performed in accordance with "Procedure for Speciation of Emissions for VISTAS BART Modeling", July 18, 2006. In the absence of continuous emissions monitoring data and specific particulate matter AP-42 factors relevant to the source classification code for each emissions unit, Georgia Rules (d) and (e) particulate matter permitted emissions limits were used as a surrogate for PM10 which are in turn speciated evenly into condensable organic (OC) particulate matter in the submicron size categories PM056 ($PM_{0.5\text{-}0.625}$) and PM081 ($PM_{0.625\text{-}1.0}$). PM056 and PM081 were modeled explicitly in CALPUFF and then summed in POSTUTIL to represent secondary organic aerosols using the following input file modification;

```
INPUT GROUP: 1 – General run control parameters
"Number of species to compute from those modeled",
! NSPECCMP=1 !,

SUBGROUP (2b)
"The following NSPECOUT species will be written",
...
```

~~! ASPECO = PM081 !~~
~~! ASPECO = PM056 !~~
! ASPECO = SOA !

SUBGROUP (2c)
"The following NSPECCMP species will be computed by scaling and summing on or more of the processed input species. Identify the name(s) of the computed species and provide the scaling factors for each of the NSPECINP input species."
! CSPECCMP = SOA !
! PM081 = 1.0 !
! PM056 = 1.0 !
! END !

4.4.2. *Nitrate Partitioning.* CALPUFF allows the full amount of the specified background concentration of ammonia to be available to each puff for forming nitrate. Therefore, the same ammonia may be used multiple times in forming nitrate, resulting in an overestimate of nitrate formation. In order to provide a conservative estimate of effects of nitrates in determined the modeled change in the haze index, the Ammonia Limiting Method was not used in POSTUTIL to repartition nitrate using the default background ammonia concentration of 0.5 ppb.

4.4.3. *Background Light Extinction Method.* A monthly average natural background was calculated using Visibility Method 6, based on the annual average default natural conditions specified in Table 3-1 and the monthly average f(RH) values specified in Table 3-2 for the centroid of each Class I Area.

4.4.4. *Light Extinction Efficiencies.* The US EPA (2003a) traditional IMROVE algorithm light extinction efficiencies were used.

5. BART-Exclusion Modeling Results Review

The BART-exclusion modeling results for Chemical Products Corporation are summarized in Table 5-1 below. The results in Table 5-1 below show the 8th highest day's impact for each year modeled using the traditional IMPROVE formula only. Figures 5-1, 5-2, and 5-3 show time-series plots of the calculated change in the haze index (Δdv) for all Class I Areas for each day modeled using the traditional IMPROVE formula for each meteorological dataset.

Table 5-1 Summary of Change in Haze Index – Traditional IMPROVE Equation

Class I Area	Distance (km)	Number of Days > 0.5 dv in Class I Area (and H8H)			Highest 8th-High (Max)	Highest 22nd-High 3 Years
		2001	2002	2003		
Cohutta Wilderness Area	78.9	2 (0.256)	2 (0.224)	5 (0.442)	0.442 (2003)	0.312 (2002)
Great Smokey Mountains National Park	167.0	0 (0.110)	0 (0.109)	1 (0.173)	0.173 (2003)	0.131 (2003)

Table 5-1 Summary of Change in Haze Index – Traditional IMPROVE Equation

Class I Area	Distance (km)	Number of Days > 0.5 dv in Class I Area (and H8H)			Highest 8th-High (Max)	Highest 22nd-High 3 Years
		2001	2002	2003		
Joyce-Kilmer Wilderness Area	153.4	0 (0.112)	0 (0.107)	1 (0.197)	0.197 (2003)	0.125 (2003)
Sipsey Wilderness Area	237.3	0 (0.083)	0 (0.078)	0 (0.127)	0.127 (2003)	0.104 (2003)
Shining Rock Wilderness Area	217.4	0 (0.090)	0 (0.090)	0 (0.087)	0.090 (2001)	0.090 (2001)

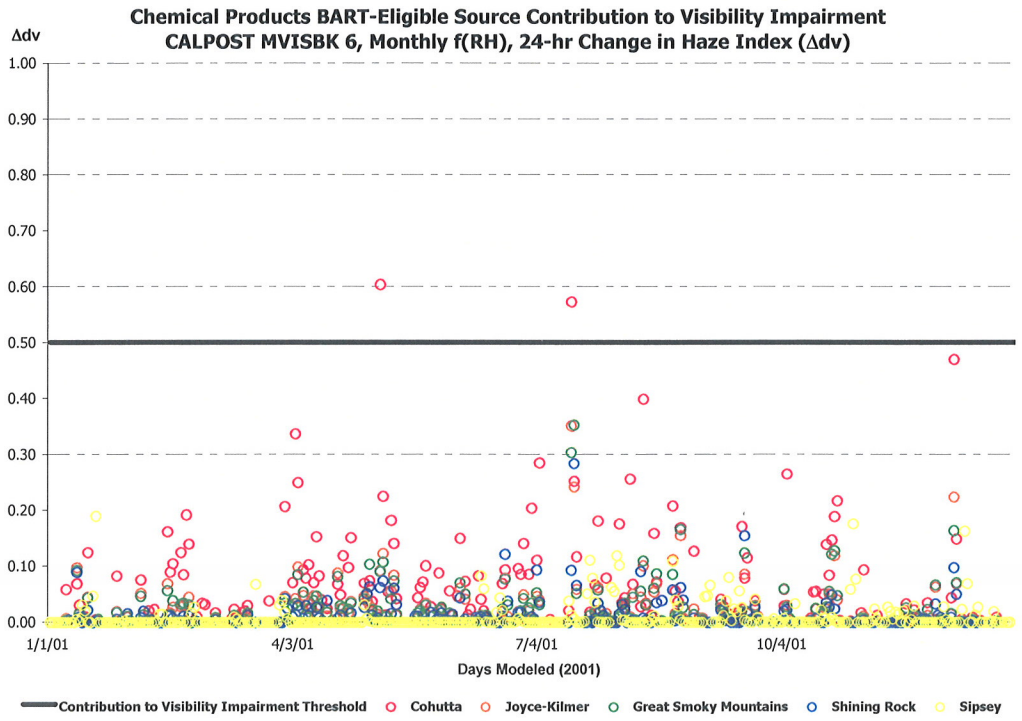

Figure 5-1 Modeled Change in Haze Index, All Class I Areas, 2001, Δdv

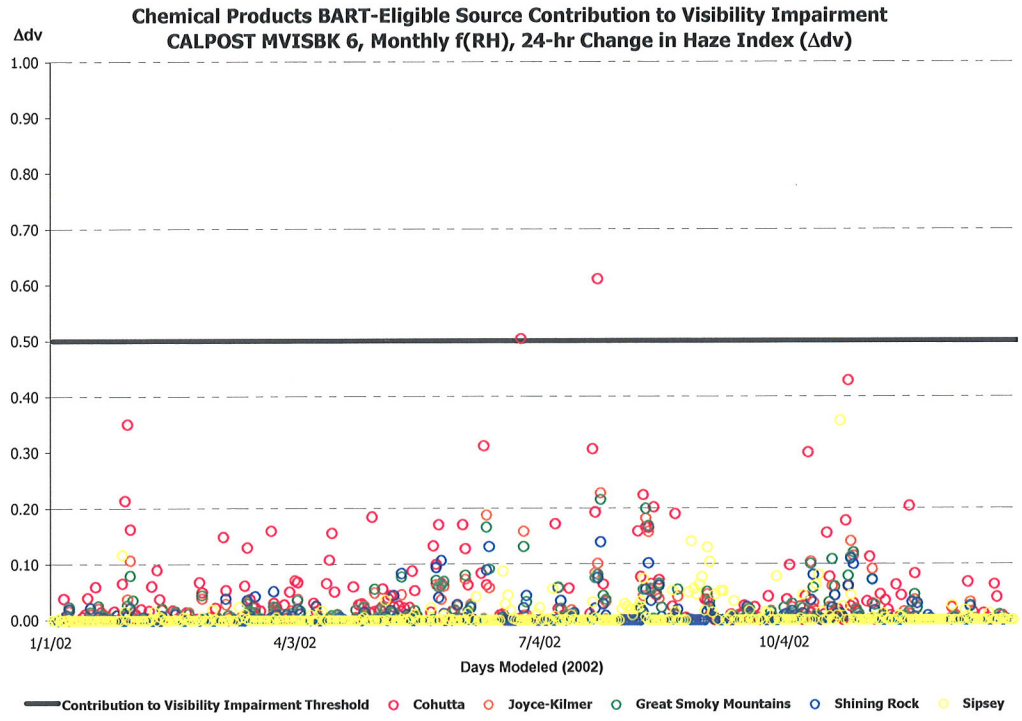

Figure 5-2 Modeled Change in Haze Index, All Class I Areas, 2002, Δdv

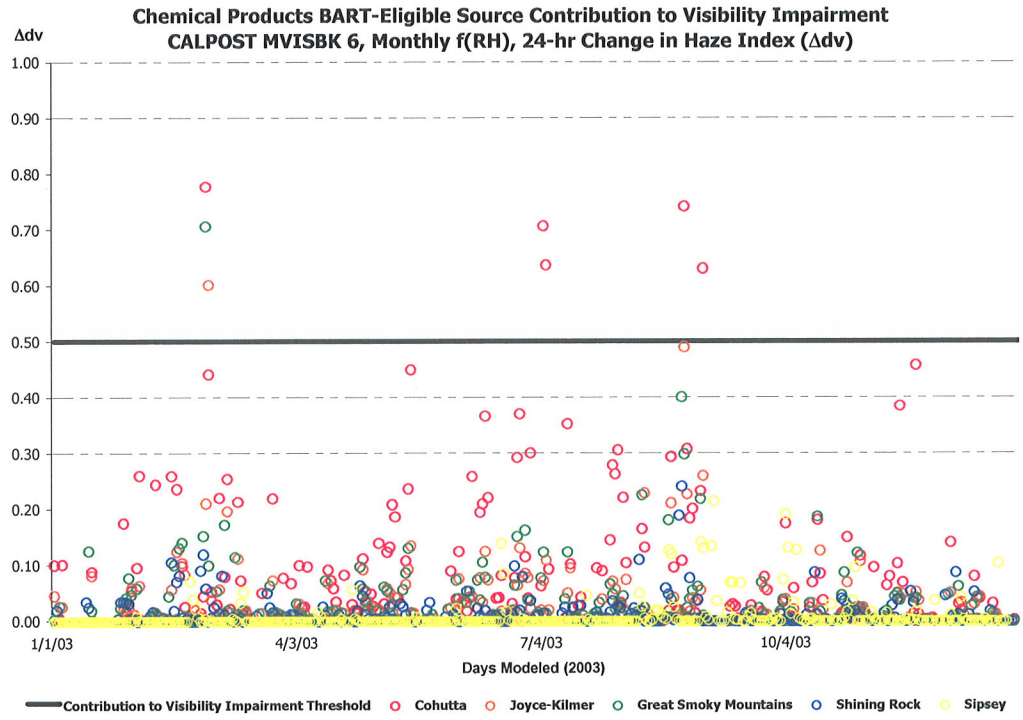

Figure 5-3 Modeled Change in Haze Index, All Class I Areas, 2003, Δdv

Recently, the IMPROVE Steering Committee developed a new algorithm for estimating light extinction from particulate matter component concentrations. This new IMPROVE algorithm provides a better correspondence measured visibility and that calculated from particulate matter component concentrations. The new algorithm differs in several substantive ways from the traditional method including the use of extinction efficiencies for sulfates, nitrates, and organics that are now functions of their concentrations, new particle growth functions for small and large sulfates and nitrates, the additional contribution of fine sea salt to light extinction accompanied by its own hygroscopic scattering enhancement factor, the Rayleigh light scattering by air itself now varies with site elevation and mean temperature and the light absorption by NO2 gas. Evaluation of visibility impairment impacts using the new IMPROVE formula can be performed using the guidance and post processing tool provided by VISTAS technical consultant, Dr. Ivar Tombach. However, the EPA requirement to include the NO2 term, which is listed as optional in the guidance, results in a volume of CALPOST post-processing that is burdensome for this application. Therefore, results were not determined using the new IMPROVE algorithm.

The inclusion of the NO2 term is recommended by Dr. Tombach if the contribution to NO2 is "of interest". To evaluate whether the inclusion of this term would be "of interest", CALPOST was used to determine the maximum 24-hr NO2 concentration for all Class I Area receptors for each metrological dataset. The national default value of 0.75 for NOx to NO2 conversion was not used in this application. Table 5-2 summarizes the maximum 24-hr NO2 concentrations for each year.

Table 5-2. Maximum 24-hr NO2 Concentrations, All Receptors ($\mu g/m^3$)

2001	2002	2003
0.0260 (0.0136 ppb)	0.0142 (0.0074 ppb)	0.0294 (0.0154 ppb)

Concentrations of NO2 were converted to parts per billion by dividing by 1.9137. Based on the maximum 24-hr concentrations of NO2 provided in Table 5-2, Chemical Products Corporations does not believe that NO2 is "of interest" since the NO2 term in the inclusion of the new IMPROVE algorithm will have a negligible effect on determination of visibility impairment.

In conclusion, the CALPUFF modeling results demonstrate that the Chemical Products Corporation BART-eligible source does not emit any air pollutant which may reasonably be anticipated to cause or contribute to impairment of visibility in any Class I Area and should be exempt from the requirements of Best Available Retrofit Technology under 40 CFR §51.303(a)(2). Based on the modeling information and results presented in this report, the Chemical Products Corporation Title V Permit No. 2819-015-0008-V-02-0 should be amended to include permit conditions, including monitoring, recordkeeping, and reporting, to limit sulfur in the fuel oil combusted in each BART-eligible emissions unit to 0.5 percent, by weight, and the sulfur in the petroleum coke processed in the East Kiln (Source Code BK02) to 15.5 percent, by weight as demonstrated in Table A-2 of Attachment A. This will make certain that the potential-to-emit visibility impairing pollutants SO2, NOx, and PM10 modeled from each BART-eligible unit is federally enforceable and enforceable as a practical manner and protects visibility in Class I Areas, an important air quality related value (AQRV).

6. Quality Assurance Methods

Air quality modeling covered under the VISTAS BART common modeling protocol is an important tool for use in determining whether a BART-eligible source can be reasonably expected to cause or contribute to visibility impairment in a Class I area, and therefore whether this source should be subject to BART controls, and if so, to determine the relative benefits of various BART controls. The purpose of quality assurance (QA) is to establish procedures for ensuring that

products produced by the application of the modeling techniques for BART studies satisfy the regulatory objectives of the BART program.

The scope of the QA program affects different users differently. Common features of most applications are the setup and execution of the CALPUFF air quality model and processing of modeling results to determine if a source contributes to visibility impairment at a Class I area. As in the case of BART-exclusion modeling conducted by Chemical Products Corporation, the permitting authority provided meteorological datasets developed by VISTAS under a suitable QA program. The CALPUFF modeling system also contains built-in features to facilitate quality assurance of the modeling results which include the automatic production of "QA" files for various datasets, including geophysical fields, sources and receptors, and imbedded tracking of model options and switches within the output files from the major modeling units of the modeling system. This information is carried forward in all of the output files to create an audit trail of software versions and major model options used that can be retrieved and displayed from the model output files.

Appendix B of the IWAQM Phase II report contains a list of recommended CALPUFF switch settings. Except as modified in Chapter 4 of the VISTAS BART common modeling protocol and in Section 4.3 above, the IWAQM guidance was used in setting up the CALPUFF simulations. The CALPUFF model obtains the switch settings from an ASCII control file which was quality assured to conform to the regulatory model options by defining MREG equal to 1. The control file was also reviewed manually to conform to the IWAQM Phase II and VISTAS BART common modeling protocol. Most of the CALPUFF input variables contain default values. However, there are several input variables that are defined by each user, including general run control parameters, species lists, map projection and grid control parameters, dry gaseous and particle deposition parameters, and wet deposition parameters. The defaults for all user defined input parameters specified in the standard CALPUFF ASCII control file obtained from the Atmospheric Studies Group at TRC were retained, excluding the map projection and grid control parameters, which were quality assured manually to conform to VISTAS sub-regional domain 4 via the automatic QA files for the datasets as discussed above. The minimum over water turbulence velocity, SVMIN, was also manually defined as 0.50 m/s to conform to the regulatory model.

POSTUTIL allows the user to sum the contributions of sources from different CALPUFF simulations into a total concentration file. In addition, it contains options to scale and sum the concentrations from different modeled species (e.g., different particle sizes) into species-dependent size distributions for the particulate matter. This was performed to develop a secondary organic aerosols (SOA) species from the particle size fractions modeled in accordance with Section 4.4.1 of the protocol as approved by EPA Region 4 and Federal Land Managers.

CALPOST was run separately for each Class I area in order to obtain the necessary visibility statistics for evaluating compliance with the BART modeling thresholds. The inputs to CALPOST involve selection of the visibility method (MVISBK=6), entry of Class I area-specific data for computing background extinction and monthly relative humidity factors for hygroscopic aerosols (Tables 3-1 and 3-2 above). CALPOST contains a receptor screening that allowed subsets of a receptor network modeled in CALPUFF to be selected for processing in a given CALPOST run. This is how receptors within a particular Class I area were selected for processing from a CALPUFF output file that may contain receptors from several Class I areas. The CALPOST output file (*.LST) contains a listing of the highest visibility impact each day of the model simulation over all receptors processed. Receptors were selected in each CALPOST run so that each CALPOST run represents the impacts at a single Class I area. The CALPOST inputs that were carefully checked as part of the CALPOST quality assurance include the following:

- Visibility Method 6 (MVISBK=6);

- Monthly Class I-specific relative humidity factors for Method 6 (RHFAC and Table 3-2);
- Natural background light extinction values (BKSOIL and Table 3-1);
- Inclusion of all appropriate species from modeled sources (LVSO4, LVNO3, and LVOC set to T);
- Extinction efficiencies for each species (traditional IMPROVE);
- Appropriate Rayleigh scattering term (default 10 Mm^{-1} is equal to, or more conservative than, each Class I Area's site-specific Rayleigh scattering term); and
- Screen to select appropriate Class I receptors for each CALPOST simulation (NDRECP set to 1 to flag desired receptors for processing using repeated value notation)

Attachment A

Chemical Products Corporation BART-Eligible Source Potential-to-Emit Calculations, Maximum 24-hr Actual Emissions Rates, and Modeled Emissions Inventory

Attachment B
Electronic Files

Chemical Products Corporation - Best Availabl

Table A-1. Chemical Products Corporation BART-Eligible Source Potential-to-Emit

Stack ID No. [a]	Emissions Unit ID No. [a]	Emission Unit Description [a]	Construction Date [a]	Maximum Rated Heat Input, (mmBtu/hr) [a]	Natural Gas Consumption, (cfh) [a, b]	Propane Consumption, (gph) [a, b]	SO2 Emissions Factor, AP-42 1.3-1 or 1.11-2, (lb/mgal)	PM10, Potential Emissions Rate, (lb/hr) [e]	NOx, Potential Emissions Rate, (lb/hr) [f, g]	SO2, Potential Emissions Rate, (lb/hr) [f]
Chemical Products Corporation, Title V Permit No. 2819-015-0008-V-02-0/-1										
BCZ1	BC01	South Rotary Calciner	1969	24.00	23,301	262	142S	12.848	3.582	63.582
BDZ1	BD01	Rotary Dryer	1964	8.89	8,631	97	142S	10.379	1.327	23.552
BDZ3	BD03	South Spray Dryer	1968	5.85	5,680	64	142S	9.491	0.873	15.498
BDZ4	BD04	Barium Chloride Rotary Dryer	1976	4.50	4,369	49	142S	8.560	0.672	11.922
BKZ1	BK02	East Rotary Kiln	1966	10.20	9,903	111	147S	13.619	8.900	646.442
GBZ1	GBX1	B&W Process Steam Boiler	1973	100.00	97,087	1,092	157S	15.811	17.910	351.493

Notes:

a. Stack and emissions unit identification, construction date, maximum rated heat input, fuel consumption rates, petroleum coke consu
b. Maximum hourly fuel consumption determined from maximum rated heat inputs divided by the heating values for each fuel provide
c. Chemical Products Corporation will propose to accept a federally enforecable permit limitation of 15.5 percent sulfur, by weight, in c
d. SO2 emissions factor for processing of petroleum coke determined from sulfur content in coke with 100% conversion to SO2; (64.0(
e. PM10 potential-to-emit determined from Georgia Rules (d) and (e).
f. NOx and SO2 potential-to-emit determined from maximum hourly emissions rates resulting from combustion of natural gas, propan
g. The East Kiln NOx equipment emissions cap specified in Condition 3.2.1 of TV-02-1 is proposed to be revised to 8.9 lb/hr NOx from

PTE (tpy)	PM	NOx	SO2
South Rotary Calciner	56.27	15.69	278.49
Rotary Dryer	45.46	5.81	103.16
South Spray Dryer	41.57	3.82	67.88
Barium Chloride Dryer	37.49	2.94	52.22
East Rotary Kiln	59.65	38.98	2831.42
B&W Boiler	69.25	78.45	1539.54
ART-Eligible Source Total	309.70	145.70	4872.70

Table A-2. Chemical Products Corporation BART-Eligible Source Maximum 24-hr Actu

Stack ID No. [a]	Emissions Unit ID No. [a]	Emission Unit Description [a]	Construction Date [a]	Maximum Rated Heat Input, (mmBtu/hr) [a]	Natural Gas Consumption, (cfh) [a, b]	Propane Consumption, (gph) [a, b]	SO2 Emissions Factor, AP-42 1.3-1 or 1.11-2, (lb/mgal)	PM10, Potential Emissions Rate, (lb/hr) [e]	NOx, Potential Emissions Rate, (lb/hr) [f, g]	SO2, Potential Emissions Rate, (lb/hr) [f]
Chemical Products Corporation, Title V Permit No. 2819-015-0008-V-02-0/-1										
BCZ1	BC01	South Rotary Calciner	1969	24.00	23,301	262	142S	12.848	3.582	12.716
BDZ1	BD01	Rotary Dryer	1964	8.89	8,631	97	142S	10.379	1.327	4.710
BDZ3	BD03	South Spray Dryer	1968	5.85	5,680	64	142S	9.491	0.873	3.100
BDZ4	BD04	Barium Chloride Rotary Dryer	1976	4.50	4,369	49	142S	8.560	0.672	2.384
BKZ1	BK02	East Rotary Kiln	1966	10.20	9,903	111	147S	13.619	8.900	624.824
GBZ1	GBX1	B&W Process Steam Boiler	1973	100.00	97,087	1,092	157S	15.811	17.910	58.582

Notes:

a. Stack and emissions unit identification, construction date, maximum rated heat input, fuel consumption rates, petroleum coke consu
b. Maximum hourly fuel consumption determined from maximum rated heat inputs divided by the heating values for each fuel provide
c. Chemical Products Corporation will propose to accept a federally enforecable permit limitations of 15.5 percent sulfur, by weight, in
d. SO2 emissions factor for processing of petroleum coke determined from sulfur content in coke with 100% conversion to SO2; (64.0(
e. PM10 potential-to-emit determined from Georgia Rules (d) and (e).
f. NOx and SO2 potential-to-emit determined from maximum hourly emissions rates resulting from combustion of natural gas, propane
g. The East Kiln NOx equipment emissions cap specified in Condition 3.2.1 of TV-02-1 is proposed to be revised to 8.9 lb/hr NOx from

PTE (tpy)	PM	NOx	SO2
South Rotary Calciner	56.27	15.69	55.70
Rotary Dryer	45.46	5.81	20.63
South Spray Dryer	41.57	3.82	13.58
Barium Chloride Dryer	37.49	2.94	10.44
East Rotary Kiln	59.65	38.98	2736.73
B&W Boiler	69.25	78.45	256.59
ART-Eligible Source Total	309.70	145.70	3093.67

Table A-3. Chemical Products Corporation BART-Eligible Source CALPUFF Modeling Ir

Stack ID No.	Emissions Unit ID No.	Emission Unit Description	Location [a] Latitude	Location Longitude	Zone	Easting, (km)	Nc	densable (OC) ction of PM10 [c] 0.5 - 0.625 µm, (%)	Organic Condensable (OC) [c] 0.625 - 1.0 µm, (lb/hr)	0.5 - 0.625 µm, (lb/hr)
Chemical Products Corporation, Title V Permit No. 2819-015-0008-V-02-0/-1									PM056	PM081
BCZ1	BC01	South Rotary Calciner [d]	34.1509	84.7861	16	1118.285		50	6.424	6.424
BDZ1	BD01	Rotary Dryer [d]	34.1509	84.7860	16	1118.296		50	5.190	5.190
BDZ3	BD03	South Spray Dryer [d]	34.1508	84.7862	16	1118.279		50	4.745	4.745
BDZ4	BD04	Barium Chloride Rotary Dryer	34.1509	84.7863	16	1118.270		50	4.280	4.280
BKZ1	BK02	East Rotary Kiln	34.1506	84.7854	16	1118.352		50	6.809	6.809
GBZ1	GBX1	B&W Process Steam Boiler	34.1505	84.7852	16	1118.374		50	7.906	7.906

Notes:

a. Lambert Conformal Conic (LCC) coordinates determined from conversion from latitude and longitude coordinates determined from G
b. Base elevations in the ASCII CALPUFF control files obtained from GA EPD from 2006 12km BART exemption modeling performed by
b. Base elevations provided in Table A-3 were determined by processing the USGS Digital Elevation Model (7.5' DEM 30m) file for Carte
b. Stack height and diameter, exhaust temperature, and exit velocity have been verified with Chemical Products Corporation and are c
c. Particulate matter speciation performed in accordance with "Procedure for Speciation of Emissions for VISTAS BART Modeling", July
d. Vertical discharge of stacks BCZ1 (South Rotary Calciner) and BDZ1 (Rotary Dryer) have been verified to be obstructed by means of
e. All stack heights have been verified to not exceed good engineering practice (GEP) stack height as defined in 40 CFR §51.100(ii); all

Coke to 1.22-
TK 221-321
GSM 322-1057
SR 1058-1167
SP 1168-1315