Prevention of Significant Air Quality Deterioration Review

Preliminary Determination

February 9, 2017

Facility Name: Hyalus, Inc.
City: Hawkinsville
County: Pulaski
AIRS Number: 04-13-23500027
Application Number: 24026
Date Application Received: October 17, 2016

Review Conducted by:
State of Georgia - Department of Natural Resources
Environmental Protection Division - Air Protection Branch
Stationary Source Permitting Program

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SUMMARY

The Environmental Protection Division (EPD) has reviewed the application submitted by Hyalus, Inc. for a permit to construct and operate a specialty glass fiber manufacturing facility. The proposed project will consist of material handling operations, a cold-top electric glass melting furnace, four natural gas heated forehearth channels for the melted glass, and forty-four spinning machines (fiberizers) where the glass fiber is attenuated.

The sources of emissions include the raw material handling, the glass melting furnace, the forehearths, the fiberizers, the emergency generator, and the cooling towers.

A Prevention of Significant Deterioration (PSD) analysis was performed for the facility for all pollutants to determine if any increase was above the "significance" level. The CO, PM, PM_{10}, $PM_{2.5}$, NO_x, and green-house gases (GHG) emissions increase was above the PSD significant level threshold.

The Hyalus, Inc. will be located in Pulaski County, which is classified as "attainment" or "unclassifiable" for SO_2, $PM_{2.5}$ and PM_{10}, NO_2, CO, lead, and ozone (VOC).

The EPD review of the data submitted by Hyalus, Inc. related to the proposed facility indicates that the project will be in compliance with all applicable state and federal air quality regulations.

It is the preliminary determination of the EPD that the proposal provides for the application of Best Available Control Technology (BACT) for the control of CO, PM, PM_{10}, $PM_{2.5}$, NO_x, and GHG, as required by federal PSD regulation 40 CFR 52.21(j).

It has been determined through approved modeling techniques that the estimated emissions will not cause or contribute to a violation of any ambient air standard or allowable PSD increment in the area surrounding the facility or in Class I areas located within 200 km of the facility. It has further been determined that the proposal will not cause impairment of visibility or detrimental effects on soils or vegetation. Any air quality impacts produced by project-related growth should be inconsequential.

This Preliminary Determination concludes that an Air Quality Permit should be issued to Hyalus, Inc. for the facility to manufacture specialty glass fiber material. Various conditions have been incorporated into the permit to ensure and confirm compliance with all applicable air quality regulations.

1.0 INTRODUCTION – FACILITY INFORMATION AND EMISSIONS DATA

On October 17, 2016, Hyalus, Inc. (hereafter Hyalus), a subsidiary of Hollingsworth & Vose Company (H&V), submitted an application for an air quality permit to manufacture specialty glass fiber material. The application was initially assigned application number 43016 and classified as a significant modification with construction because H&V already had an existing Title V Operating Permit No. 2621-235-0008-V-04-0 at the same site. However, the new facility was subsequently assigned application number 24026 as a separate facility from the existing facility because the facilities will not manufacture the same product and therefore do not belong to the same industrial grouping (and Hyalus is not a support facility for the existing Hollingsworth and Vose plant). The new facility is located contiguously with the existing facility at 106 Industrial Boulevard in Hawkinsville, Pulaski County.

The Hyalus and Hollingsworth and Vose facilities have different SIC codes and therefore are considered separate sources for the purposes of Title V and PSD/NSR. However, NESHAP regulations do not consider SIC code in determining whether facilities should be aggregated for the purposes of determining NESHAP applicability. Commonly controlled and adjacent facilities must aggregate emissions of HAPs to determine their major source HAP status. Since the existing Hollingsworth and Vose facility is currently a major source of HAP, due to the potential to emit HAP from an existing solvent line, and the proposed Hyalus facility will be commonly controlled with and adjacent to the existing facility, the proposed Hyalus facility will be located at a major source of HAP and thus regulated as a major source of HAP with respect to the NESHAPs evaluated in the regulatory applicability section of this document.

Table 1-1: Title V Major Source Status

Pollutant	Is the Pollutant Emitted?	If emitted, what is the facility's Title V status for the Pollutant?		
		Major Source Status	Major Source Requesting SM Status	Non-Major Source Status
PM	Yes			✓
PM_{10}	Yes			✓
$PM_{2.5}$	Yes			✓
SO_2	Yes			✓
VOC	Yes			✓
NO_x	Yes			✓
CO	Yes	✓		
TRS	n/a			
H_2S	n/a			
Individual HAP	Yes	✓		✓*
Total HAPs	Yes	✓		✓*

* The Title III site, which includes existing Hollingworth and Vose site, is HAP major. Hyalus is HAP minor.

Based on the proposed project description and data provided in the permit application, the emissions of regulated pollutants from the facility are listed in Table 1-2 below:

Table 1-2: Emissions from the Project

Pollutant	Potential Emissions (tpy)	PSD Significant Emission Rate (tpy)	Subject to PSD Review
PM	50.5	25	Yes
PM_{10}	51.8	15	Yes
$PM_{2.5}$	46.9	10	Yes
VOC	16.1	40	No
NO_X	72.1	40	Yes
CO	1,576	100	Yes
SO_2	0.49	40	No
TRS	n/a	10	No
Pb	6.8E-8	0.6	No
Fluorides	1.06	3	No
H_2S	n/a	10	No
SAM	n/a	7	No
GHG	98,122	75,000	Yes
Total HAP	11.3	n/a	n/a
Toluene[1]	4.17	n/a	n/a
Arsenic	2.9E-3	n/a	n/a
Benzene	3.83	n/a	n/a
Chromium	8.5E-3	n/a	n/a
Formaldehyde	2.02	n/a	n/a
Hydrogen Fluoride	1.01	n/a	n/a

[1] Maximum Individual HAP

The emissions of PSD regulated pollutant by equipment source are listed in Table 1-3 below:

Table 1-3: PSD Emissions from the Project by Source (tpy)

Pollutant	Raw Material Handling[1]	Glass Melting Furnace[2]	Forehearths[3]	Rotary Fiberizers[4]	Emergency Generator[5]	Cooling Towers[6]
PM	0.89	1.37	0.31	47.8	0.044	0.053
PM_{10}	0.89	2.63	0.41	47.8	0.044	0.048
$PM_{2.5}$	0.89	2.58	0.41	43.0	0.044	0.029
VOC	--	0.11	0.30	15.7	0.049	--
NO_X	--	--	0.71	70.8	0.62	--
CO	--	--	3.01	1,573	0.13	--
SO_2	--	--	0.032	0.42	0.041	--
TRS	--	--	--	--	--	--
Pb	--	1.1E-4	2.7E-5	1.92E-3	8.4E-6	--
Fluorides	--	0.47	--	0.49	--	--
H_2S	--	--	--	--	--	--
SAM	--	--	--	--	--	--
GHG	--	8,227	6,505	83,368	22.7	--

[1] ID Nos. RMH, RMT, and RMF
[2] ID No. MELT
[3] ID Nos. FORA, FORB, FORC, and FORD
[4] ID Nos. RA01 through RA10, RB01 through RB10, RC01 through RC12, and RD01 through RD12
[5] ID No. EGEN
[6] ID Nos. CT01 through CT03

Based on the information presented in Tables 1-2 and 1-3 above, Hyalus' proposed source, as specified per Georgia Air Quality Application No. 24026, is classified as a major source because the potential emission of CO is greater than the major source threshold of 250 tons per year (ton/yr).

Through its new source review procedure, EPD has evaluated Hyalus' proposal for compliance with State and Federal requirements. The findings of EPD have been assembled in this Preliminary Determination.

2.0 PROCESS DESCRIPTION

According to Application No. 24026, Hyalus has proposed to construct and operate a separate specialty glass fiber manufacturing facility. The Hyalus facility will be located adjacent to an existing facility owned and operated by Hollingsworth and Vose, the parent company of Hyalus, which manufactures specialty aqueous and solvent based filter paper by continuous web process under Air Quality Permit No. 2621-235-0008-V-04-0. The new Hyalus facility will be located on the same site under the same management control, but as a separate facility for Title V and PSD purposes because the two facilities do not belong to the same industrial grouping. However, the facilities are evaluated as a single source to determine major source status under the NESHAP program [40 CFR 52.21(b)(6)(i); 40 CFR 70.2; 40 CFR 63.2].

The following is a description of the manufacturing process from raw material receipt through product collection and emissions control.

Raw Material Handling
The raw material received may include, but is not limited to; soda ash, borax, syenite, sand, fluorspar, zinc oxide, potassium carbonate, burnt dolomite, and barium. Bulk truck and super sack raw materials will be unloaded through separate unloading stations to eight raw material hoppers (ID No. RMH). Particulate emissions from each hopper will be vented to atmosphere through eight high efficiency dust filters (ID Nos. FB01 through FB08). Raw materials in each hopper will be loaded by weight into batch weigh hoppers then directed to the mixing tank (ID No. RMT) where the glass product recipe is blended. Particulate emissions generated from the weigh bin and mixing tank will also be vented to atmosphere through a high efficiency filter bank (ID No FB11).

Processed material received from the mixing tank will be transported to a feed hopper (ID No. RMF). The feed hopper will include a chute that transfers the good batch material to a conveyor continuously feeding processed material onto the top of a bed of molten glass inside the glass melt furnace. The raw material waste will be transported to a bad batch bin [ID No. RMF (combined with feed hopper ID)]. The feed hopper and bad batch bin will vent particulate emissions through filters (ID No. FB09 and FB10).

Glass Melt Furnace
Inside the glass melt furnace (ID No. MLTR), newly processed material of a specific recipe will be added to the surface of the molten glass already present, thereby ensuring a continuous homogeneous mixture. The glass melt furnace will be a cold top electrically heated design. Fumes resulting from the melting of the bulk materials in the glass melt furnace will be vented to a baghouse (ID No. BH01) for control. Controlled emissions from the particulate control device will exhaust through a single stack.

Forehearths

The forehearths (ID Nos. FORA, FORB, FORC, and FORD) will receive molten glass at high temperatures from the glass melt furnace. Each of the four forehearths will maintain the molten glass at the high temperature needed for it to flow into a specific fiberizer. The forehearths will also be able to deliver molten glass to a glass patty former or to a station that produces glass cullet. Glass patties and cullet are glass that has hardened. Patties are glass that has hardened in a mold. Cullet is formed from molten glass that has been routed to a fiberizer position that is inactive. The molten glass stream is then directed around the fiberizer position in a water cooled trough. Cullet forms into hardened glass with an amorphous shape.

Unlike the glass melt furnace, the forehearths will utilize natural gas combustion to maintain the molten glass temperature. Natural gas combustion emissions from each forehearth will be captured by suspended hoods and conveyed through ductwork to vent from a common forehearth exhaust stack.

Rotary Fiberizers

Rotary fiberizer positions [ID Nos. RA01 through RA10, RB01 through RB10, RC01 through RC12, and RD01 through RD12 (44 positions)] will receive molten glass from the forehearths. The molten glass will be fed to a rotary spinner which utilizes centrifugal forces to push the molten glass outward through small holes resulting in thin glass fibers. The newly formed glass fibers will be pneumatically conveyed to collection drums for capture and packaging.

As an alternative to receiving molten glass from the forehearth, it may be desirable to deploy re-melters on some rotary fiberizer positions. This technology allows the facility to recycle glass patties and cullet by placing this glass in a hopper and then melting it with electric heaters. This molten glass is then processed through the rotary fiberizer in the same manner as described in the previous paragraph.

There are two fiber sizes being proposed – “course” and “fine. “ It is anticipated that “course” fiber will make up the bulk of production. Course fiber has a higher throughput rate per fiberizer than fine fiber, and thus course fiber has a lower emission factor per ton of product than fine fiber.

Product Collection

After glass fibers have been created by the rotary fiberizers, the product is collected on a small drum screen (also called a condenser). The drum is a spinning cylinder with small holes. A fan will be used to pull air from inside the drum. As the air is sucked through the outside holes in the drum, the fiber will collect on the drum surface. The glass fibers then build up a mat on the drum. The mat is then removed automatically for product packaging. Some particulate, including fibers, will pass through the collection drums. Each drum will vent particulate emissions through a high-efficiency rotary drum filter [ID Nos. DF01 through DF22 (one filter for every two fiberizer positions) with additional filter stages. The remaining particulate will then pass through a cyclone [ID No. CY01 through CY22 (one cyclone for every filter outlet)] and a baghouse [ID Nos. DB01 through DB11 (one baghouse for every two cyclone outlets)]. Emissions (NOx, CO, PM, etc) from each set of four fiberizers and two condensers will exhaust from one of the eleven stacks F_1 to F_11.

Cooling Towers
Wet Cooling towers (ID Nos. CT01 through CT03) will be utilized to condition the air used in various processes at the proposed facility and to cool the closed-loop cooling water on the fiberizers. The proposed facility will utilize cooling towers with three cells. A drift eliminator will be installed in the cooling towers that has a drift rate of 0.001%.

Emergency Generator
An emergency generator (ID No. EGEN) will be located onsite and will only operate to keep the glass molten in the furnace throat in the event that power is interrupted. Emissions will be limited through the combustion of ultra-low sulfur diesel fuel. The only non-emergency situations in which the generators will be operated is for maintenance checks and readiness testing recommended by the vendor or manufacturer as needed to ensure appropriate emergency response capabilities.

The Hyalus permit application and supporting documentation are found online at http://epd.georgia.gov/air/psd112gnaa-nsrpcp-permits-database.

3.0 REVIEW OF APPLICABLE RULES AND REGULATIONS

State Rules

Georgia Rule for Air Quality Control (Georgia Rule) 391-3-1-.03(1) requires that any person prior to beginning the construction or modification of any facility which may result in an increase in air pollution shall obtain a permit for the construction or modification of such facility from the Director upon a determination by the Director that the facility can reasonably be expected to comply with all the provisions of the Act and the rules and regulations promulgated thereunder. Georgia Rule 391-3-1-.03(8)(b) continues that no permit to construct a new stationary source or modify an existing stationary source shall be issued unless such proposed source meets all the requirements for review and for obtaining a permit prescribed in Title I, Part C of the Federal Act [i.e., Prevention of Significant Deterioration of Air Quality (PSD)], and Section 391-3-1-.02(7) of the Georgia Rules (i.e., PSD).

Georgia Rule (b) "Visible Emissions" [391-3-1-.02(2)(b)] is a general rule that limits the opacity of emissions from any air contaminant source to less than 40%. Georgia Rule (b) applies to the Melting Furnace (ID No. MLTR), the Forehearths (ID Nos. FORA, FORB, FORC, and FORD), the Fiberizers (ID Nos. RA01-RA10, RB01-RB10, RC01-RC12, and RD01-RD12), the Cooling Towers (ID Nos CT01-CT03), and material handling operations (ID Nos. RMH, RMT, and RMF).

Georgia Rule (e) "Particulate Emission from Manufacturing Processes" [391-3-1-.02(2)(e)], commonly known as the process weight rule, limits PM emissions based on the following equations:

For $P \leq 30$ ton/hr, $E = 4.1 \times P^{0.67}$
For $P > 30$ ton/hr, $E = 55 \times P^{0.11} - 40$

where E = emission rate (lb/hr) and P = process input rate (ton/hr). The Melting Furnace (ID No. MLTR), the Forehearths (ID Nos. FORA, FORB, FORC, and FORD), the Fiberizers (ID Nos. RA01-RA10, RB01-RB10, RC01-RC12, and RD01-RD12), the Cooling Towers (ID Nos CT01-CT03), and raw material handling operations (ID Nos. RMH, RMT, and RMF) are subject to Georgia Rule (e).

Georgia Rule (g) "Sulfur Dioxide" [391-3-1-.02(2)(g)] applies to all fuel-burning sources. Paragraph 1 limits the emission of SO_2 from new fuel-burning sources based on the type of fuel burned in the source. Paragraph 2 of the rule limits the percentage of sulfur, by weight, in the fossil fuel burned to 2.5 percent for fuel-burning sources with a maximum heat input less 100 MMBtu/hr. Paragraph 2 applies to the Forehearths (ID Nos. FORA, FORB, FORC, and FORD), the Fiberizers (ID Nos. RA01-RA10, RB01-RB10, RC01-RC12, and RD01-RD12) that burn natural gas.

Georgia Rule (n) "Fugitive Dust" [391-3-1-.02(2)(n)] applies to any operation, process, handling, transportation or storage facility that may result in fugitive dust. Rule (n) applies to the plant roads and material handling operations.

Georgia Rule (oo) "Fiberglass Insulation Manufacturing Plants" [391-3-1-.02(2)(oo)] applies to particulate matter emissions from any fiberglass insulation production lines. This rule does not apply to the Fiberizer units (ID Nos. RA01-RA10, RB01-RB10, RC01-RC12, and RD01-RD12) because these fiberizer units do not produce any fiberglass insulation material.

Federal Rule - PSD

The regulations for PSD in 40 CFR 52.21 require that any new major source or modification of an existing major source be reviewed to determine the potential emissions of all pollutants subject to regulations under the Clean Air Act. The PSD review requirements apply to any new or modified source which belongs to one of 28 specific source categories having potential emissions of 100 tons per year or more of any regulated pollutant, or to all other sources having potential emissions of 250 tons per year or more of any regulated pollutant. They also apply to any modification of a major stationary source which results in a significant net emission increase of any regulated pollutant.

Georgia has adopted a regulatory program for PSD permits, which the United States Environmental Protection Agency (EPA) has approved as part of Georgia's State Implementation Plan (SIP). This regulatory program is located in the Georgia Rules at 391-3-1-.02(7). This means that Georgia EPD issues PSD permits for new major sources pursuant to the requirements of Georgia's regulations. It also means that Georgia EPD considers, but is not legally bound to accept, EPA comments or guidance. A commonly used source of EPA guidance on PSD permitting is EPA's Draft October 1990 New Source Review Workshop Manual for Prevention of Significant Deterioration and Nonattainment Area Permitting (NSR Workshop Manual). The NSR Workshop Manual is a comprehensive guidance document on the entire PSD permitting process.

The PSD regulations require that any major stationary source or major modification subject to the regulations meet the following requirements:

- Application of BACT for each regulated pollutant that would be emitted in significant amounts;
- Analysis of the ambient air impact;
- Analysis of the impact on soils, vegetation, and visibility;
- Analysis of the impact on Class I areas; and
- Public notification of the proposed plant in a newspaper of general circulation

Definition of BACT

The PSD regulation requires that BACT be applied to all regulated air pollutants emitted in significant amounts. Section 169 of the Clean Air Act defines BACT as an emission limitation reflecting the maximum degree of reduction that the permitting authority (in this case, EPD), on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such a facility through application of production processes and available methods, systems, and techniques. In all cases BACT must establish emission limitations or specific design characteristics at least as stringent as applicable New Source Performance Standards (NSPS). In addition, if EPD determines that there is no economically reasonable or technologically feasible way to measure the emissions, and hence to impose and enforceable emissions standard, it may require the source to use a design, equipment, work practice or operations standard or combination thereof, to reduce emissions of the pollutant to the maximum extent practicable.

EPA's NSR Workshop Manual includes guidance on the 5-step top-down process for determining BACT. In general, Georgia EPD requires PSD permit applicants to use the top-down process in the BACT analysis, which EPA reviews. The five steps of a top-down BACT review procedure identified by EPA per BACT guidelines are listed below:

Step 1: Identification of all control technologies;
Step 2: Elimination of technically infeasible options;
Step 3: Ranking of remaining control technologies by control effectiveness;
Step 4: Evaluation of the most effective controls and documentation of results; and
Step 5: Selection of BACT.

The following is a discussion of the applicable federal rules and regulations pertaining to the equipment that is the subject of this preliminary determination, which is then followed by the top-down BACT analysis.

New Source Performance Standards

Federal Rule – 40 CFR 60, Subpart IIII - Standards of Performance for Stationary Compression Ignition Internal Combustion Engines

The emergency generator engine (ID No. EGEN) is potentially subject to 40 CFR 60, Subpart IIII:

"The provisions of this subpart are applicable to manufacturers, owners, and operators of stationary compression ignition (CI) internal combustion engines (ICE) and other persons as specified in paragraphs (a)(1) through (4) of this section. For the purposes of this subpart, the date that construction commences is the date the engine is ordered by the owner or operator.

2) Owners and operators of stationary CI ICE that commence construction after July 11, 2005, where the stationary CI ICE are manufactured: …………………

(i) Manufactured after April 1, 2006, and are not fire pump engines"

Thus the emergency generator engine (ID No. EGEN) is subject to 40 CFR 60, Subpart IIII.

Federal Rule – 40 CFR 60, Subpart CC – Standards of Performance for Glass Manufacturing Plants

The glass melting furnace (ID No. MLTR) is potentially subject to this rule. Each glass melting furnace that commences construction after June 15, 1979 is subject to this rule. However, pursuant to 40 CFR 60.290(c), all-electric melters are not subject to this rule. Glass melting furnace MLTR is a cold-top all-electric melting furnace. Therefore it is not subject to the rule.

Federal Rule - 40 CFR 60, Subpart PPP - Standard of Performance for Wool Fiberglass Insulation Manufacturing Plants.

Each fiberizer (ID No. RA01-RA10, RB01-RB10, RC01-RC12, or RD01-RD12) is potentially subject to this rule. Each rotary spin wool fiberglass insulation manufacturing line that commences construction after February 7, 1984 is subject to this rule. Pursuant to 40 CFR 60.681, "Wool fiberglass insulation means a thermal insulation material composed of glass fibers and made from glass produced or melted at the same facility where the manufacturing line is located.

Manufacturing line means the manufacturing equipment comprising the forming section, where molten glass is fiberized and a fiberglass mat is formed; the curing section, where the binder resin in the mat is thermally "set;" and the cooling section, where the mat is cooled."

Hyalus will not produce a wool fiberglass insulation material or manufacture glass fibers on a manufacturing line. Therefore, each fiberizer is not subject to this rule.

National Emissions Standards for Hazardous Air Pollutants

Federal Rule - 40 CFR 63, Subpart NNN - National Emission Standards for Hazardous Air Pollutants for Wool Fiberglass Manufacturing.

This rule potentially applies to any wool fiberglass manufacturing facility that is a major source for hazardous air pollutants (HAPs). It applies to the glass melting furnace and the manufacturing line consisting of forming, curing, and cooling sections.

This rule does not apply to this facility because it does not manufacture wool fiberglass insulation material and will not include a manufacturing line.

Federal Rule - 40 CFR 63, Subpart NN - National Emission Standards for Hazardous Air Pollutants for Wool Fiberglass Manufacturing at Area Sources.

This rule potentially applies to any wool fiberglass manufacturing facility that is an area source for HAPs or is located at a facility that is an area source. It applies to emissions of chromium compounds from new and existing gas–fired glass melting furnaces located at a wool fiberglass manufacturing facility.

This rule does not apply to this facility because it does not manufacture wool fiberglass insulation material, the glass melting furnace is not gas-fired, and the facility is regulated as a major source for HAPs.

Federal Rule - 40 CFR 63, Subpart SSSSSS - National Emission Standards for Hazardous Air Pollutants for Glass Manufacturing Area Sources.

This rule potentially applies to any glass manufacturing facility that is an area source of HAPs. A glass manufacturing facility is a plant used for the manufacture of container, flat, or pressed and blown glass.

This rule does not apply to this facility because it does not produce container, flat, or pressed and blown glass. Furthermore, the glass produced does not contain compounds of one or more glass manufacturing metal HAP including arsenic, cadmium, chromium, lead, manganese, and nickel. Additionally, this facility is regulated as a major for HAPs.

Federal Rule - 40 CFR 63, Subpart ZZZZ - National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines.

The Emergency Generator Engine (ID No. EGEN) is potentially subject to this rule because it is a stationary reciprocating internal combustion engine (RICE) located at a major source of HAP emissions. Since the emergency generator engine is not being tested at a stationary RICE test cell/stand, it is subject to this rule.

112(g) Case-by-Case MACT

The Hyalus facility will be a minor source for hazardous air pollutants as presented in Section 1 of this determination. The facility is not subject to case-by-case MACT.

State and Federal – Startup and Shutdown and Excess Emissions

Excess emission provisions for startup, shutdown, and malfunction are provided in Georgia Rule 391-3-1-.02(2)(a)7. Excess emissions from the equipment associated with the proposed project would most likely results from a malfunction of the associated control equipment. The facility cannot anticipate or predict malfunctions. However, the facility is required to minimize emissions during periods of startup, shutdown, and malfunction.

Federal Rule – 40 CFR 64 – Compliance Assurance Monitoring

Under 40 CFR 64, the *Compliance Assurance Monitoring* Regulations (CAM), facilities are required to prepare and submit monitoring plans for certain emission units with the Title V application. The facility has not submitted a Title V application; therefore CAM is not applicable at this time.

4.0 CONTROL TECHNOLOGY REVIEW

The proposed project will result in emissions that are significant enough to trigger PSD review for the following pollutants: PM, PM_{10}, $PM_{2.5}$, NO_x, CO, and GHG.

<u>Raw Material Handling Units</u>

The raw material handling units (ID No. RMH, RMF, and RMT) consists of a raw material hopper, weigh bin, mixing vessel, bad batch bin, and furnace day bin. Particulate matter emissions from these units are routed to baghouses (ID Nos. FB01-FB11) for control of PM, PM_{10}, and $PM_{2.5}$.

<u>Raw Material Handling Units – PM Emissions</u>

<u>Step 1: Identify all Control Technologies</u>

The currently available particulate matter (PM) controls include fabric filters (baghouses and in filter banks), dry electrostatic precipitators (ESPs), wet ESPs (WESPs), high efficiency wet scrubbers (venturi scrubbers), and cyclones.

Fabric filtration is a common method for removing dry particulate matter from many types of industrial gas streams. Filters are available in a variety of types, materials, and sizes. Fabric filters are reusable filters that can be cleaned by sonic vibration, shaking, reversing the airflow, or pulsing the airflow. Fabric materials used in fabric filters include cotton, Dacron®, Fiberglas®, Teflon®, Nomex®, polypropylene, and polytetrafluoroethylene (PTFE). In a fabric filter, flue gas is passed through a tightly woven or felted fabric, causing PM in the flue gas to be collected on the fabric by sieving and other mechanisms. Fabric filters may be in the form of sheets, cartridges, or bags, with a number of the individual fabric filter units housed together in a group. Bags are one of the most common forms of fabric filter. The dust cake that forms on the filter from the collected PM can significantly increase collection efficiency. Typical new equipment design efficiencies are between 99 to 99.9%. Several factors determine fabric filter collection efficiency. These include gas filtration velocity, particle characteristics, fabric characteristics, and cleaning mechanism. In general, collection efficiency increases with decreasing filtration velocity and increasing particle size. Fabric filters are generally less expensive than ESPs and they do not require complicated control systems. However, fabric filters are subject to plugging for certain exhaust streams and do require maintenance and inspection to ensure that plugging or holes in the fabric have not developed. Regular replacement of the filters is required, resulting in higher maintenance and operating costs. Bag sizes are differentiated by their diameter and measured in inches. Bags come in diameters from 4 to 12 inches.

ESPs are available in a variety of types including plate-wire, flat plate, tubular, wet, and two-stage precipitators. In the case of an ESP, high voltage electrodes impart a negative charge to the particles entrained in the exhaust gas stream. These negatively charged particles are then attracted to a grounded collecting surface, which is positively charged. The cleaned gas then exits the ESP. Inside the ESP, the particles build up on the collecting plates. For dry ESPs, at periodic intervals, the plates are rapped, causing the agglomerated particles to fall into hoppers. The particles are then removed from the hoppers by a gravity fed rotary screw arrangement. In the case of wet ESPs, a liquid wash down collects the particulates and wet sluicing is used to remove the particles. ESPs offer very high efficiencies for particulates of very small size (above 1 micron in size).

Wet scrubbers remove particulates from a gas stream by a variety of mechanisms including impaction, diffusion, interception, and/or absorption of the pollutant onto droplets of liquid. In comparison to fabric filters and ESPs, scrubbers are smaller and more compact. They are particularly useful in the removal of PM when the waste gas stream is (1) sticky and/or hygroscopic; (2) combustible, corrosive and explosive; (3) particles that are difficult to remove in their dry form; (4) particles with high moisture content; or (5) particles in the presence of soluble gases. Scrubber systems are generally more expensive to purchase and operate than dry filtration systems.

Cyclones are available in many different styles and designs, but each operates using the same basic principles. In all cyclones, PM is separated from the gas stream by centrifugal force. PM is thrown toward the outside of a spinning column of gas, while the relatively clean gas exhausts from the center of the spinning vortex.

Option 1: Fabric filter (baghouse and filter banks)
Option 2: Dry Electrostatic Precipitator
Option 3: Wet Electrostatic Precipitator
Option 4: Wet Scrubber
Option 5: Cyclones

Step 2: Eliminate Technically Infeasible Options

All of the identified technologies are technically feasible.

Step 3: Ranking Remaining Control Technologies by Control Effectiveness

Fabric filters are considered the most effective means of controlling PM from the exhaust gas from raw material handling units. This control technology is widely used at many facilities. Other technologies would be technically viable; however, they would not be expected to be as effective as a fabric filter.

Ranking of Control Technology

Control Technology Ranking	Control Technology	Control Efficiency
1	Fabric filters (baghouse and filter banks)	99-99.9%
2	Dry ESP	99-99.9%
3	Wet ESP	99-99.9%
4	Wet scrubbers	70-99%
5	Cyclones	80-99%

Step 4: Evaluate Most Effective Controls and Document Results

Table B-6 of Appendix B of the PSD application contains a list from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC) database of PM emission rates and controls for raw material handling units. As indicated, the most utilized PM control technology for raw material handling units is the fabric filter.

Step 5: Select BACT

The RBLC database lists four facilities and twenty three processes, including Owens Corning, Cordele, in Georgia for PM. The facilities used a fabric filter (baghouse) to meet PM emission limit ranging from 0.02-0.25 lb/hr. Hyalus proposes to meet a limit of 0.017 pound $PM/PM_{10}/PM_{2.5}$ per ton of raw material loading.

Conclusion – PM Control

The EPD has determined that Hyalus' proposal to use passive fabric filter banks to minimize PM emissions constitutes BACT. The BACT emission limit has been established as 0.017 lb/ton of raw material loading as proposed by Hyalus. Compliance with the PM limit must be demonstrated through performance testing and monitoring of the associated passive fabric filter banks.

Summary – Control Technology Review for PM from Raw Material Handling Units

To fulfill the PSD permitting requirements for $PM/PM_{10}/PM_{2.5}$, Hyalus conducted a BACT analysis for the Raw Material Handling Units. The BACT selection for the raw material handling units is summarized in the table below. The emission limit selected is representative of previous PSD BACT determination levels published in the RBLC database.

Table 4-1: BACT Summary for the Raw Material Handling Units

Pollutant	Control Technology	Proposed BACT Limit	Averaging Time	Compliance Determination Method
$PM/PM_{10}/PM_{2.5}$	Fabric Filter Banks	0.017 lb-$PM/PM_{10}/PM_{2.5}$ per ton of raw material loading	3-hour	Performance testing

Glass Melting Furnace

The glass melting furnace (ID No. MLTR) is a cold top electrically heated furnace that has a melt capacity of 75 tons per day (ton/day). Exhaust fumes from the surface of the glass melting furnace will be ducted to Baghouse (ID No. BH01), which is the control equipment for particulate matter emissions of PM, PM_{10}, and $PM_{2.5}$.

Glass Melting Furnace – PM Emissions

Step 1: Identify all Control Technologies

The currently available particulate matter (PM) controls include fabric filters, dry electrostatic precipitators (ESPs), wet ESPs (WESPs), high efficiency wet scrubbers (venturi scrubbers), batch wetting systems, and cyclones.

Option 1: Fabric filters
Option 2: Dry electrostatic precipitators
Option 3: Wet electrostatic precipitators
Option 4: Wet scrubbers
Option 5: Batch wetting systems
Option 5: Cyclones

Step 2: Eliminate Technically Infeasible Options

All of the identified technologies are technically feasible.

Step 3: Ranking Remaining Control Technologies by Control Effectiveness

Fabric filters are considered the most effective means of controlling PM from the exhaust gas from glass melting furnaces. This control technology is widely used at many facilities. Other technologies would be technically viable; however, they would not be expected to be as effective as a fabric filter.

Ranking of Control Technology

Control Technology Ranking	Control Technology	Control Efficiency
1	Fabric filters (baghouse)	99-99.9%
2	Dry ESP	99-99.9%
3	Wet ESP	99-99.9%
4	Wet scrubbers	90%
5	Cyclones	80-99%

Step 4: Evaluate Most Effective Controls and Document Results

Table B-7 of Appendix B of the PSD application contains a list from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC) database of PM emission rates and controls for glass melting furnaces. As indicated, the most utilized PM control technology for glass melting furnaces is the fabric filter.

Step 5: Select BACT

The RBLC database lists five facilities and fifteen processes, including Owens Corning, Cordele, in Georgia for PM. The facilities used a fabric filter (baghouse) to meet PM emission limit ranging from 0.03-8.16 lb/hr. Note that BACT for Owens Corning, Cordele, Georgia was 0.58 lb total PM per ton of glass pulled. Hyalus proposes to meet a limit of 0.19 lb-PM/PM_{10}/$PM_{2.5}$ per ton of glass pulled.

Conclusion – PM Control

The EPD has determined that Hyalus' proposal to use fabric filter to minimize PM emissions constitutes BACT. The BACT emission limit has been established as 0.19 lb-PM/PM_{10}/$PM_{2.5}$ per ton of glass pulled proposed by Hyalus. Compliance with the PM limit must be demonstrated through performance testing and monitoring of the fabric filter.

Summary – Control Technology Review for PM from the Glass Melting Furnace

To fulfill the PSD permitting requirements for PM/PM_{10}/$PM_{2.5}$, Hyalus conducted a BACT analysis for the glass melting furnace. The BACT selection for the glass melting furnace is summarized in the table below. The emission limit selected is representative of previous PSD BACT determination levels published in the RBLC database.

Table 4-2: BACT Summary for Glass Melting Furnace

Pollutant	Control Technology	Proposed BACT Limit	Averaging Time	Compliance Determination Method
PM/PM_{10}/$PM_{2.5}$	Fabric Filter	0.19 lb-PM/PM_{10}/$PM_{2.5}$ per ton of glass pulled	3-hour	Performance testing

Glass Melting Furnace – GHG Emissions

Step 1: Identify all Control Technologies

Green House Gas (GHG) emissions from the electric glass melting furnace result from the use of carbon-containing raw materials, not the burning of fossil fuels.

The currently available GHG control technology includes recycled glass, electric arc melter, raw material substitution, carbon capture and sequestration, and no controls.

Option 1: Recycled glass
Option 2: Electric arc melter
Option 3: Raw material substitution
Option 4: Carbon capture and sequestration (CCS)
Option 5: No controls

Recycled glass was identified as a control technology for the control of GHG emissions resulting from the glass melt furnace. The use of recycled glass as a raw material would decrease the amount of carbonate materials (e.g. calcium carbonate) needed for the glass melting process and potentially reduce the amount of energy needed. However, this option would require a reliable source of recycled glass with the unique recipe necessary for the glass fiber properties that the Hyalus facility is seeking to produce.

No known source of recycled glass with the appropriate recipe is known to exist.
Therefore, using recycled glass as a control technology for GHG emissions resulting from the glass melt furnace is considered to be technically infeasible.

An electric arc melter was identified during review of historical PSD permit applications for control of GHG emissions resulting from the glass melt furnace. Glass melt furnaces can be fueled using electricity or natural gas. Electrically fueled glass melt furnaces result in no GHG emissions. However, glass melt furnaces fueled by natural gas result in GHG emission net increases from combustion. Therefore, the use of electricity is akin to good combustion practices glass melt furnace operations. The proposed glass melt furnace at the Hyalus facility will be designed to use electricity as a fuel source and is thereby committing to this good combustion practice. As noted, previously, the source will generate GHG due to the use of carbonate-containing raw materials, not due to fuel usage.

Therefore, utilization of an electric arc melter is considered to be technically feasible for the reduction of GHG emissions resulting from the glass melt furnace.

Raw material replacement was identified as a control technology option for the control of GHG emissions resulting from the glass melt furnace. In general, raw material replacement functions to reduce GHG emissions by introducing raw materials that are not composed of carbonate-based raw materials that are added to the glass melt furnace. The replacement of high concentrations of carbonate-based raw materials (such as limestone) with non-carbonate-based raw materials effectively decreases the concentration of CO_2 present in the molten glass mixture located in the glass melt furnace. Therefore, the potential for volatilization of CO_2 is reduced resulting in lower GHG emissions.

Moreover, raw material replacement would also alter the proprietary recipe developed for the proposed facility and subsequently, the unique properties of the glass fibers produced. At this time, there are no known suitable raw material substitutions for the carbonate materials included in the proprietary recipe at the proposed facility.

Therefore, raw material replacement as a control technology for GHG emissions from the glass melt furnace is considered to be technically infeasible.

Carbon capture and sequestration (CCS) consists of three parts; post combustion capture of CO_2 from exhaust stacks, transportation of the CO_2 by pipeline or other method, and secure injection and geologic sequestration of the CO_2 into deep underground rock formations. These underground rock formations are often a mile or more beneath the ground surface and consist of porous rock that maintain the injected CO_2 in place. Non-porous layers of rock (i.e. overlying impermeable layers) trap the CO_2 and prevent upward migration to the atmosphere.

Due to the nature of injection and geologic sequestration, CCS relies on the capture of pure CO_2 in order to avoid potential contamination to the underground environment. It is not suitable for exhaust streams that contain a mixture of pollutants that cannot reasonably be separated. In addition to CO_2, the glass melt furnace will also emit arsenic, cobalt, chromium, cadmium, nickel, fluorides, and other pollutants.

Therefore, CCS is considered to be technically infeasible for the control of GHG emissions resulting from the glass melt furnace.

Step 2: Eliminate Technically Infeasible Options

Only the electric arc melter is considered to be technically feasible. The proposed glass melting furnace will use electricity as a fuel source.

Step 3: Ranking Remaining Control Technologies by Control Effectiveness

Hyalus has decided to use the electric arc melter for melting the batch material in the glass melting furnace. The furnace will be designed to use electricity as a fuel source.

Step 4: Evaluate Most Effective Controls and Document Results

The RACT/BACT/LAER Clearinghouse (RBLC) database did not contain any facilities or processes that controlled GHG emissions from glass melting furnaces.

Step 5: Select BACT

The RBLC database did not contain any facilities or processes that controlled GHG emissions from the glass melting furnace. Hyalus proposes to meet a limit of 8,227 tons of GHG per year from the glass melting furnace determined using raw material usage records.

Conclusion – GHG Control

The EPD has determined that Hyalus' proposal to use an electric arc melter to minimize GHG emissions constitutes BACT. The BACT emission limit has been established as 8,227 tons of GHG per year. Compliance with the GHG limit must be demonstrated through calculations using records of raw material usage and emission factors established by US EPA in 40 CFR 98.

Summary – Control Technology Review for GHG from Glass Melting Furnace

To fulfill the PSD permitting requirements for GHG, Hyalus conducted a BACT analysis for the glass melting furnace. The BACT selection for the glass melting furnace is summarized in the table below.

Table 4-3: BACT Summary for Forehearth Units

Pollutant	Control Technology	Proposed BACT Limit	Averaging Time	Compliance Determination Method
GHG	Electric arc melter	8,227 ton/yr	12-consecutive month period	Record keeping

Forehearth Units

The forehearth unit (ID Nos. FORA, FORB, FORC, FORD) is the channel through which molten glass flows from the melting furnace to the rotary fiberizes. The function of the forehearth is to keep the glass in the molten state prior to the rotary fiberizers. Therefore, the forehearth unit is heated by combusting natural gas, oil, etc. Forehearth unit can also be electrically heated to keep the glass in the molten state. Hyalus' forehearth unit (FORA, FORB, FORC, and FORD) will be heated with natural gas.

Forehearths – PM Emissions

Step 1: Identify all Control Technologies

The currently available particulate matter (PM) controls include fabric filters, dry electrostatic precipitators (ESPs), wet ESPs (WESPs), and high efficiency wet scrubbers (venturi scrubbers).

Option 1: Fabric filters
Option 2: Dry electrostatic precipitators
Option 3: Wet electrostatic precipitators
Option 4: Wet scrubbers
Option 5: No controls

Step 2: Eliminate Technically Infeasible Options

All of the identified technologies are technically feasible.

Step 3: Ranking Remaining Control Technologies by Control Effectiveness

Fabric filters are considered the most effective means of controlling PM from the exhaust gas from the forehearth unit. This control technology is widely used at many facilities. Other technologies would be technically viable; however, they would not be expected to be as effective as a fabric filter.

Ranking of Control Technology

Control Technology Ranking	Control Technology	Control Efficiency
1	Fabric filters (baghouse)	99-99.9%
2	Dry ESP	99-99.9%
3	Wet ESP	99-99.9%
4	Wet scrubbers	70-90%

Step 4: Evaluate Most Effective Controls and Document Results

Table B-8 of Appendix B of the PSD application contains a list from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC) database of PM emission rates and controls for forehearth unit. As indicated, the most utilized PM control technology for forehearth unit is no control.

As indicated, the forehearth unit will be fired with natural gas, a clean burning fuel when compared to oil, coal, or wood. Therefore, the use of natural gas constitutes good combustion practices for minimizing emissions.

Additionally, Hyalus plans to install forehearth unit that is designed to efficiently retain heat, thereby minimizing heat loss, reducing the amount of natural gas combusted, and lowering emissions. Therefore, energy efficient design and energy conservation is also representative of good combustion practices for the forehearth unit.

The $PM_{10}/PM_{2.5}$ uncontrolled potential to emit for the forehearth unit is 0.4 ton/yr. If one assumes an upper range of cost effectiveness of $5,000/ton of emissions controlled, then the annualized cost of any control equipment will need to be less than $2,000. Based on the design of the forehearth systems and the airflow requirements, it would not be possible to design, install and operate a baghouse or any of the other potentially effective control devices (e.g. ESPs or wet scrubbers) for only $2,000 per year. Therefore, there is no cost effective PM control device for the forehearth unit.

Step 5: Select BACT

The RBLC database lists four facilities. Three facilities used "no controls" and one facility used a fabric filter to control PM emissions. The facilities met PM emission limit ranging from 0.03-0.49 lb/hr. Hyalus proposes to meet a limit of 7.60 lb-$PM_{10}/PM_{2.5}$ per MMscf of gas usage, which is approximately equivalent to 0.08 lb/hr.

Conclusion – PM Control

The EPD has determined that Hyalus' proposal to use good combustion practices and energy efficient design to minimize PM emissions constitutes BACT. The BACT emission limit has been established as 7.60 lb-$PM_{10}/PM_{2.5}$ per MMscf of gas usage. Compliance with the PM limit must be demonstrated through natural gas usage.

Summary – Control Technology Review for PM from Raw Material Handling Units

To fulfill the PSD permitting requirements for $PM_{10}/PM_{2.5}$, Hyalus conducted a BACT analysis for the forehearths. The BACT selection for the forehearths is summarized in the table below. The emission limit selected is representative of previous PSD BACT determination levels published in the RBLC database.

Table 4-4: BACT Summary for forehearth units

Pollutant	Control Technology	Proposed BACT Limit	Averaging Time	Compliance Determination Method
$PM_{10}/PM_{2.5}$	Good combustion practices and energy efficient design	7.60 lb-$PM_{10}/PM_{2.5}$ per MMscf of gas usage	n/a	Record keeping

Forehearth Unit – CO Emissions

Step 1: Identify all Control Technologies

CO is a result of incomplete combustion and can be minimized through the use of good combustion practices (including assuring sufficient air-to-fuel ratios). The currently available CO controls include natural gas as a fuel source, over-fire air, regenerative thermal oxidizer (RTO), regenerative catalytic oxidizer (RCO).

Option 1: Natural gas as a fuel source
Option 2: Over-fire air
Option 3: Regenerative thermal oxidizer
Option 4: Regenerative catalytic oxidizer
Option 5: No controls

As indicated, the forehearth unit will be fired with natural gas, a clean burning fuel when compared to oil, coal, or wood. Therefore, the use of natural gas constitutes good combustion practices for minimizing emissions.

Additionally, Hyalus plans to install forehearth unit that is designed to efficiently retain heat, thereby minimizing heat loss, reducing the amount of natural gas combusted, and lowering emissions. Therefore, energy efficient design and energy conservation is also representative of good combustion practices for the forehearth unit.

Over-fire air systems function by diverting a portion of the combustion air stream from the primary zone and reintroducing it above the flame zone, which creates a fuel rich combustion environment, and increases the combustion efficiency. This is commonly used to ensure complete combustion in industrial boilers, and is frequently employed for the reduction of CO, as well as NO_x. In other for over-fire air systems to work, it is necessary to be able to inject a portion of the combustion air directly above the primary combustion zone.

Over-fire air cannot be used in the forehearth unit. The forehearth unit is narrow tunnel constructed of refractory brick through which molten glass flows. Natural gas burners direct combustion flame into the forehearth unit, where the temperature is maintained above the melting point of the glass. The configuration of the forehearth unit will not allow for over-fire air injection because there is no available space above the flames where over-fire air could be injected, as in the case with large commercial boilers.

Therefore, over-fire air is considered to be technically infeasible for the control of CO emissions resulting from the forehearth unit.

Thermal oxidation employs high temperatures (approximately 1,500°F) to achieve a 90 percent or greater oxidation rate of VOCs. Thermal oxidation is rarely employed to control CO emissions because even higher temperatures are required to oxidize CO. However, if employed, typical new equipment design efficiencies are approximately 95% efficient or greater.

There are many types of thermal oxidation units currently on the market, however the RTO type would likely be selected over a simple “flame in a can” thermal oxidizer based on energy recovery/conservation. The achievable thermal energy recovery efficiency for a regenerative thermal oxidizer is roughly 95%, meaning the amount of heat input required over time would only be approximately 5% of the requirements for a simple thermal oxidizer.

Regenerative thermal oxidation is a technically feasible control option for CO emissions resulting from the forehearth unit.

Noble metal (commonly platinum or palladium) oxidation catalysts are used to promote the oxidation of CO to CO_2 and water. The operating temperature range for a conventional oxidation catalyst is between 500 and 1,250°F with efficiencies of greater than 90%.

Oxidation catalysts are not recommended where catalyst poisons may be present. The challenge with using catalyst-based control technologies on the exhaust stream at the Hyalus facility is the presence of arsenic and alkali metals such as sodium and potassium in the exhaust stream. Sodium and potassium will poison catalysts and the effects are irreversible.

Therefore, due to the high likelihood for catalyst poisoning, an RCO is considered to be technically infeasible for the control of CO emissions resulting from the forehearth units.

Step 2: Eliminate Technically Infeasible Options

Over-fire air and RCO are technically infeasible.

Step 3: Ranking Remaining Control Technologies by Control Effectiveness

RTO is the highest ranking control option in terms of control effectiveness for CO control from the forehearths unit. However, this technology is not widely used at many facilities.

Ranking of Control Technology

Control Technology Ranking	Control Technology	Control Efficiency
1	RTO	95-99%
2	No controls	

Step 4: Evaluate Most Effective Controls and Document Results

Table B-1 of Appendix B of the PSD application contains a list from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC) database of CO emission rates and controls for forehearth unit. As indicated, the most utilized CO control technology for forehearth unit is no control.

No instance of CO emissions resulting from a forehearth unit being controlled by RTO was discovered in the RBLC searches or any other available information. Moreover, in order to control the low emissions of forehearth natural gas combustion (i.e., 3.01 tons per year), the RTO control device would require the combustion of natural gas as a fuel source, resulting in additional pollutants generated. Combusting supplemental natural gas, because the forehearth unit has almost no fuel value in the resulting emissions, in order to combust the products of natural gas combustion from the forehearth unit is not practical or environmentally sound.

No established cost effectiveness threshold for CO removal is currently published by the Georgia Environmental Protection Division (EPD) Air Protection Branch. Therefore, the Division reviewed historically published BACT assessments for cost effectiveness thresholds representative of other jurisdictions and found the following cost effectiveness thresholds:

- The San Joaquin Valley Unified Air Pollution Control Division (SJVAPCD) Final Staff Report concluded a cost effectiveness threshold of $300 per tons of CO removed (SJVAPCD 2008).

- The Puget Sound Clean Air Authority (PSCAA) uses a BACT cost effectiveness threshold of $2,000 per ton of CO removed as stated in the Best Available Control Technology (BACT) Cost Analysis Report for Biofuels Energy, LLC.

- The South Coast Air Quality Management District (SCAQMD) Best Available Control Technology Guidelines state a cost effectiveness threshold of $400 per ton of CO removed (SCAQMD 2006).

Moreover, the Division reviewed a correspondence prepared by Bingham McCutchen LLP that researched cost effectiveness thresholds published in the RBLC database and found average cost effectiveness thresholds to be approximately $1,750, $2,730, and $1,160 per ton of CO removed for approved BACT determinations (Poloncarz 2009). Therefore, the RTO installation would need to achieve a cost effectiveness threshold of under $2,730 based on the historically published BACT assessments stated above for the level of CO emissions resulting from the forehearth unit (i.e., only 3.01 tons of uncontrolled CO emissions per year).

As discussed, economic impacts are often expressed in terms of a calculated cost effectiveness. There are two key inputs to the calculated cost-effectiveness; the emission rate and the annualized cost of the control device. Hence, by using the 3.01 tons of uncontrolled CO emissions per year and conservatively selecting the highest acceptable cost effectiveness threshold of $2,730 per ton of emissions controlled, the estimated control option annualized cost can be calculated.

By conservatively assuming the control efficiency of the RTO to be 100%, the annualized cost of the RTO installation and operation would need to be less than approximately $8,200 per year. Based on a budgetary quote provided by Anguil Environmental, an RTO unit would require approximately $123,000 per year in annual natural gas costs alone.

For this reason, RTO for control of CO emissions resulting from the forehearth unit is not considered an appropriate control technology, which is supported by the absence of installations in the industry.

<u>Step 5: Select BACT</u>

The RBLC database lists four facilities. All four facilities used “no controls” for CO emissions. The facilities met CO emission limits ranging from 1.1-1.9 lb/hr. Hyalus proposes to meet a limit of 0.22 lb-CO/ton glass pulled.

<u>Conclusion – CO Control</u>

The EPD has determined that Hyalus’ proposal to use good combustion practices and energy efficient design to minimize CO emissions constitutes BACT. The BACT emission limit has been established as 0.22 lb-CO per ton glass pulled.

<u>Summary – Control Technology Review for CO from Forehearth Units</u>

To fulfill the PSD permitting requirements for CO, Hyalus conducted a BACT analysis for the forehearth units. The BACT selection for the forehearth units is summarized in the table below. The emission limit selected is representative of previous PSD BACT determination levels published in the RBLC database.

Table 4-5: BACT Summary for forehearth units

Pollutant	Control Technology	Proposed BACT Limit	Averaging Time	Compliance Determination Method
CO	Good combustion practices and energy efficient design	0.22 lb-CO per ton of glass pulled	3-Hours	Performance testing

Forehearth Unit – NO_x Emissions

Step 1: Identify all Control Technologies

NO_x is a result of the combustion of natural gas in the forehearth units. The NO_x emission can be from the fuel (fuel NO_x) or nitrogen contained in air combusted at elevated temperatures (thermal NO_x). NO_x emission can be minimized through the use of good combustion practices (including assuring sufficient air-to-fuel ratios). The currently available nitrogen oxides (NO_x) controls include combustion controls, selective non-catalytic reduction (SNCR), selective catalytic reduction (SCR), regenerative selective catalytic reduction (RSCR), and no controls.

Option 1:	Combustion controls
Option 2:	SNCR
Option 3:	SCR
Option 4:	RSCR
Option 5:	No control

As indicated, natural gas is a clean burning fuel. Additionally, through efficient energy design and energy conservation, the forehearth unit design will ensure good combustion practices, thereby minimizing emissions of NO_x.

Combustion controls rely on optimization of combustion by fine-tuning and balancing fuel and air flow to the combustion zone. Optimizing combustion can also be achieved through the monitoring of the air-to-fuel ratio and adjusting to get complete combustion. Achieving optimal combustion is a standard practice to limit NO_x emissions from combustion units. The proposed forehearth units are inherently designed for the appropriate air-to-fuel ratio and mixing.

SNCR utilizes a combustion chamber as the control device reactor, achieving NO_x control efficiencies of 30% to 70%. SNCR systems rely on the reaction of ammonia and nitrogen oxide at temperatures of 1,500°F to 1,950°F to produce molecular nitrogen and water, common atmospheric constituents.

In the SNCR process, ammonia or urea is injected into the combustion chamber where the combustion gas temperature is in the proper range for the reaction. The combustion chamber on the forehearth unit operates using an “open flame” that is not fully enclosed. Due to the combustion chamber not being fully enclosed, the proper reaction time for the ammonia and nitrogen oxide reaction cannot be guaranteed resulting in potential inefficiencies.

Moreover, because the combustion chamber is not enclosed, the injected ammonia has the potential to leak into the work area. This is of significant concern because exposures to ammonia concentrations in low levels can cause irritation to eyes, skin, or the lungs. Exposure to higher concentration levels is corrosive to human tissue and possibly life threatening.

Thus, due to the open combustion chamber and likelihood of ammonia leakage into the work area, SNCR is considered to be technically infeasible for control of NO_x emissions resulting from the forehearth units.

Unlike SNCR, SCR reduces NO_x emissions with ammonia in the presence of a catalyst. The major advantages of this are the higher control efficiency (70% to 90%) and the lower temperatures at which the reaction can take place (400°F to 800°F, depending upon the catalyst selected). SCR is widely used for combustion processes where the type of fuel produces a relatively clean combustion gas. Due to the potential presence of catalyst poisons that are volatile from the molten glass in the forehearth units, SCR is considered to be technically infeasible. Additionally, due to the potential for plugging, the SCR unit would need to be installed downstream of particulate control device where the temperature of the gas will be too low for effective reaction with ammonia.

RSCR is a commercially demonstrated add-on technology that combines the technology of a regenerative thermal oxidizer device and SCR for control device locations where the temperature of the exhaust is too low for traditional SCR systems. Ammonia is injected upstream of the catalyst just as with a traditional SCR unit. The reactions between ammonia and NO are the same. Intended to be placed downstream of emission control systems where the exhaust gas is clean, but the temperature is below the optimal temperature range for catalytic reduction of NO_x, the RSCR unit has a front-end pre-heating section that reheats the exhaust stream with a regenerative thermal device. An RSCR unit is approximately 95% efficient at thermal recovery. The exhaust is heated to a temperature in the range optimal for catalytic reduction (600°F to 800°F) prior to entering an SCR unit.

In both cases, SCR and RSCR are not recommended where catalyst poisons may be present. The challenge with using catalyst-based control technologies on the exhaust stream at the Hyalus facility is the presence of arsenic and alkali metals such as sodium and potassium in the exhaust stream. Sodium and potassium will poison catalysts and the effects are irreversible. The likelihood for trace amounts of sodium and potassium to reach the catalyst is high based on an analysis of historical source test data provided for a similar exhaust stream at the Hollingsworth & Vose Fiber Company facility in Corvallis, Oregon. The historical source test data detected these metals downstream of a particulate control device, evidence that some of these may be volatile and evade even the most stringent particulate pre-controls.

Therefore, due to the high particulate loading upstream of the control device and the high likelihood for catalyst poisoning, SCR and RSCR are considered to be technically infeasible for control of NO_x emissions resulting from the forehearth unit.

Step 2: Eliminate Technically Infeasible Options

SNCR, SCR, RSCR are considered technically infeasible.

Step 3: Ranking Remaining Control Technologies by Control Effectiveness

Combustion control is the only technically feasible option for controlling NO_x emissions from the forehearth unit.

Step 4: Evaluate Most Effective Controls and Document Results

Table B-3 of Appendix B of the PSD application contains a list from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC) database of NO_x emission rates and controls for forehearths. As indicated, the most utilized NO_x control technology for the forehearth unit is no control.

Step 5: Select BACT

The RBLC database lists five facilities. Four of the facilities indicate "no controls" and one facility indicates combustion controls for NO_x emissions control. The facilities met NO_x emission limit ranging from 0.59-2.23 lb/hr. Hyalus proposes to meet a limit of 0.052 lb-NO_x/ton glass pulled.

Conclusion – NO_x Control

The EPD has determined that Hyalus' proposal to use good combustion practices and energy efficient design to minimize NO_x emissions constitutes BACT. The BACT emission limit has been established as 0.052 lb-NO_x per ton glass pulled. Compliance with the NO_x limit must be demonstrated through performance testing.

Summary – Control Technology Review for NO_x from Forehearth Unit

To fulfill the PSD permitting requirements for NO_x, Hyalus conducted a BACT analysis for the forehearth unit. The BACT selection for the forehearth unit is summarized in the table below. The emission limit selected is representative of previous PSD BACT determination levels published in the RBLC database.

Table 4-6: BACT Summary for forehearth units

Pollutant	Control Technology	Proposed BACT Limit	Averaging Time	Compliance Determination Method
NO_x	Good combustion practices and energy efficient design	0.052 lb-NO_x per ton of glass pulled	3-Hours	Performance testing

Forehearth Unit – GHG Emissions

Step 1: Identify all Control Technologies

Green House Gas (GHG) emissions result from the burning of fossil fuels, solid waste, trees and wood products, and certain chemical reactions. Examples of GHG include carbon dioxide, methane, nitrous oxide, and fluorinated gases.

The currently available GHG control technology includes carbon capture and sequestration, energy efficiency practices, and natural gas as a fuel source.

Option 1: CCS
Option 2: Energy efficiency practices
Option 3: Natural gas as a fuel source

CCS consists of three parts; post combustion capture of CO_2 from exhaust stacks, transportation of the CO_2 by pipeline or other method, and secure injection and geologic sequestration of the CO_2 into deep underground rock formations. These formations are often a mile or more beneath the surface and consist of porous rock that holds the CO_2. Overlying these formations are impermeable, non-porous layers of rock that trap the CO_2 and prevent it from migrating upward.

Due to the nature of injection and geologic sequestration, CCS relies on the capture of pure CO_2 in order to avoid contaminating the underground environment. It is not suitable for exhaust streams that contain a mixture of pollutants that cannot reasonably be separated. In addition to CO_2, the forehearth unit will also emit arsenic, cobalt, chromium, cadmium, nickel, Fluorides, and other pollutants

Therefore, CCS is considered to be technically infeasible for the control of GHG emissions resulting from the forehearth units.

Energy efficiency practices were identified as a viable control technology option for emissions resulting from the forehearth unit. It is critical that the forehearth unit maintain the temperature of the molten glass so it does not solidify in the forehearth. The facility will install forehearth units that are designed to retain heat to the extent practical. The reduction of heat loss will lower the total amount of fuel needed for combustion in order to keep the temperatures elevated to maintain the molten glass. Subsequently, this will limit the amount of GHG emissions from the forehearth unit.

Therefore, energy efficiency practices is a technically feasible control technology for GHG emissions resulting from the forehearth unit.

Utilization of natural gas or propane as a fuel source can result in lower emissions of GHG when compared to the combustion of other fossil fuels such as coal and oil, and biomass fuels such as wood. Generally speaking, natural gas is the least carbon intensive combustion fuel and emits fewer air pollutants than other common fuel sources. The forehearth unit to be installed at the proposed facility will only combust natural gas. There is no other viable fuel type that could be used by the facility, and natural gas combustion is a fundamental component of forehearth combustion and overall fiber production, as discussed previously.

Therefore, combusting natural gas is a technically feasible control technology for the control of GHG emissions resulting from the forehearth unit.

Step 2: Eliminate Technically Infeasible Options

CCS is considered technically infeasible.

Step 3: Ranking Remaining Control Technologies by Control Effectiveness

Hyalus has decided to use natural gas as a fuel source for the forehearth unit. The facility will also be designed with energy efficient forehearth construction to limit fuel use to the extent practical.

Step 4: Evaluate Most Effective Controls and Document Results

The RACT/BACT/LAER Clearinghouse (RBLC) database did not contain any facilities or processes that controlled GHG emissions from the forehearth unit.

Step 5: Select BACT

The RBLC database did not contain any facilities or processes that controlled GHG emissions from the forehearth unit. Hyalus proposes to meet a limit of 6,505 tons of GHG per year from the forehearth unit determined from calculations using natural gas fuel records and emission factors established by US EAP in 40 CFR 98.

Conclusion – GHG Control

The EPD has determined that Hyalus' proposal to use good combustion practices and energy efficient design to minimize GHG emissions constitutes BACT. The BACT emission limit has been established as 6,505 tons of GHG per year. Compliance with the GHG limit must be demonstrated through record keeping of natural gas usage.

Summary – Control Technology Review for GHG from Forehearth Unit

To fulfill the PSD permitting requirements for GHG, Hyalus conducted a BACT analysis for the forehearth unit. The BACT selection for the forehearth unit is summarized in the table below.

Table 4-7: BACT Summary for forehearth units

Pollutant	Control Technology	Proposed BACT Limit	Averaging Time	Compliance Determination Method
GHG	Good combustion practices and energy efficient design	6,505 ton/yr	12-consecutive month period	Record keeping

Rotary Fiberizer Unit

Rotary fiberizer unit (ID Nos. RA01-RA10, RB01-RB10, RC01-RC12, or RD01-RD12) will receive molten glass from the forehearth unit. The molten glass will be fed to a rotary spinner which utilizes centrifugal forces to push the molten glass outward through small holes resulting in thin glass fibers. The molten glass is formed into fibers by blowing a stream of air through the molten glass. The newly formed glass fibers will be pneumatically conveyed to collection drums for capture and packaging.

Step 1: Identify all Control Technologies

The currently available particulate matter (PM) controls include fabric filters and cyclones, wet scrubber, low pressure drop scrubber and cyclone separator, venture scrubbers, drop out boxes with water sprayers, wet ESPs (WESPs), Osprey rotary drum 4 stage with HEPA filtration, Osprey rotary drum 3 stage, Tri-Mer ceramic filtration, Tri-Mer cloud chamber scrubber, and Verantis ionizing wet scrubber.

Option 1: Fabric filters and cyclones
Option 2: Wet scrubbers
Option 3: Low pressure drop scrubber and cyclone separator
Option 4: Venturi scrubbers
Option 5: Drop out boxes with water sprayers
Option 6: Wet electrostatic precipitators (WESP)
Option 7: Osprey Rotary Drum 4 Stage with HEPA filtration
Option 8: Osprey Rotary Drum 3 Stage
Option 9: Tri-Mer Ceramic Filtration
Option 10: Tri-Mer Cloud Chamber Scrubber
Option 11: Verantis Ionizing Wet Scrubber

Control technology vendors universally agreed that a fabric filter or similar regenerating fabric filter design would not work as the primary PM control device for the rotary fiberizer unit because of the low bulk density of the collected material. While the material can be collected, it settles very slowly in air and therefore tends to plug a baghouse or similar control device rather than effectively removing the collected material. This is a challenge with cyclone technology as well. The extremely low bulk density of the material, which forms loose agglomerations that are similar to cobwebs or cotton candy, means that this material stays suspended very easily. It would be very difficult to collect this material in a device that relies on settling when airflow is present. It will form bridging between bags and will stay suspended during cleaning cycles in a fabric filter. In a cyclone it would continue to swirl and agglomerate, filling the cyclone throat.

Fabric filters and cyclones are considered to be technically infeasible for the control of PM emissions from rotary fiberizer units.

Wet scrubbers were identified as a control option within the RBLC search and industry control technology option searches for the control of PM emissions resulting from the rotary fiberizer units. The control options identified for the rotary fiberizer units include scrubbers, low pressure drop scrubber and cyclone separator, three venturi scrubbers in parallel, and drop out boxes with water sprayers. These control options are similar such that moisture is used to increase the mass of the collected particulate so that it can be collected in a sump or by cyclonic separation. Typically wet scrubbing will be less than 90 percent effective at particulate removal from rotary fiberizer unit emissions.

Wet scrubbers remove particulate from gas streams principally by inertial impaction of the particulate onto a water droplet. Particles can be wetted by impingement, diffusion, or condensation mechanics. To be wetted, particulate must either make contact with a spray droplet or impinge upon a wet surface. In a venturi scrubber, the gas is constricted in a throat section. The large volume of gas passing through a small constriction gives a high gas velocity and a high-pressure drop across the system. As water is introduced into the throat, the gas is forced to move at a higher velocity causing the water to shear into droplets. Particles in the gas stream then impact onto the water droplets produced. The entrained water droplets are subsequently removed from the gas stream by a cyclonic separator. Venturi scrubber collection efficiency increases with increasing pressure drops for a given particle size. Collection efficiency will also increase with increasing liquid-to-gas ratios up to the point where flooding of the system occurs. Packed bed and venturi scrubber collection efficiencies are typically 90% for particles around 2.5 microns in size or larger. Other wet scrubber designs are possible, but result in lower control efficiencies.

It is important to note that although wet scrubbers solve an air pollution concern, wet scrubbers also create a water pollution concern. The effluent wastewater and wet sludge stream created by wet scrubber control requires the operating facility to have a water treatment system and subsequent disposal system in place. The consequential water treatment system and disposal system increases the overall cost of wet scrubbers and is an important environmental impact to consider.

Wet scrubbers are considered to be technically feasible for the control of PM emissions resulting from the rotary fiberizer units.

The McGill WESP is a possible control option. Electrostatic precipitators (ESPs) are used extensively for control of PM emissions. An ESP is a particulate control device that uses electrical forces to move particles entrained within an exhaust stream onto collection surfaces. The entrained particles are given an electrical charge when they pass through a corona, a region where gaseous ions flow. Electrodes in the center of the flow lane are maintained at high voltage and generate the electrical field that forces the particles to the collector walls. In wet ESPs, the collectors are either intermittently or continuously washed by a spray of liquid, usually water. Instead of the collection hoppers used by dry ESPs, wet ESPs utilize a drainage system and water treatment of some sort. In dry ESPs, the collectors are knocked, or “rapped”, by various mechanical means to dislodge the collected particles, which slide downward into a hopper where they are collected.

Typical new equipment efficiencies are between 99 to 99.9%. Older existing equipment has a range of actual operating efficiencies of 90 to 99.9%. While several factors determine ESP collection efficiency, ESP size is the most important. ESP size determines treatment time; the longer a particle spends in the ESP, the greater its chance of being collected. Maximizing electric field strength will maximize ESP collection efficiency. Collection efficiency is also affected to some extent by dust resistivity, gas temperature, chemical composition (of the dust and the gas), and particle size distribution. Based on a vendor quote, the McGill WESP is currently proven to achieve a 93% control efficiency for similar rotary fiberizer unit applications in industry.

Hence, the McGill WESP is considered to be technically feasible for the control of PM emissions resulting from the rotary fiberizer units.

The Osprey Rotary Drum 4 Stage and Osprey Rotary Drum 3 Stage were identified as viable control technologies for control of PM emissions. Both Osprey Rotary Drums systems use similar control methods.

The first stage of both Osprey Rotary Drum systems is composed of a perforated drum filter encased in filter media that continuously rotates inside an enclosure. As process exhaust gas flows through the perforated drum filter, particulate matter is collected onto the filter media. The collected particulate waste is separated and passes through a secondary cyclone and small baghouse where it is removed from the exhaust stream. The outlet of the small baghouse is connected to the primary fan outlet stack.

The Osprey Rotary Drum 4 Stage includes two additional passive filter stages for fine particulate removal. The two passive filter stages contain coarse and fine filter media rated to a minimum efficiency reporting value (MERV) of 11 and 14, respectively. The Osprey Rotary Drum 4 Stage includes a final high-efficiency particulate arrestance (HEPA) filter stage attached to the outlet of the passive filters that can collect particulate at a minimum of 0.3 microns in diameter. Each filter included in the Osprey Rotary Drum 4 Stage is designed to operate at a maximum exhaust stream temperature of 500 degrees Fahrenheit (°F).

Similarly, the Osprey Rotary Drum 3 Stage includes two additional passive filter stages containing coarse and fine filter media rated to MERV 11 and 15, respectively. The MERV 15 can collect particulate ranging from 0.3 to 1 micron or larger in diameter. Each filter included in the Osprey Rotary Drum 3 Stage is designed to operate at a maximum exhaust stream temperature of 500°F.

Typical new equipment control efficiencies for the Osprey Rotary Drum 4 Stage and Osprey Rotary Drum 3 Stage are 99 percent and 98 percent, respectively. Both control technologies require regular inspection and maintenance of the drum filter enclosure to ensure accumulation of collected wastes is not occurring.

Furthermore, regular replacement of filter media is required and the frequency varies based on the particulate loading of the inlet exhaust stream. The regular maintenance and filter replacement results in higher direct operating costs and subsequent environmental impacts.

The Osprey Rotary Drum 4 Stage and Osprey Rotary Drum 3 Stage are considered to be technically feasible for the control of PM emissions resulting from the rotary fiberizer unit.

Tri-Mer Ceramic Filtration was identified as a viable PM control technology during communications with leading control technology vendors. The Tri-Mer Ceramic Filtration system includes a series of low density ceramic filters (commonly referred to as “candles”) arranged in parallel within an enclosure. Process exhaust enters the enclosure at the bottom of the ceramic filters at a maximum temperature of approximately 750°F.

As the exhaust gas flows through the tube-like structures of the ceramic filters, particulate matter is captured onto the outer walls of the filter surface along with an injected sorbent that helps add bulk density to the collected material. This captured particulate allows for the development of a filter cake that is periodically removed from the filtration system with a reverse pulse of compressed air. The reverse pulse forces the accumulated particulate to fall into a collection hopper for subsequent removal. Thus, although the Tri-Mer Ceramic Filtration is not proven in industry for rotary fiberizer unit applications, strictly speaking, ceramic filtration is technically feasible.

Typical control efficiencies for new installations are estimated to achieve 99% reduction. Regular replacement of filter media is required and the frequency varies based on the particulate loading of the inlet exhaust stream. The regular maintenance and filter replacement results in higher direct operating costs and subsequent environmental impacts.

Tri-Mer Ceramic Filtration is considered to be technically feasible for the control of PM emissions resulting from the rotary fiberizer unit.

The Tri-Mer Cloud Chamber Scrubber (CCS) was identified as a viable control technology for the control of PM emissions. The Tri-Mer CCS control system begins with the process exhaust gas entering a pre-conditioning chamber. In the preconditioning chamber, the process exhaust gas is cooled and large coarse particles are removed by a mist eliminator.

The pre-conditioned exhaust stream is then introduced to the first Cloud Generation Vessel (CGV #1). The CGV #1 contains a complex “scrubbing cloud” of billions of high-density, charged water droplets. Here electrical forces cause a mutual attraction and absorption to occur between the “scrubbing cloud” water droplets and the submicron particulate in the exhaust stream. This interaction results in the capture of the submicron particulate which falls into a sump at the bottom of the Tri-Mer CCS system.

The treated CGV #1 exhaust stream continues through a second Cloud Generation Vessel (CGV #2) containing oppositely charged droplets for additional particulate removal. CGV #2 operates similar to CGV #1 and directs captured particulate to the Tri-Mer CCS sump. Captured particulate from CGV #1 and CGV #2 coagulate into a slurry on the sump floor and are removed from the system. The treated CGV #2 exhaust stream is directed through a final mist eliminator. The subsequent mist eliminator exhaust is routed to the stack and vented to atmosphere.

Typical control efficiency for new installations is 88%. Although the Tri-Mer CCS system is not proven in industry for rotary fiberizer unit applications, strictly speaking, Tri-Mer CCS is technically feasible for the control of PM emissions. Also, subsequent removal of the captured particulate slurry from the system results in increased direct annual costs due to regular inspection and maintenance requirements. Furthermore, landfilling and the introduction of a wastewater stream results in adverse environmental impacts.

The Tri-Mer Cloud Chamber Device is considered to be technically feasible for the control of PM emissions resulting from the rotary fiberizer unit.

The Verantis Ionizing Wet Scrubber (IWS) combines the collection principles of an electrostatic precipitator with a wet scrubber. The IWS is effective in some industrial applications where it is desirable to control both gases and PM. The exhaust passes through an ionizing field and then a bed of packing material that is continuously washed into a sump for collection of the PM. The charged particles are collected on the packing material by magnetic attraction. The Verantis IWS has not been used in a specialty glass fiber manufacturing setting with the loading and fiber size produced by the Hyalus facility. As such it is unproven and would need to go through research and development to determine whether plugging would be a problem. H&V has trialed a number of PM collection systems at their Corvallis, Oregon facility with mixed results due to the plugging caused by the agglomeration of the glass fibers emitted from the process. Based on this experience, the Verantis IWS would be considered unproven for this application unless successful trials could be completed.

The Verantis IWS is considered to be technically infeasible as a proven control solution for application to the control of PM emissions from the rotary fiberizer unit at this time.

Step 2: Eliminate Technically Infeasible Options

Fabric filters, cyclones, and Verantis IWS are considered to be technically infeasible.

Step 3: Ranking Remaining Control Technologies by Control Effectiveness

Osprey rotary drum 4-stage is the highest ranking control option in terms of control effectiveness for PM control from the rotary fiberizer unit.

Ranking of Control Technology

Control Technology Ranking	Control Technology	Control Efficiency
1	Osprey rotary drum 4 stage (HEPA)	99%
2	Tri-Mer ceramic filtration	99%
3	Osprey rotary drum 3 stage	98%
4	McGill WESP	93%
5	Wet scrubbers	90%
6	Tri-Mer CCS	88%

Step 4: Evaluate Most Effective Controls and Document Results

Table B-9 of Appendix B of the PSD application contains a list from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC) database of PM emission rates and controls for rotary fiberizer units. As indicated, the most utilized PM control technology for rotary fiberizer unit is scrubbers followed by drop-out boxes.

The Osprey Rotary Drum 4 Stage system was identified as a leading control option for the control of PM emissions from the rotary fiberizer unit. The energy, environmental, and economic impacts of the Osprey Rotary Drum 4 Stage system is presented in the following paragraphs.

The Osprey Rotary Drum 4 Stage system will require the use of electricity. Based on a budgetary quote provided by the Osprey Corporation, the Osprey Rotary Drum 4 Stage system will require approximately 1,419,120 kilowatt-hours (kW) per year of electricity. This equates to a total annual electricity cost of approximately $99,000 per year as shown in Table C-5 in Appendix C of the PSD application.

The Osprey Rotary Drum 4 Stage system requires the use of several filters to capture filterable PM. The subsequent filters and collected particulate will require proper waste disposal. Typically, this material is sent to be landfilled, which is an environmental concern, but not prohibitive. The Osprey 4 Stage system has one additional layer of filtration than the Osprey 3 Stage system so it would generate additional landfill waste.

As discussed previously, economic impacts are often expressed in terms of a calculated cost effectiveness value calculated from two key inputs to the: the emission rate, and the annualized cost of the control device. The emission rate associated with use of the Osprey Rotary Drum 4 Stage has been estimated for the proposed Hyalus facility using the emission rates for filterable PM_{10} and filterable $PM_{2.5}$. The annualized cost of the control device was calculated based on the methodologies presented in the US EPA Air Pollution Control Cost Manual (EPA 2002). The cost effectiveness of the Osprey Rotary Drum 4 Stage was estimated to be $5,823.87 per ton of controlled PM_{10}, and $6,792.56 per ton of controlled $PM_{2.5}$, assuming 99% control. A detailed costing sheet for the calculations is presented in Table C-5 in Appendix C of the PSD application. Many agencies consider $5,000 per ton removed to be the cost effective threshold for PM emissions in attainment areas. Both the PM_{10} and $PM_{2.5}$ cost effectiveness values exceed $5,000 per ton.

In addition, the incremental cost effectiveness of the Osprey Rotary Drum 4 Stage is very high. Other than the Tri-Mer Ceramic Filtration system (which as noted below is clearly an inferior control option because it would only achieve the same control efficiency as the Osprey Rotary Drum 4 Stage but at a much higher cost), the Osprey 3 Stage system represents the next highest control efficiency. At 98 percent control efficiency for PM, the Osprey 3 Stage system controls only 0.7 tons of PM_{10} less than the Osprey 4 Stage system, but at a much lower cost. As a result, the incremental cost effectiveness of the Osprey 4 Stage system relative to the Osprey 3 Stage system is \$54,823 per ton of PM_{10} and \$63,965 per ton of $PM_{2.5}$ as shown in Table C-8 of Appendix C of the PSD application. This is a measure of the cost to attain a small incremental amount of additional particulate removal and is not considered cost effective.

Based on the cost effectiveness calculations provided, and the incremental cost effectiveness compared to the Osprey Rotary Drum 3 Stage, the Osprey Rotary Drum 4 Stage control option for control of PM emissions from the rotary fiberizer units is not considered cost effective.

Tri-Mer Ceramic Filtration was identified as a leading control option for the control of PM emissions from the rotary fiberizer unit. The energy, environmental, and economic impacts of the Tri-Mer Ceramic Filtration system is presented in the following paragraphs.

The Tri-Mer Ceramic Filtration system will require the use of electricity. Based on a budgetary quote provided by the Tri-Mer Corporation, the Tri-Mer Ceramic Filtration control option will require approximately 1,095,000 kW per year of electricity. This equates to a total annual electricity cost of approximately \$77,000 per year as shown in Table C-6 in Appendix C of the PSD application.

The use of Tri-Mer Ceramic Filtration requires the use of multiple ceramic filter tubes to capture PM. The ceramic filter tubes have an expected service life of 5 to 10 years, so filter disposal is considered to be negligible. Also, collected PM is sent to be landfilled along with the ceramic filter tubes, which is an environmental concern, but not prohibitive.

The cost effectiveness of Tri-Mer Ceramic Filtration was estimated to be \$6,060.04 per ton of controlled PM_{10}, and \$7,068.01 per ton of controlled $PM_{2.5}$, assuming a 99 percent control efficiency. Detailed costing sheets are presented in Table C-6 in Appendix C of the PSD application. Assuming a typical cost effectiveness threshold of \$5,000 per ton of PM controlled, these costs are 20 percent and 40 percent above the typical cost effectiveness threshold, respectively.

The Tri-Mer Ceramic Filtration has the same control efficiency as the Osprey Rotary Drum 4 Stage, yet is costlier in terms of initial installation and cost-per-ton of emissions reduced. Since that option would only provide the same control efficiency as the Osprey Rotary Drum 4 Stage option, but at a much higher cost, Tri-Mer Ceramic Filtration is clearly inferior to the Osprey Rotary Drum 4 Stage. Moreover, the incremental cost effectiveness when compared to the Osprey Rotary Drum 3 Stage is \$78,224 per ton of controlled PM_{10}, and \$91,235 per ton of controlled $PM_{2.5}$ as shown in Table C-8 of Appendix C of the PSD application. These incremental costs represent the high cost of removing an additional 0.7 tons of PM_{10} and $PM_{2.5}$. These value confirm that Tri-Mer Ceramic Filtration is not cost effective.

Based on the estimated cost effectiveness analysis provided above the Tri-Mer Ceramic Filtration control option for control of PM emissions from the rotary fiberizer unit is not cost effective.

The Osprey Rotary Drum 3 Stage was identified as a leading control option for the control of PM emissions from the rotary fiberizer unit. The energy, environmental, and economic impacts of the Osprey Rotary Drum 3 Stage is presented in the following paragraphs.

The Osprey Rotary Drum 3 Stage system will require the use of electricity. Based on a budgetary quote provided by the Osprey Corporation, the Osprey Rotary Drum 3 Stage system will require approximately 1,182,600 kilowatt-hours (kW) per year of electricity. This equates to a total annual electricity cost of approximately $82,800 per year as shown in Table C-7 in Appendix C of the PSD application.

The use of filters requires that the collected material as well as the expended filters must be removed and disposed. Typically, this material is sent to be landfilled, which is an environmental concern, but not prohibitive. The Osprey Rotary Drum 3 Stage does not require the use of a HEPA filter, which results in smaller landfill volumes than the Osprey Rotary Drum 4 Stage.

The cost effectiveness of the Osprey Rotary Drum 3 Stage was estimated to be $5,323.67 per ton of controlled PM10, and $6,209.17 per ton of controlled PM2.5, assuming a 98 percent control efficiency. Detailed costing sheets are presented in Table C-7 of Appendix C of the PSD application. This result is slightly above the typical cost effectiveness threshold for PM of $5,000 per ton.

However, Hyalus is committed to installing a control device to limit PM emissions with at least 98 percent control efficiency, and the Osprey Rotary Drum 3 Stage is more cost effective than the Osprey Rotary Drum 4 Stage and the Tri-Mer Ceramic Filter.

Step 5: Select BACT

The RBLC database lists three facilities and nine processes.. Six of the processes use scrubbers and three processes use drop-out boxes for PM emissions control. The facilities met PM emission limit ranging from 2.32-5.5 lb/hr. Hyalus proposes to meet a limit of 8.11 lb-PM/PM_{10} per ton of rotary fine fiber produced and 1.70 lb-PM/PM_{10} per ton of coarse fiber produced. Hyalus also proposes to meet a limit of 7.24 lb-$PM_{2.5}$ per ton of rotary fine fiber produced and 1.58 lb-$PM_{2.5}$ per ton of rotary coarse fiber produced.

Conclusion – PM Control

The EPD has determined that Hyalus' proposal to use Osprey Rotary Drum 3 Stage to minimize PM emissions constitutes BACT. The BACT emission limit has been established as 8.11 lb-PM/PM_{10} per ton of rotary fine fiber produced and 1.70 lb-PM/PM_{10} per ton of coarse fiber produced. In addition, the BACT emission limit has been established as 7.24 lb-$PM_{2.5}$ per ton of rotary fine fiber produced and 1.58 lb-$PM_{2.5}$ per ton of rotary coarse fiber produced. Compliance with the PM/PM_{10} limit and the $PM_{2.5}$ limit must be demonstrated through performance testing.

Summary – Control Technology Review for PM from Rotary Fiberizer Unit

To fulfill the PSD permitting requirements for PM, Hyalus conducted a BACT analysis for the rotary fiberizer unit. The BACT selection for the rotary fiberizer unit is summarized in the table below. The emission limit selected is representative of previous PSD BACT determination levels published in the RBLC database.

Table 4-8: BACT Summary for rotary fiberizer unit

Pollutant	Control Technology	Proposed BACT Limit	Averaging Time	Compliance Determination Method
PM	Osprey Rotary Drum 3 Stage	8.11 lb-PM/PM_{10} per ton of rotary fine fiber produced 1.7 lb-PM/PM_{10} per ton of rotary coarse fiber produced 7.24 lb-$PM_{2.5}$ per ton of rotary fine fiber produced 1.58 lb-$PM_{2.5}$ per ton of rotary coarse fiber produced	3-hour	Performance testing

Rotary Fiberizer Units – CO Emissions

Step 1: Identify all Control Technologies

CO emissions result from incomplete combustion of natural gas fired to keep the glass in the molten state during fiberization. The currently available CO controls include good combustion practices, monitoring air-to-fuel ratio, utilizing natural gas/propane as a fuel source, RTO, RCO, and no controls.

Option 1: Good combustion practices
Option 2: Monitoring air-to fuel ratio
Option 3: Utilizing natural gas/propane as a fuel source
Option 4: RTO
Option 5: RCO
Option 6: No controls

Additionally and where possible, energy efficient design and energy conservation (e.g. insulation) can reduce the potential levels of CO emissions by the Hyalus facility. The rotary fiberizer units at the Hyalus facility will utilize the direct injection of natural gas and air to heat and attenuate the glass fibers to the appropriate size during fiber formation. Therefore, the rotary fiberizer design will be as thermally efficient as practical to minimize the use of natural gas. However, the rotary fiberizer design does not lend itself to the type of insulation and lean consumption of fuel that might be expected with an industrial boiler with a combustion chamber. Alterations to the method in which fuel and air are mixed or the heat is dissipated would affect the formation and properties of the fibers. In general, energy efficient design and energy conservation is also representative of good combustion practices for the rotary fiberizer units.

Good combustion practices and monitoring the air-to-fuel ratio are control options identified within the RBLC for rotary fiberizer units. These options are synonymous. Good combustion practices rely on optimization of combustion by fine-tuning and balancing fuel and air flow to the combustion zone. Optimizing combustion can also be achieved through the monitoring of the air-to-fuel ratio and adjusting to get complete combustion. Achieving optimal combustion is a standard practice to limit CO emission from combustion units.

Hyalus will use a proprietary glass fiber forming process at the facility. The fiber forming process uses equipment that combusts mixtures of natural gas and air directly injected at rotary formed glass fibers to achieve and maintain critical glass product specifications. The Hyalus facility will monitor the natural gas flow rate required to maintain the temperature necessary to ensure the molten glass in liquid form and to maximize the blast velocity required for proper fiber formation. Therefore, the Hyalus facility will monitor air-to-fuel ratios.

However, re-engineering of the fiber forming process to result in lower CO emissions is currently infeasible. Alternative forming methods with lower CO emissions have not been achieved in practice, and no alternative methods are known in the public domain.

Based on the discussions above, making process alterations that may be considered good combustion practices (excluding energy efficient design or energy conservation) is considered to be technically infeasible. However, monitoring the air-to-fuel ratio is considered to be a technically feasible control options for CO emissions resulting from the rotary fiberizer units.

Utilizing natural gas or propane as a fuel source was identified within the RBLC as a control option for the rotary fiberizer unit. Utilization of natural gas or propane as a fuel source can result in lower emissions of CO when compared to the combustion of other fossil fuels such as coal and oil, and biomass fuels such as wood. Generally speaking, natural gas is the least carbon intensive combustion fuel and emits fewer air pollutants than other common fuel sources. The fiberizers to be installed at the Hyalus facility will only combust natural gas. There is no other viable fuel type that could be used by the Hyalus facility, and natural gas combustion is a fundamental component of fiber production.

Therefore, utilization of natural gas as a fuel source is a technically feasible control option currently proposed to be employed for the rotary fiberizer unit.

Regenerative thermal oxidizers can be used as CO control devices for a variety of source types. Typical new equipment design efficiencies are approximately 95-99% efficient. For a more detailed description of RTO, please refer to the forehearth unit technology review for CO.

No instance of CO emissions from glass rotary fiberizer unit being controlled by RTO was found in the RBLC searches. However, strictly speaking, the use of RTO is technically feasible provided the facility utilizes the particulate controls identified as BACT in this report, upstream of the regenerative thermal oxidizer.

Therefore, an RTO is a technically feasible control option for the reduction of CO emissions resulting from rotary fiberizer unit.

RCO is not recommended where catalysts poisons (such as sodium and potassium) may be present. The likelihood for trace amounts of sodium and potassium to reach the catalyst is high based on an analysis of historical source test data provided for a similar exhaust stream at the Hollingsworth & Vose Fiber Company facility in Corvallis, Oregon. The historical source test data detected these metals downstream of a particulate control device, evidence that some of these poisons may be volatile and evade even the most stringent particulate pre-controls.

Therefore, due to the high likelihood for catalyst poisoning, an RCO is considered to be technically infeasible for control of CO emissions resulting from the rotary fiberizer units.

Step 2: Eliminate Technically Infeasible Options

RCO is technically infeasible due to the possibility of catalyst poisoning.

Step 3: Ranking Remaining Control Technologies by Control Effectiveness

RTO is the highest ranking control option in terms of control effectiveness for CO control from the rotary fiberizer units. However, this technology is not widely used at many facilities.

Ranking of Control Technology

Control Technology Ranking	Control Technology	Control Efficiency
1	RTO	95-99%
2	No controls	

Step 4: Evaluate Most Effective Controls and Document Results

Table B-2 of Appendix B of the PSD application contains a list from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC) database of CO emission rates and controls for rotary fiberizer units. As indicated, the most utilized CO control technology for fiberizer units is no control.

An RTO uses a highly efficient regenerative thermal system to recover thermal energy that must be added to the combustion chamber for heating to the appropriate temperature for effective CO oxidation and subsequent removal. Based on a budgetary quote provided by Anguil Environmental, the RTO unit would use approximately $115,000 per year in electrical energy and $123,000 per year in natural gas as shown in Table C-4 of Appendix C of the PSD permit application. While these energy costs by themselves are not cost prohibitive, they reduce the net energy and environmental benefit of the project by consuming fossil fuels.

As discussed, there are environmental impacts associated with the use of an RTO unit. These discussions are generally limited to air emissions and the consequential impacts to the airshed. The only other waste stream is the eventual replacement of the RTO ceramic media and worn parts, which is considered to be negligible due to an estimated economic life of 10 years. However, the impacts from emissions to the airshed are not considered to be trivial. The use of a RTO control system would introduce the use of natural gas which results in emission of GHGs as well as other products of combustion.

The economic feasibility of an RTO control system was evaluated based on a budgetary quote provided by Anguil Environmental as shown in Table C-4 of Appendix C of the PSD application. The average cost effectiveness of the RTO control system was estimated to be approximately $3,500 per ton of CO removed (Table C-4 of PSD permit application).

As discussed previously, no established cost effectiveness thresholds for CO removal are currently published by the Georgia Environmental Protection Division (EPD) Air Protection Branch. Therefore, a review of historically published BACT assessments for cost effectiveness thresholds representative of other jurisdictions found the highest historically published cost effectiveness threshold to be $2,730.

None of the published thresholds or approved BACT determinations reviewed were as high as the RTO control technology average cost effectiveness for the Hyalus facility. Presumably these cost thresholds are lower than other criteria pollutants because CO does not present the same health impact concerns as other pollutants. RTO control technology is not considered cost effective for the rotary fiberizer unit as a CO emission control solution.

Therefore, the RTO control technology is inappropriate as BACT for the rotary fiberizer unit in the proposed project.

Step 5: Select BACT

The RBLC database lists nine facilities. The majority of the facilities use “no controls” and good combustion practices for CO emissions. The facilities met CO emission limit ranging from 2.2-99.63 lb/hr. Hyalus proposes to meet a limit of 53.0 lb-CO per ton of rotary coarse fiber produced and 270.0 lb-CO per ton of rotary fine fiber produced.

Conclusion – CO Control

The EPD has determined that Hyalus’ proposal to use natural gas as a fuel source and monitoring of the air-to-fuel ratio (i.e., inherently an energy efficient design with energy conservation) to minimize CO emissions constitutes BACT. The BACT emission limit has been established as 53.0 lb-CO per ton of rotary coarse fiber produced and 270.0 lb-CO per ton of rotary fine fiber produced. Compliance with the CO limit must be demonstrated through performance testing.

Summary – Control Technology Review for CO from Rotary Fiberizer Unit

To fulfill the PSD permitting requirements for CO, Hyalus conducted a BACT analysis for the rotary fiberizer unit. The BACT selection for the rotary fiberizer unit is summarized in the table below. The emission limit selected is representative of previous PSD BACT determination levels published in the RBLC database.

Table 4-9: BACT Summary for fiberizer unit

Pollutant	Control Technology	Proposed BACT Limit	Averaging Time	Compliance Determination Method
CO	Natural gas as a fuel source and monitoring of the air-to-fuel ratio	53.0 lb-CO per ton of rotary coarse fiber produced 270.0 lb-CO per ton of rotary fine fiber produced	3-hour	Performance testing

Rotary Fiberizer Units – NO_x Emissions

Step 1: Identify all Control Technologies

NO_x is a result of the combustion of natural gas in the rotary fiberizer units. The NO_x emission can be from the fuel (fuel NO_x) or nitrogen contained in air combusted at elevated temperatures (thermal NO_x). NO_x emission can be minimized through the use of good combustion practices (including assuring sufficient air-to-fuel ratios). The currently available NO_x controls include low NO_x burners, combustion controls, good combustion practices, monitoring the air-to-fuel ratio, SCR, SNCR, RSCR, and no controls.

Option 1:	Low NO_x burners
Option 2:	Combustion controls
Option 3:	Good combustion practices
Option 4:	Monitoring air-to-fuel ratios
Option 5:	SCR
Option 6:	SNCR
Option 7:	RSCR
Option 8:	No control

Additionally and where possible, energy efficient design and energy conservation (e.g. insulation) can reduce the potential levels of NO_x emissions from the Hyalus facility. The rotary fiberizer units at the Hyalus facility will utilize the direct injection of natural gas and air to heat and attenuate the glass fibers to the appropriate size during fiber formation. Therefore, the rotary fiberizer design will be as thermally efficient as practical to minimize the use of natural gas. However, the rotary fiberizer design does not lend itself to the type of insulation and lean consumption of fuel that might be expected with an industrial boiler with a combustion chamber. Alterations to the method in which fuel and air are mixed or the heat is dissipated would affect the formation and properties of the fibers. In general, energy efficient design and energy conservation is also representative of good combustion practices for the rotary fiberizer unit.

Good combustion practices, combustion controls, and monitoring air-to-fuel ratio are control options identified within the RBLC for rotary fiberizer units. These control options are synonymous and were discussed in more detail previously.

As indicated, the Hyalus facility will use a proprietary glass fiber forming process. The fiber forming process uses equipment that combusts mixtures of natural gas and air directly injected at rotary formed glass fibers to achieve and maintain critical glass product specifications. The Hyalus facility will monitor the natural gas flow rate required to maintain the temperature necessary to ensure the molten glass is in liquid form and to maximize the blast velocity required for proper fiber formation. Therefore, the Hyalus facility will monitor air-to-fuel ratios.

However, re-engineering of the rotary fiberizer process to result in lower NO_x emissions is not currently feasible, although H&V has conducted research and development in an attempt to lower CO and NO_x emissions. Unfortunately, attempts to modify the combustion parameters results in unacceptable changes to the glass fiber specifications. Alternative forming methods with lower NO_x emissions have not been achieved in practice, and no alternative methods are known in the public domain.

Based on the discussions above, making process alterations that may be considered good combustion practices and combustion controls (excluding energy efficient design or energy conservation) are considered to be technically infeasible. However, monitoring the air-to-fuel ratio is considered to be a technically feasible control options for NO_x emissions resulting from the rotary fiberizer units.

Low NO_x burners were identified within the RBLC as a control option for the rotary fiberizer units. Low NO_x burners use modified air and fuel entry in a staged process to slow the mixing rate, reduce the oxygen available for NO_x formation in critical NO_x formation zones, and/or reduce the amount of fuel burned at peak flame temperatures.

The H&V rotary fiberizer unit do not use a burner that could be replaced. They use direct injection of gas and air at specific pressures to achieve the attenuation of the glass fibers needed for their product specifications.

Therefore, low NO_x burners are not applicable to the rotary fiberizer unit.

SNCR was identified as a control option for control of NO_x emissions. This control option is synonymous with the discussion presented previously in the NO_x technology review for the forehearth unit. The rotary fiberizer units use equipment that combust mixtures of natural gas and air to achieve and maintain critical glass product specifications.

In the SNCR process, ammonia or urea is injected into the combustion chamber where combustion gas temperature is in the proper range for the reaction. Also important in the SCNR process is the amount of ammonia injected into the combustion chamber. The larger volume of ammonia injected results in higher SCNR control efficiencies of NO_x emissions.

At the Hyalus facility, the rotary fiberizer unit will not have a combustion chamber amenable to injection of ammonia or adequate time at the appropriate temperature to ensure reaction. Additionally, the ammonia would be introduced near the molten glass fibers during formation and could affect the chemical properties of the glass fiber.

Because there is no reaction chamber or appropriate time and temperature for reaction, SNCR is considered to be technically infeasible for NO_x emissions resulting from the rotary fiberizer unit.

SCR and RSCR were identified as control options for control of NO_x emissions. These control options are described in the technology review for the forehearth units where they are discussed in more detail. As described in the forehearth technology review, the likelihood for trace amounts of sodium and potassium to reach the catalyst is high based on an analysis of historical source test data provided for a similar exhaust stream at the Hollingsworth & Vose Fiber Company facility in Corvallis, Oregon. The historical source test data detected these metals downstream of a particulate control device, evidence that some of these poisons may be volatile and evade even the most stringent particulate pre-controls.

Therefore, due to the high particulate loading upstream of the control device and the high likelihood for catalyst poisoning, SCR and RSCR is considered to be technically infeasible for NO_x emissions resulting from the rotary fiberizer unit.

Step 2: Eliminate Technically Infeasible Options

Low NO_x burners, combustion control, good combustion practices, SNCR, SCR, and RSCR are considered technically infeasible.

Step 3: Ranking Remaining Control Technologies by Control Effectiveness

Monitoring the air-to-fuel ratio is the only technically feasible option for controlling NO_x emissions from the rotary fiberizer unit.

Step 4: Evaluate Most Effective Controls and Document Results

Table B-4 of Appendix B of the PSD application contains a list from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC) database of NO_x emission rates and controls for rotary fiberizer units. As indicated, the most utilized NO_x control technology for rotary fiberizer units is monitoring the air-to-fuel ratio.

Step 5: Select BACT

The RBLC database lists five facilities. One of the facilities indicate monitoring the air-to fuel ratio, one low NO_x burners and combustion control, and one good combustion practices for NO_x emissions control. The facilities met NO_x emission limit ranging from 0.203-6.32 lb/hr. Hyalus proposes to meet a limit of 2.58 lb-NO_x per ton of rotary coarse fiber produced and 12.0 lb-NO_x per ton of rotary fine fiber produced.

Conclusion – NO_x Control

The EPD has determined that Hyalus' proposal to monitor the air-to-fuel ratio (i.e., inherently an energy efficient design with energy conservation) to minimize CO emissions constitutes BACT. The BACT emission limit has been established as 2.58 lb-NO_x per ton of rotary coarse fiber produced and 12.0 lb-NO_x per ton of rotary fine fiber produced. Compliance with the NO_x limit must be demonstrated through performance testing.

Summary – Control Technology Review for NO_x from Rotary Fiberizer Units

To fulfill the PSD permitting requirements for NO_x, Hyalus conducted a BACT analysis for the rotary fiberizer unit. The BACT selection for the rotary fiberizer unit is summarized in the table below. The emission limit selected is representative of previous PSD BACT determination levels published in the RBLC database.

Table 4-10: BACT Summary for rotary fiberizer units

Pollutant	Control Technology	Proposed BACT Limit	Averaging Time	Compliance Determination Method
CO	Monitoring of the air-to-fuel ratio	2.58 lb-NO_x per ton of rotary coarse fiber produced 12.0 lb-NO_x per ton of rotary fine fiber produced	3-hour	Performance testing

Rotary Fiberizer Unit – GHG Emissions

Green House Gas (GHG) emissions result from the burning of fossil fuels, solid waste, trees and wood products, and certain chemical reactions. Examples of GHG include carbon dioxide, methane, nitrous oxide, and fluorinated gases.

The currently available GHG control technology includes carbon capture and sequestration, energy efficiency practices, and natural gas as a fuel source.

Option 1:	CCS
Option 2:	Natural gas as a fuel source
Option 3:	Energy efficiency practices

As previously discussed, CCS is not a technically feasible option for controlling GHG emission from the rotary fiberizer units. For further details, refer to the discussion of GHG in the forehearth units section.

As previously discussed, combusting natural gas is a technically feasible control technology for the control of GHG emissions resulting from the rotary fiberizer unit. For further details, refer to the discussion of GHG in the forehearth unit section.

Energy efficiency practices reduce the use of fuels, thereby reducing the production of GHG emissions from combustion. Where possible, energy efficient design and energy conservation (e.g. insulation) can significantly reduce GHG generation. The rotary fiberizer unit at the Hyalus facility will utilize the direct injection of natural gas and air to heat and attenuate the glass fibers to the appropriate size during formation. The Hyalus facility will monitor the natural gas flow rate required to maintain the temperature necessary to ensure the molten glass in liquid form and to maximize the blast velocity required for proper fiber formation. Thus, the rotary fiberizer unit design will be as thermally efficient as practical to minimize the use of natural gas. However, the rotary fiberizer unit design does not lend itself to the type of insulation and lean consumption of fuel that might be expected with an industrial boiler with a combustion chamber. Alterations to the method in which fuel and air are mixed or the heat is dissipated would affect the formation and properties of the fibers.

Therefore, energy efficiency practices is a technically feasible control technology for the control of GHG emissions resulting from the rotary fiberizer unit.

Step 2: Eliminate Technically Infeasible Options

CCS is considered technically infeasible.

Step 3: Ranking Remaining Control Technologies by Control Effectiveness

Hyalus has decided to use natural gas as a fuel source for the rotary fiberizer unit. The rotary fiberizer unit will be designed to be thermally efficient to limit fuel use to the extent practical.

Step 4: Evaluate Most Effective Controls and Document Results

The RACT/BACT/LAER Clearinghouse (RBLC) database did not contain any facilities or processes that controlled GHG emissions from rotary fiberizer units.

Step 5: Select BACT

The RBLC database did not contain any facilities or processes that controlled GHG emissions from rotary fiberizer units. Hyalus proposes to meet a limit of 83,368 tons of GHG per year from the rotary fiberizer unit determined from calculations using natural gas fuel records.

Conclusion – GHG Control

The EPD has determined that Hyalus' proposal to use good combustion practices and energy efficient design to minimize GHG emissions constitutes BACT. The BACT emission limit has been established as 83,368 tons of GHG per year. Compliance with the GHG limit must be demonstrated through record keeping of natural gas usage and emission factors established by US EPA in 40 CFR 98.

Summary – Control Technology Review for GHG from Rotary Fiberizer Units

To fulfill the PSD permitting requirements for GHG, Hyalus conducted a BACT analysis for the rotary fiberizer unit. The BACT selection for the rotary fiberizer unit is summarized in the table below.

Table 4-11: BACT Summary for rotary fiberizer unit

Pollutant	Control Technology	Proposed BACT Limit	Averaging Time	Compliance Determination Method
GHG	Good combustion practices and energy efficient design	83,368 ton/yr for all 44 rotary fiberizer units	12-consecutive month period	Record keeping

Cooling Tower Units

Cooling tower units (ID Nos. CT01-CT03) are used to condition the air used in all parts of the facility and to cool the closed-loop cooling water on the rotary fiberizer units.

Step 1: Identify all Control Technologies

The currently available particulate matter (PM) control is high efficiency drift eliminators.

High efficiency drift eliminators

Drift eliminators are a possible control option for the control of PM emissions from the cooling tower. Drift eliminators are an add-on control technology that reduces the amount of entrained water droplets that leave the cooling towers. These water droplets rapidly dry and leave the remaining mineral content of the water as a particulate emission source.

Drift Eliminators are considered to be technically feasible control technology for PM emissions resulting from the cooling towers.

Step 2: Eliminate Technically Infeasible Options

Only drift eliminators are considered to be technically feasible option for controlling PM emissions from the cooling tower units.

Step 3: Ranking Remaining Control Technologies by Control Effectiveness

Only drift eliminators are considered to be technically feasible option for controlling PM emissions from the cooling tower units.

Step 4: Evaluate Most Effective Controls and Document Results

Table B-5 of Appendix B of the PSD application contains a list from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC) database of PM emission rates and controls for cooling tower units. As indicated, only drift eliminators are utilized as the PM control technology for cooling tower units.

The RBLC database identified multiple installations of high efficiency drift eliminators to control PM emissions resulting from cooling towers at a drift loss of 0.0005% which is representative of the top control option. The Hyalus facility has committed to installing a series of high efficiency drift eliminators with a drift loss of 0.001% for the cooling towers. Based on information provided by the high efficiency drift eliminator vendor, the cost to install a second bank of high efficiency drift eliminators in order to achieve the 0.0005% drift loss is approximately $10,800. Moreover, the cooling tower size and water usage would need to be increased in order to achieve the same process heat dissipation resulting in adverse environmental and energy impacts.

The cost effectiveness for installing a second set of high efficiency drift eliminators has been estimated for the Hyalus facility using the methodologies presented in the US EPA Air Pollution Control Cost Manual (EPA 2002). The PM_{10} and $PM_{2.5}$ annual emission estimates for the cooling towers, assuming a drift loss of 0.001% and 0.0005%, were estimated using the calculations provided in Table 16 of the Emissions Inventory (Attachment A of the PSD permit application):

Annual emission estimates assuming a drift loss of 0.001%

- PM_{10} = 0.048 tons per year
- $PM_{2.5}$ = 0.029 tons per year

Annual emission estimates assuming a drift loss of 0.0005%

- PM_{10} = 0.024 tons per year
- $PM_{2.5}$ = 0.014 tons per year

By achieving the 0.0005% drift loss, the additional reduction in PM_{10} and $PM_{2.5}$ annual emission estimates is approximately 0.024 and 0.014 tons per year, respectively. This equates to an incremental cost effectiveness of approximately $450,600 and $751,100 per ton removed for PM_{10} and $PM_{2.5}$, respectively (i.e. the quoted cost to install the second bank of high efficiency drift eliminators divided by the additional reduction in PM_{10} and $PM_{2.5}$ annual emission estimates, respectively). Thus, the cost to attain a small incremental amount of additional particulate removal is not considered to be cost effective. As a result, the high efficiency drift eliminator at a drift loss of 0.0005% is inappropriate as BACT for the cooling towers in the proposed project.

Step 5: Select BACT

The RBLC database lists thirty nine facilities and one process. All use drift eliminators for PM emissions control from cooling towers. The facilities met percent drift loss ranging from 0.0005 to 0.008. Hyalus proposes to meet a drift loss of 0.001 percent using high efficiency drift eliminators.

Conclusion – PM Control

The EPD has determined that Hyalus' proposal to use high efficiency drift eliminators to minimize PM emissions constitutes BACT.

Summary – Control Technology Review for PM from Cooling Towers

To fulfill the PSD permitting requirements for PM, Hyalus conducted a BACT analysis for the control tower units. The BACT selection for the cooling towers is summarized in the table below.

Table 4-12: BACT Summary for rotary fiberizer units

Pollutant	Control Technology	Proposed BACT Limit	Averaging Time	Compliance Determination Method
PM	High efficiency drift eliminators	N/a	N/a	N/a

5.0 TESTING AND MONITORING REQUIREMENTS

Testing Requirements:

Raw Material Handling
The Permittee is required to test the raw material handling stacks to demonstrate compliance with the PSD limit for $PM_{10}/PM_{2.5}$.

Glass Melting Furnace
The Permittee is required to test the glass melting furnace stack to demonstration compliance with the PSD limit for $PM_{10}/PM_{2.5}$. The testing will be repeated every three years.

Forehearths
The Permittee is required to test the forehearth unit stack to demonstrate compliance with PSD limits for CO and NO_X. Testing has not been required for PM because the limit is based on the AP-42 emission for natural gas. The CO and NO_X testing will be repeated every two years.

Rotary Fiberizers
The Permittee is required to test the fiberizers for $PM/PM_{10}/PM_{2.5}$ during the production of coarse and fine fibers. The testing is used to demonstrate compliance with PSD limits as well as to collect data for calculating combined $PM/PM_{10}/PM_{2.5}$ on a 12-month rolling basis. The testing will be repeated every three years.

The Permittee is required to test the fiberizers for CO and NO_X during the production of coarse and fine fibers. The testing is used to demonstrate compliance with PSD limits as well as to collect data for calculating combined CO and NO_X on a 12-month rolling basis. The CO and NO_X testing will be repeated every two years.

Flourides
The Permittee is required to test the glass melting furnace and the fiberizers (fine fiber and coarse fiber) for fluorides. The testing is necessary to collect data for calculating facility wide emissions and demonstrating compliance with the PSD avoidance limit. The testing will be repeated every two years.

Formaldehyde
The Permittee is required to test the fiberizers (fine fiber and coarse fiber) for formaldehyde. The testing is necessary to ensure the emission factors used in the application were appropriate.

Monitoring Requirements:

Raw Material Handling
The Permittee is required to monitor pressure drop, conduct visible emission checks, and develop a preventative maintenance plan for the raw material handling baghouses. The monitoring provides a reasonable assurance that particulate emissions are properly controlled.

The facility is required to monitor throughput for the material handling equipment.

Glass Melting Furnace
The Permittee is required to monitor pressure drop, conduct visible emission checks, and develop a preventative maintenance plan for the glass melting furnace baghouse. The monitoring provides a reasonable assurance that particulate emissions are properly controlled.

The facility is required to monitor throughput and material usage for the furnace. The methods for direct monitoring of furnace pull rate are very limited; manual grab sampling and weighing is an option. The sum of glass pulled through the fiberizers, plus any glass patties and cullet equals the furnace glass pull rate. Final production rate may be lower due to loss between fiberizing and final packing.

Forehearths
The facility is required to monitor the amount of natural gas burned in the forehearths.

Rotary Fiberizers
The Permittee is required to monitor pressure drop and develop a preventative maintenance plan for the rotary fiberizer drum filters. The facility must also conduct visible emission checks. The monitoring provides a reasonable assurance that particulate emissions are properly controlled.

The Permittee is required to conduct inspections for the rotary fiberizer cyclones. The monitoring provides a reasonable assurance that particulate emissions are properly controlled.

The Permittee is required to monitor pressure drop and develop a preventative maintenance plan for the rotary fiberizer baghouses. The monitoring provides a reasonable assurance that particulate emissions are properly controlled.

The facility is required to monitor the amount of natural gas burned in the fiberizers and the product rate at the fiberizers.

Emergency Engine
The Permittee is required to monitor usage hours in order to ensure emergency classification for the engine.

<u>CAM Applicability:</u>

The new specialty glass fiber manufacturing facility will be subject to the requirements of compliance assurance monitoring (CAM) as specified in 40 CFR 64 upon being issued a Part 70 permit. No CAM requirements have been included in this permit.

6.0 AMBIENT AIR QUALITY REVIEW

An air quality analysis is required to determine the ambient impacts associated with the construction and operation of the proposed modifications. The main purpose of the air quality analysis is to demonstrate that emissions emitted from the proposed modifications, in conjunction with other applicable emissions from existing sources (including secondary emissions from growth associated with the new project), will not cause or contribute to a violation of any applicable National Ambient Air Quality Standard (NAAQS) or PSD increment in a Class I or Class II area. NAAQS exist for NO_2, CO, $PM_{2.5}$, PM_{10}, SO_2, Ozone (O_3), and lead. PSD increments exist for SO_2, NO_2, and PM_{10}.

The proposed project at Hyalus, Inc. triggers PSD review for CO, NO_x, PM_{10}, $PM_{2.5}$. An air quality analysis was conducted to demonstrate the facility's compliance with the NAAQS and PSD Increment standards for CO, NO_2, PM_{10}, $PM_{2.5}$. An additional analysis was conducted to demonstrate compliance with the Georgia air toxics program. This section of the application discusses the air quality analysis requirements, methodologies, and results. Supporting documentation may be found in the Air Quality Dispersion Report of the application and in the additional information packages.

The construction of Hyalus will have no effect on the operations of the existing Hollingsworth and Vose paper facility. H&V was considered "non-ambient" air for the purposes of modeling because the facilities are under common control and are located on the contiguous property. The Toxic Impact Assessment included emissions from the H&V facility at EPD's request in an abundance of caution. Only those compounds to be emitted at Hyalus were considered in including H&V (compounds at H&V that are not increasing were not modeled). The site is surrounded by a fence to serve as a physical barrier.

<u>Modeling Requirements</u>

The air quality modeling analysis was conducted in accordance with Appendix W of Title 40 of the Code of Federal Regulations (CFR) §51, *Guideline on Air Quality Models*, and Georgia EPD's *Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions (Revised).*

The proposed project will cause net emission increases of CO, NO_x, PM_{10}, $PM_{2.5}$ that are greater than the applicable PSD Significant Emission Rates. Therefore, air dispersion modeling analyses are required to demonstrate compliance with the NAAQS and PSD Increment.

<u>Significance Analysis: Ambient Monitoring Requirements and Source Inventories</u>

Initially, a Significance Analysis is conducted to determine if the CO, NO_x, PM_{10}, $PM_{2.5}$ emissions increases at the Hyalus, Inc. would significantly impact the area surrounding the facility. Maximum ground-level concentrations are compared to the pollutant-specific U.S. EPA-established Significant Impact Level (SIL). The SIL for the pollutants of concern are summarized in Table 6-1.

If a significant impact (i.e., an ambient impact above the SIL) does not result, no further modeling analyses would be conducted for that pollutant for NAAQS or PSD Increment. If a significant impact does result, further refined modeling would be completed to demonstrate that the proposed project would not cause or contribute to a violation of the NAAQS or consume more than the available Class II Increment.

Under current U.S. EPA policies, the maximum impacts due to the emissions increases from a project are also assessed against monitoring *de minimis* levels to determine whether pre-construction monitoring should be considered. These monitoring *de minimis* levels are also listed in Table 6-1. If either the predicted modeled impact from an emission increase or the existing ambient concentration is less than the monitoring *de minimis* concentration, the permitting agency has the discretionary authority to exempt an applicant from pre-construction ambient monitoring. This evaluation is required for CO, NO_x, PM_{10}, $PM_{2.5}$.

If any off-site pollutant impacts calculated in the Significance Analysis exceed the SIL, a Significant Impact Area (SIA) would be determined. The SIA encompasses a circle centered on the facility with a radius extending out to (1) the farthest location where the emissions increase of a pollutant from the project causes a significant ambient impact, or (2) a distance of 50 km, whichever is less. All sources within a distance of 50 km of the edge of a SIA are assumed to potentially contribute to ground-level concentrations within the SIA and would be evaluated for possible inclusion in the NAAQS and PSD Increment analyses.

Table 6-1: Summary of Modeling Significance Levels (Class II)

Pollutant	Averaging Period	PSD Significant Impact Level (ug/m^3)	PSD Monitoring Deminimis Concentration (ug/m^3)
PM_{10}	Annual	1	--
	24-Hour	5	10
PM2.5	Annual	0.3	
	24-hour	1.2	
NO2	Annual	1	14
	1-hour	7.5	
CO	8-Hour	500	575
	1-Hour	2000	--

NAAQS Analysis

The primary NAAQS are the maximum concentration ceilings, measured in terms of total concentration of pollutant in the atmosphere, which define the "levels of air quality which the U.S. EPA judges are necessary, with an adequate margin of safety, to protect the public health." Secondary NAAQS define the levels that "protect the public welfare from any known or anticipated adverse effects of a pollutant." The primary and secondary NAAQS are listed in Table 6-2 below.

Table 6-2: Summary of National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS	
		Primary / Secondary (ug/m^3)	Primary / Secondary (ppm)
PM_{10}	Annual	*Revoked 12/17/06	*Revoked 12/17/06
	24-Hour	150 / 150	--
$PM_{2.5}$	Annual	12 / 12	--
	24-Hour	35 / 35	--
NO_2	Annual	100 / 100	0.053 / 0.053
NO2	1-hour	188	
CO	8-Hour	10,000 / None	9 / None
	1-Hour	40,000 / None	35 / None

If the maximum pollutant impact calculated in the Significance Analysis exceeds the SIL at an off-property receptor, a NAAQS analysis is required. The NAAQS analysis would include the potential emissions from all emission units at Hyalus, except for units that are generally exempt from permitting requirements and are normally operated only in emergency situations. The emissions modeled for this analysis would reflect the results of the BACT analysis for the modified emission unit. Facility emissions would then be combined with the allowable emissions of sources included in the regional source inventory. The resulting impacts, added to appropriate background concentrations, would be assessed against the applicable NAAQS to demonstrate compliance. For an annual average NAAQS analysis, the highest modeled concentration among five consecutive years of meteorological data would be assessed, while the highest second-high impact would be assessed for the short-term averaging periods.

PSD Increment Analysis

The PSD Increments were established to "prevent deterioration" of air quality in certain areas of the country where air quality was better than the NAAQS. To achieve this goal, U.S. EPA established PSD Increments for certain pollutants. The sum of the PSD Increment concentration and a baseline concentration defines a "reduced" ambient standard, either lower than or equal to the NAAQS that must be met in an attainment area. Significant deterioration is said to have occurred if the change in emissions occurring since the baseline date results in an off-property impact greater than the PSD Increment (i.e., the increased emissions "consume" more that the available PSD Increment).

U.S. EPA has established PSD Increments for NO_X, SO_2, PM_{10} and PM2.5; no increments have been established for CO. The PSD Increments are further broken into Class I, II, and III Increments. Hyalus will be located in a Class II area. The PSD Increments are listed in Table 6-3.

Table 6-3: Summary of PSD Increments

Pollutant	Averaging Period	PSD Increment	
		Class I (ug/m^3)	Class II (ug/m^3)
PM_{10}	Annual	4	17
	24-Hour	8	30
PM2.5	Annual	1	4
	24-hour	2	9
NO_X	Annual	2.5	25

To demonstrate compliance with the PSD Increments, the increment-affecting emissions (i.e., all emissions increases or decreases after the appropriate baseline date) from the facility and those sources in the regional inventory would be modeled to demonstrate compliance with the PSD Class II increment for any pollutant greater than the SIL in the Significance Analysis. For an annual average analysis, the highest incremental impact will be used. For a short-term average analysis, the highest second-high impact will be used.

The determination of whether an emissions change at a given source consumes or expands increment is based on the source classification (major or minor) and the time the change occurs in relation to baseline dates. The major source baseline date for NO_X is February 8, 1988, and the major source baseline for SO_2 and PM_{10} is January 5, 1976. Emission changes at major sources that occur after the major source baseline dates affect Increment. In contrast, emission changes at minor sources only affect Increment after the minor source baseline date, which is set at the time when the first PSD application is completed in a given area, usually arranged on a county-by-county basis. The minor source baseline dates have been set for PM_{10} , SO_2 , and PM2.5 as January 30, 1980, and for NO_2 as April 12, 1991, and for PM2.5 as October 20, 2010.

Modeling Methodology

Details on the dispersion model, including meteorological data, source data, and receptors can be found in EPD's PSD Dispersion Modeling and Air Toxics Assessment Review in Appendix C of this Preliminary Determination and in the Atlanta Air Protection Branch office.

Modeling Results

Table 6-4 show that the proposed project will not cause ambient impacts of CO and PM_{10} above the appropriate SIL. Because the emissions increases from the proposed project result in ambient impacts less than the SIL, no further PSD analyses were conducted for these pollutants.

However, ambient impacts above the SILs were predicted for NO2 and $PM_{2.5}$ for the 1-hour, 24-hour, and annual averaging periods, requiring NAAQS and Increment analyses be performed for NO_2 and $PM_{2.5}$.

Table 6-4: Class II Significance Analysis Results – Comparison to SILs

Pollutant	Averaging Period	Year	UTM East (km)	UTM North (km)	Maximum Impact (ug/m^3)	SIL (ug/m^3)	Significant?
NO_2	Annual	2011	268212.94	3576148.25	0.63	1	No
	1-hour	5-yr avg	268476.25	3576260.75	11.87	7.5	**Yes**
PM_{10}	24-hour	2013	267225.97	3576228.19	4.83	5	No
	Annual	2014	268194.21	3576161.88	0.90	1	No
CO	1-hour	2013	268476.25	3576260.75	530.93	2000	No
	8-hour	2012	268079.13	3576325.79	235.27	500	No
$PM_{2.5}$	Annual	5-yr avg	268194.21	3576161.88	0.8	0.3	**Yes**
	24-hour	5-yr avg	267259.76	3576087.71	3.72	1.2	**Yes**

Data for worst year provided only.

As indicated in the tables above, maximum modeled impacts were below the corresponding SILs for CO and PM_{10}. However, maximum modeled impacts were above the SILs for NO_2 and $PM_{2.5}$. Therefore, a Full Impact Analysis was conducted for NO_x and $PM_{2.5}$ for the 1-hour, 24-hour, and annual averaging periods

Significant Impact Area

For any off-site pollutant impact calculated in the Significance Analysis that exceeds the SIL, a Significant Impact Area (SIA) must be determined. The SIA encompasses a circle centered on the facility being modeled with a radius extending out to the lesser of either: 1) the farthest location where the emissions increase of a pollutant from the proposed project causes a significant ambient impact, or 2) a distance of 50 kilometers. All sources of the pollutants in question within the SIA plus an additional 50 kilometers are assumed to potentially contribute to ground-level concentrations and must be evaluated for possible inclusion in the NAAQS and Increment Analysis.

Based on the results of the Significance Analysis, the distance between the facility and the furthest receptor from the facility that showed a modeled concentration exceeding the corresponding SIL was determined to be less than 18.96, 1.16, and 1.99 kilometers for NO_2, and $PM_{2.5}$.

NAAQS and Increment Modeling

The next step in completing the NAAQS and Increment analyses was the development of a regional source inventory. Nearby sources that have the potential to contribute significantly within the facility's SIA are ideally included in this regional inventory. Hyalus requested and received an inventory of NAAQS and PSD Increment sources from Georgia EPD. Hyalus, Inc. reviewed the data received and calculated the distance from the mill to each facility in the inventory. All sources more than 18.96, 1.16, and 1.99 km outside the SIA were excluded.

The distance from the facility of each source listed in the regional inventories was calculated, and all sources located more than 18.96, 1.16, and 1.99 kilometers from the mill were excluded from the analysis. Additionally, pursuant to the "20D Rule," facilities outside the SIA were also excluded from the inventory if the entire facility's emissions (expressed in tons per year) were less than 20 times the distance (expressed in kilometers) from the facility to the edge of the SIA. In applying the 20D Rule, facilities in close proximity to each other (within approximately 5 kilometers of each other) were considered as one source. Then, any Increment consumers from the provided inventory were added to the permit application forms or other readily available permitting information.

The regional source inventory used in the analysis is included in the permit application and the attached modeling report.

NAAQS Analysis

In the NAAQS analysis, impacts within the facility's SIA due to the potential emissions from all sources at the facility and those sources included in the regional inventory were calculated. Since the modeled ambient air concentrations only reflect impacts from industrial sources, a "background" concentration was added to the modeled concentrations prior to assessing compliance with the NAAQS.

The results of the NAAQS analysis are shown in Table 6-5. For the short-term averaging periods, the impacts are the highest second-high impacts. For the annual averaging period, the impacts are the highest impact. When the total impact at all significant receptors within the SIA are below the corresponding NAAQS, compliance is demonstrated.

Table 6-5: NAAQS Analysis Results

Pollutant	Averaging Period	Year	UTM East (km)	UTM North (km)	Maximum Impact (ug/m^3)	Background (ug/m^3)	Total Impact (ug/m^3)	NAAQS (ug/m^3)	Exceed NAAQS?
NO_2	1-hour	5-yr	267943	3576499	71.53	30.3	101.8	188	No
$PM_{2.5}$	24-hour	5-yr	268194	3576162	3.30	17.9	21.21	35	No
	Annual	5-yr	268085	3576302	1.18	8.2	9.38	12	No

Data for worst year provided only.

As indicated in Table 6-5 above, all of the modeled impacts at all significant receptors within the SIA are below the corresponding NAAQS.

Increment Analysis

The modeled impacts from the NAAQS run were evaluated to determine whether compliance with the Increment was demonstrated. The results are presented in Table 6-6.

Table 6-6: Increment Analysis Results

Pollutant	Averaging Period	Year	UTM East (km)	UTM North (km)	Maximum Impact (ug/m^3)	Increment (ug/m^3)	Exceed Increment?
$PM_{2.5}$	24-hour	2014	267260	3576088	4.54	9	No
	Annual	2011	268085	3576302	1.23	4	No

Data for worst year provided only

Table 6-6 demonstrates that the impacts are below the corresponding increments for $PM_{2.5}$ at the 24-hour and annual averaging period even with the conservative modeling assumption that all NAAQS sources were Increment sources.

Ambient Monitoring Requirements

Table 6-7: Significance Analysis Results – Comparison to Monitoring *De Minimis* Levels

Pollutant	Averaging Period	Year*	UTM East (km)	UTM North (km)	Monitoring De Minimis Level (ug/m^3)	Modeled Maximum Impact (ug/m^3)	Significant?
NO_2	Annual	2011	268212.94	3576148.25	14	0.63	No
PM_{10}	24-hour	2013	267225.97	3576228.19	10	4.83	No
CO	8-hour	2012	268079.13	3576325.79	575	235.27	No

Data for worst year provided only

The impacts for NO_X, CO, and PM_{10} quantified in Table 6-4 of the Class I Significance Analysis are compared to the Monitoring *de minimis* concentrations, shown in Table 6-1, to determine if ambient monitoring requirements need to be considered as part of this permit action. Because all maximum modeled impacts are below the corresponding de minimis concentrations, no pre-construction monitoring is required for NO_2, PM_{10}, or CO.

As noted previously, the VOC *de minimis* concentration is mass-based (100 tpy) rather than ambient concentration-based (ppm or $\mu g/m^3$). Projected VOC emissions increases resulting from the proposed modification are less than 100 tpy. Therefore, no ozone ambient analysis is required.

Class I Area Analysis

Federal Class I areas are regions of special national or regional value from a natural, scenic, recreational, or historic perspective. Class I areas are afforded the highest degree of protection among the types of areas classified under the PSD regulations. U.S. EPA has established policies and procedures that generally restrict consideration of impacts of a PSD source on Class I Increments to facilities that are located near a federal Class I area. Historically, a distance of 100 km has been used to define "near", but more recently, a distance of 200 kilometers has been used for all facilities that do not combust coal.

Four Class I areas exist within a 300 km range from the Hyalus facility: Okefenokee Wildlife Refuges, GA; Wolf Island Wildlife Refuges, GA; St. Marks Wildlife Refuges, FL; and Bradwell Bay Wilderness Area, FL.

The Class I area within approximately 200 kilometers of the Hyalus facility is the Okefenokee Wildlife Refuge, located approximately 175 kilometers of the facility.. The U.S. Fish and Wildlife Service (FWS) is the designated Federal Land Manager (FLM) responsible for oversight of the Class I area.

To determine whether the proposed project is subject to the Class I modeling analysis, a Q/D screening analysis was performed, where Q is the sum of all visibility-affecting pollutants in tons per year emitted from the proposed facility, calculated on a worse-case 24-hour period basis (FLAG 2010 Approach), and D is the distance in kilometers, from the proposed facility to the corresponding Class I area boundary. The sum of the pollutants (NOx + PM_{10} + SO_2) from the proposed H&V facility is 124 tpy. The distance to the nearest Class I area (Okefenokee Wildlife Refuges, GA) is 175 km from the Hyalus Inc. facility. This yields a Q/D ratio of 0.71, well below the value of 10 currently used by the Federal Land Management (FLM) to screen a proposed project. The FLM typically does not require Air Quality Related Values (AQRV) assessments in nearby Class I areas (those within 300 km of the project site) if the Q/D ratio is less than 10.

Hyalus, Inc. provided the applicable FLM agencies (the Fish and Wildness Service and the National Park Service) the qualitative Q/D evaluation of its impact on Class I areas within 300km distance from the facility, and requested their opinions on the findings of no adverse impacts to any AQRVs at the nearby Class I areas. No feedback has been received.

A Class I area significant impact analysis (also referred to as a Class I PSD increment analysis) was performed by the applicant using AERMOD (version 15181) to conservatively assess the maximum concentration of NO_2, PM_{10} and $PM_{2.5}$ emitted from the Hyalus, Inc. facility without building downwash at a distance of 50 km from the project site since all Class I areas are located further than 50 km. The 360 receptors are about 1-km evenly spaced on a 50 km circle from the facility. Table 6-8 shows that the modeled maximum impacts of the modeled criteria pollutants were below their respective Class I area Significance Impact Levels (SILs) except the 24-hour $PM_{2.5}$. Therefore, CALPUFF (version 5.8.5) significance modeling is required to assess the impact on those Class I areas.

TABLE 6-8. PROJECT IMPACTS VS. SIGNIFICANCE LEVEL (CLASS I AREAS)

Criteria Pollutant	Averaging Period	Significance Level	Maximum Projected Concentration*	Receptor UTM Zone: 17		Model Met Data Period	Exceeds SIL?
		($\mu g/m^3$)	($\mu g/m^3$)	(meter East)	(meter North)	[yymmddhh]	(Yes/No)
NO_2	Annual	0.1	0.015	233055.21	3612104.35	2012	No
PM_{10}	Annual	0.16	0.015	317028.52	3567454.95	2011	No
	24-Hour	0.32	0.248	273014.55	3625863.45	2010062324	No
$PM_{2.5}$	Annual	0.06	0.018	316869.49	3566596.91	2010	No
	24-Hour	0.07	0.236	273014.55	3625863.45	2010062324	**Yes**

* Highest concentration over 5-year modeling period.

The CALPUFF meteorological dataset provided by GA EPD are from 2001 to 2003 covering a domain of 992 km by 1028 km with a grid scale of 4 km. The Lambert Conic Conformal (LCC) projection was used with origin of 40N latitude and 97W longitude with matching parallel latitudes of 33N and 45N. All coordinates are in the NWS-84 datum. Discrete receptor locations and elevations for the four Class I areas within 300 km from the project site were downloaded through the Lakes Interface from the National Parks Service Air Resource Division. The receptors spacing is approximately 1 km. The POSTUTIL (version 1.56) post-processer was used to combine concentrations at each receptor to determine the total $PM_{2.5}$ concentration. CALPOST (version 6.221) was used to extract the maximum modeled 24-hr $PM_{2.5}$ concentration. The modeled maximum impacts of 24-hour $PM_{2.5}$ were below the significance level of 0.07 $\mu g/m^3$, as indicated in Table I-1. For this reason, a refined Class I Increment assessment was not required.

TABLE 6-9 PROJECT IMPACTS VS. SIGNIFICANCE LEVEL (CLASS I AREAS, CALPUFF)

Criteria Pollutant	Averaging Period	Significance Level	Maximum Projected Concentration*	Receptor UTM Zone: 17		Model Met Data Period	Exceeds SIL?
		($\mu g/m^3$)	($\mu g/m^3$)	(meter East)	(meter North)	[yymmddhh]	(Yes/No)
$PM_{2.5}$	24-Hour	0.07	0.010	358677.64	3422689.84	03011100 Okefenokee	No

* Highest concentration over 3-year modeling period.

7.0 ADDITIONAL IMPACT ANALYSES

PSD requires an analysis of impairment to visibility, soils, and vegetation that will occur as a result of the construction and operation of a facility and an analysis of the air quality impact projected for the area as a result of the general commercial, residential, and other growth associated with the proposed project.

To address the potential soil and vegetation impacts, the applicant adopted the NAAQS analysis presented above because EPA recently proposed to use the secondary NAAQS standards for such analysis. Note that CO, PM_{10}, and annual NO_2 were not significant (the maximum modeling concentration due to the proposed project were less than their respective SILs). Table 6-10 shows the total potential impact of NO_2 and $PM_{2.5}$ are all below their respective screening threshold level. Therefore, no detrimental effects on soil or vegetation are expected from the proposed facility.

In addition, emissions from the proposed facility were compared to the significant emission rates according to the US EPA guidance document "*A Screening Procedure for the Impact of air Pollution Sources on the Plants, Soils, and Animals*" (December 1980). Potential annual emissions from the proposed facility are all below the significant emission rates in the guidance.

TABLE 6-10: CLASS II AREA Vegetative Impact Results (AERMOD with downwash)

Pollutant	Averaging Period	All Source Impact * (μg/m³)	Background Concentration (μg/m³)	Total Potential Impact* (μg/m³)	Screening Level⁺ (μg/m³)	Exceed Screening Level?
NO_2^+	1-hour	71.53	30.3	101.8	188	No
$PM_{2.5}$	24-hour	3.31	17.9	21.2	35	No
	Annual	1.18	8.2	9.4	15	No

* NAAQS results including both project and offsite inventories, and 2nd $PM_{2.5}$ as Nitrate. Total impact is the sum of the predicted concentration plus the background concentration.
+ Screening levels for NOx are the existing secondary annual and proposed secondary 1-hour NAAQS standards.

Hyalus submitted an analysis impacts due to growth. The analysis concludes that the addition of ~70 jobs and temporary construction activities will not cause undo burden on the community.

Regarding to the Class II visibility analysis, neither the modeled annual NO_2 nor 24-hr PM_{10} concentrations exceeded their respective significant impact levels. Therefore, it was not necessary to conduct an analysis of visible plume impacts.

Georgia Toxic Air Pollutant Modeling Analysis

Georgia EPD regulates the emissions of toxic air pollutant (TAP) emissions through a program covered by the provisions of *Georgia Rules for Air Quality Control*, 391-3-1-.02(2)(a)3.(ii). A TAP is defined as any substance that may have an adverse effect on public health, excluding any specific substance that is covered by a State or Federal ambient air quality standard. Procedures governing the Georgia EPD's review of TAP emissions as part of air permit reviews are contained in the agency's "*Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions (Revised).*"

Selection of Toxic Air Pollutants for Modeling

For projects with quantifiable increases in TAP emissions, an air dispersion modeling analysis is generally performed to demonstrate that off-property impacts are less than the established Acceptable Ambient Concentration (AAC) values. The TAP evaluated are restricted to those that may increase due to the proposed project. Thus, the TAP analysis would generally be an assessment of off-property impacts due to facility-wide emissions of any TAP emitted by a facility. To conduct a facility-wide TAP impact evaluation for any pollutant that could conceivably be emitted by the facility is impractical. A literature review would suggest that at least one molecule of hundreds of organic and inorganic chemical compounds could be emitted from the various combustion units. This is understandable given the nature of the operation at the facility. The vast majority of compounds potentially emitted however are emitted in only trace amounts that are not reasonably quantifiable.

For each TAP identified for further analysis, both the short-term and long-term AAC were calculated following the procedures given in Georgia EPD's *Guideline*. Figure 8-3 of Georgia EPD's *Guideline* contains a flow chart of the process for determining long-term and short-term ambient thresholds. Hyalus, Inc. referenced the resources previously detailed to determine the long-term (i.e., annual average) and short-term AAC (i.e., 24-hour or 15-minute). The AACs were verified by the EPD.

Determination of Toxic Air Pollutant Impact

The Georgia EPD *Guideline* recommends a tiered approach to model TAP impacts, beginning with screening analyses using SCREEN3, followed by refined modeling, if necessary, with ISCST3 or ISCLT3. For the refined modeling completed, the infrastructure setup for the SIA analyses was relied upon with appropriate sources added for the TAP modeling. Note that per the Georgia EPD's *Guideline*, downwash was not considered in the TAP assessment.

Initial Screening Analysis Technique

Generally, an initial screening analysis is performed in which the total TAP emission rate is modeled from the stack with the lowest effective release height to obtain the maximum ground level concentration (MGLC). Note the MGLC could occur within the facility boundary for this evaluation method. The individual MGLC is obtained and compared to the smallest AAC. Due to the likelihood that this screening would result in the need for further analysis for most TAP, the analyses were initiated with the secondary screening technique.

The impacts of facility-wide toxic air pollutant (TAP) emissions at the Hyalus, Inc. facility were evaluated. The following five air toxic pollutants (TAPs) were included in the analysis: arsenic, benzene, chromium, formaldehyde, and HF. The annual, 24-hour and 15-minute AACs of the above five TAPs were reviewed based on U.S. EPA IRIS reference concentration (RfC) and OSHA Permissible Exposure (PEL) according to the Georgia Air Toxics Guideline. The modeled maximum ground-level concentrations (MGLCs) were calculated using the AERMOD dispersion model (version 15181) without building downwash for 1-hour, 24-hour, and annual averaging periods, and the hourly and annual emission rates were used for short term (1-hour and 24-hour) and annual averaging periods, respectively. The impact at 24-hour period for a given TAP is not required when the respective annual AAC exists. The receptor grid developed for the PSD Significant impact analysis (Cartesian grid extending 5 km with 100 m spacing) was utilized for this assessment. Table VI summarizes the AAC levels and MGLCs of the TAPs at the above three averaging periods. Note that the maximum 15-min impact is based on the maximum 1-hour modeled impact multiplied by a factor of 1.32. As shown in the Table 6-11, the modeled MGLCs for all TAPs evaluated by the applicant are well below their respective AAC levels. Therefore, the applicant meets the applicable Georgia Air Toxics Guideline.

TABLE 6-11. MODELED MGLCS AND THE RESPECTIVE AACS

Pollutant	CAS	Averaging period	MGLC ($\mu g/m^3$)	AAC ($\mu g/m^3$)	Exceed AAC?	Averaging period	MGLC ($\mu g/m^3$)	AAC ($\mu g/m^3$)	Exceed AAC?
Arsenic	7440382	Annual	2.00E-05	2.33E-04	No	15-min	1.32E-03	0.2	No
Benzene	71432	Annual	0.027	0.13	No	15-min	1.72	1600	No
Chromium	7440473	Annual	7.00E-05	8.30E-05	No	15-min	4.01E-03	10	No
Formaldehyde	50000	Annual	0.08	0.77	No	15-min	4.01	245	No
HF	7664393	24-hour	0.07	5.84	No	15-min	0.46	245	No

Note: All concentrations are the highest 1st high modeled impacts for all 5 model years.

8.0 EXPLANATION OF DRAFT PERMIT CONDITIONS

The permit requirements for this proposed facility are included in draft Permit No. 3296-235-0027-P-01-0.

Section 1.0: Facility Description

See Section 2.0 of this document.

Section 2.0: Requirements Pertaining to the Entire Facility

There are no conditions in Section 2.0.

Section 3.0: Requirements for Emission Units

Pursuant to BACT, Condition No. 3.2.1 limits particulate matter ($PM_{10}/PM_{2.5}$) emissions from stacks RM01, RM02, or RM03 to 0.017 pound per ton (lb/ton) of raw material input.

Pursuant to BACT, Condition No. 3.2.2 limits the processing of raw materials to 34,786 tons during any consecutive 12-month period.

Pursuant to BACT, Condition No. 3.2.3 limits $PM_{10}/PM_{2.5}$ from the glass melting furnace to 0.19 lb/ton of molten glass pulled through the furnace.

Pursuant to BACT, Condition No. 3.2.4 limits the glass pulled from the glass melting furnace to 27,375 tons during any consecutive 12-month period.

Pursuant to BACT, Condition No. 3.2.5 limits green-house gas emission from the glass melting furnace to 8,227 tons during any consecutive 12-month period.

Pursuant to BACT, Condition No. 3.2.6 limits $PM_{10}/PM_{2.5}$ emissions from the forehearth stack to 7.6 pounds per million standard cubic feet (lb/MMScf) of natural gas fired in the forehearth unit.

Pursuant to BACT, Condition No. 3.2.7 limits CO emission from the forehearth stack to 0.22 lb/ton of molten glass pulled through the forhearth unit.

Pursuant to BACT, Condition No. 3.2.8 limits NO_x emission from the forehearth stack to 0.052 lb/ton of molten glass pulled through the forhearth unit.

Pursuant to BACT, Condition No. 3.2.9 limits green-house gas emission from the forehearth to 6,505 tons during any consecutive 12-month period.

Pursuant to BACT, Condition No. 3.2.10 limits PM/PM_{10} emission from any rotary fiberizer stack to 8.11 lb-PM/PM_{10}/ton of rotary fine fiber produced.

Pursuant to BACT, Condition No. 3.2.11 limits $PM_{2.5}$ emission from any rotary fiberizer stack to 7.24 lb-$PM_{2.5}$/ton of rotary fine fiber produced.

Pursuant to BACT, Condition No. 3.2.12 limits PM/PM_{10} emission from any rotary fiberizer stack to 1.70 lb-PM/PM_{10}/ton of rotary coarse fiber produced.

Pursuant to BACT, Condition No. 3.2.13 limits $PM_{2.5}$ emission from any rotary fiberizer stack to 1.58 lb-$PM_{2.5}$/ton of rotary coarse fiber produced.

Pursuant to BACT, Condition No. 3.2.14 limits PM/PM_{10} emission from the rotary fiberizer stacks to 47.8 tons during any consecutive 12-month period. This condition is necessary to confirm compliance with the consecutive 12-month PM/PM_{10} limit in the permit because the facility needs flexibility in producing fine or coarse fiber according to market demand.

Pursuant to BACT, Condition No. 3.2.15 limits $PM_{2.5}$ emission from the rotary fiberizer stacks to 43.0 tons during any consecutive 12-month period. This condition is necessary to confirm compliance with the consecutive 12-month $PM_{2.5}$ limit in the permit because the facility needs flexibility in producing fine or coarse fiber according to market demand.

Pursuant to BACT, Condition No. 3.2.16 limits CO emission from any rotary fiberizer stack to 270.0 lb-CO/ton of rotary fine fiber produced.

Pursuant to BACT, Condition No. 3.2.17 limits CO emission from any rotary fiberizer stack to 53.0 lb-CO/ton of rotary coarse fiber produced.

Pursuant to BACT, Condition No. 3.2.18 limits CO emission from the rotary fiberizer stacks to 1,573 tons during any consecutive 12-month period. This condition is necessary to confirm compliance with the consecutive 12-month CO limit in the permit because the facility needs flexibility in producing fine or coarse fiber according to market demand.

Pursuant to BACT, Condition No. 3.2.19 limits NO_x emission from any rotary fiberizer stack to 12.0 lb-NO_x/ton of rotary fine fiber produced.

Pursuant to BACT, Condition No. 3.2.202 limits NO_x emission from any rotary fiberizer stack to 2.58 lb-NO_x/ton of rotary coarse fiber produced.

Pursuant to BACT, Condition No. 3.2.21 limits NO_x emission from the rotary fiberizer stacks to 70.8 tons during any consecutive 12-month period. This condition is necessary to confirm compliance with the consecutive 12-month NO_x limit in the permit because the facility needs flexibility in producing fine or coarse fiber according to market demand.

Pursuant to BACT, Condition No. 3.2.22 limit green-house gas emissions from the rotary fiberizer stacks to 83,368 tons during any consecutive 12-month period. Compliance with this limit will be determined via calculation using the record of natural gas fired in the rotary fiberizer unit.

Pursuant to PSD avoidance, Condition No. 3.2.23 limits facility-wide fluoride emissions to 2.9 tons during any consecutive 12-month period.

Condition No. 3.2.24 requires the Permittee to operate the Emergency Generator according to the operational limitations therein. This is necessary for the engine to remain an "emergency" engine.

Condition Nos. 3.3.1 through 3.3.7 specify the requirement for the emergency generator under 40 CFR 60 Subpart IIII and 40 CFR 63 Subpart ZZZZ.

Pursuant to Georgia Rule (b), Condition No. 3.4.1 limits visible emissions from the indicated emission units to less than 40 percent.

Pursuant to Georgia Rule (e), Condition No. 3.4.2 limits particulate matter emissions from the units indicated in Condition No. 3.4.1 to less than or equal to the Rule (e) limit.

Pursuant to Georgia Rule (g), Condition 3.4.3 requires the facility to burn only natural gas in the specified equipment.

Pursuant to Georgia Rule (n), Condition 3.4.4 limits fugitive emissions from the plant roads to less than or equal to 20 percent.

Pursuant to Georgia Rule (n), the facility is required to take all reasonable precautions to prevent dust from becoming airborne.

Condition No. 3.5.1 requires that an inventory of filter bags be available to replace defective bags to minimize emissions.

Condition No. 3.5.2 requires that an inventory of drum filter media and the perforated drum filter be available to replace defective bags to assure a continuous supply of media and the perforated drum filter for the rotary fiberizer unit.

Section 4.0: Requirements for Testing

Condition Nos. 4.2.1 through 4.2.3 specify the initial and ongoing performance testing that must be conducted for the source. The conditions also specify how air pollution control equipment should be monitored during test.

Section 5.0: Requirements for Monitoring

Condition No. 5.2.1 requires the Permittee to install, calibrate, and operate equipment to monitor operating parameters at the facility, including, throughput rates, material usage, and natural gas usage. The data is necessary to calculate emissions and demonstrate compliance with the operating caps in Part 3.0 of the permit.

Condition 5.2.2 requires the Permittee to install, calibrate, operate, and monitor devices to determine pressure drop across each baghouse and each rotary drum filter, daily. An excessive pressure drop might indicate that the baghouse/drum filter is clogged. A small pressure drop might indicate the presence of hole(s) in the baghouse/drum filter.

Condition No. 5.2.3 requires the Permittee to check for visible emissions from the baghouse(s)/drum filters stack(s). Visible emissions might indicate defective bag(s)/drum filters. A properly designed and maintained baghouse/drum filter should display no visible emissions.

Condition No. 5.2.4 requires the Permittee to develop and implement within 60 days of the issuance of the permit a preventive maintenance program for the baghouses. The operation and maintenance check is required to be performed at least once daily. This is to assure that the baghouses are working properly.

Condition No. 5.2.5 requires the Permittee to develop and implement within 60 days of the issuance of the permit a preventive maintenance program for the drum filters. The operation and maintenance check is required to be performed at least once daily. This is to assure that the drum filters are working properly.

Condition 5.2.6 requires the Permittee to inspect the exterior of the cyclone for holes or evidence of malfunction each week that the rotary fiberizer is in operation.

Pursuant to 40 CFR 60.4209(a), Condition No. 5.2.7 requires the Permittee to install a non-resettable hour meter on the emergency generator.

<u>Section 6.0: Other Recordkeeping and Reporting Requirements</u>

Part 6.1.7.b of the permit lists the reportable exceedances for the source. The exceedances as any 12-month rolling period during which an operating or emission cap (tons per 12-months) listed in Part 3.0 of the permit is exceeded. The facility must also report visible emission or preventative maintenance plan deviations with regard to sources that control particulate matter emissions.

Part 6.1.7.c of the permit lists the reportable excursions for the source. The main excursions are pressure drop readings out of range for the baghouses and filters. The facility must also report non-complaince with emergency generator requirements.

Condition No. 6.2.1 requires the Permittee to maintain records and perform calculations to demonstrate compliance with the raw material throughput limit.

Condition No. 6.2.2 requires the Permittee to maintain records and perform calculations to demonstrate compliance with the molten glass throughput limit.

Condition No. 6.2.3 requires the Permittee to maintain records of raw material inputs to the glass melting furnace. The information is necessary to calculate GHG emissions.

Condition No. 6.2.4 requires the Permittee to maintain records of natural gas fired in the forehearths and the fiberizers. The information is necessary to calculate GHG emissions.

Condition No. 6.2.5 requires the Permittee to maintain records of fine and coarse fiber production. The information is necessary to calculate emissions and demonsrate compliance with the fiberizer emission caps.

Condition Nos. 6.2.6 through 6.2.13 lay out requirements for developing emission calculation protocols for $PM/PM_{10}/PM_{2.5}$, CO, NO_X, GHG, and flourides for each relevant emission source. The calculations are necessary to demonstrate compliance with the 12-month (tpy) emission caps in Part 3.0 of the permit.

Condition No. 6.2.14 requires the facility to maintain records of the hours of operation for the emergency generator to demonstrate compliance with the operating limit in Part 3.0 of the permit.

Condition No. 6.2.15 requires the Permittee to notify the Division in writing of the startup date of this source within 15 days.

Section 7.0: Other Specific Requirements

Conditions 7.1.1 through 7.1.3 discuss construction requirements under PSD and require the facility to submit a Title V permit within 12 months of startup of the source.