OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

MEMORANDUM **March 18, 2003**

TO: Dawson Lasseter, P.E., Chief Engineer, Air Quality

THROUGH: Phillip Fielder, P.E., Engineering Section
Eric Milligan, P.E., Engineering Section

THROUGH: Peer Review

FROM: David Schutz, P.E., New Source Permits Section

SUBJECT: Evaluation of Permit Application No. **2002-487-C (PSD)**
Cardinal FG Company
Flat Glass Plant
Section 27 - T6S – R8E
Durant, Bryan County, Oklahoma

SECTION I. INTRODUCTION

Cardinal FG Company submitted an application for a construction permit on November 7, 2002. The proposed flat glass plant (SIC Code 3211) will consist of a gas-fired furnace (200 MMBTUH); units for raw material and "cullet" (recycle glass) receiving, handling, storage, and transfer; a glass cutting operation; and two 2,000 KW emergency generators powered by diesel engines. Since the facility will have emissions in excess of the Prevention of Significant Deterioration (PSD) threshold level (250 TPY), the application has been determined to require Tier III public review.

SECTION II. PROCESS DESCRIPTION

Glass manufacturing is conducted by melting silica sand, soda ash (sodium carbonate), limestone (calcium carbonate), dolomite (calcium magnesium carbonate), "salt cake" (sodium sulfate), cullet (broken glass), iron, and carbon. The capacity of the plant will be 650 tons per day glass. However, since a portion of carbonate materials will be discharged as carbon dioxide, more solids than 650 TPD must be processed to achieve that output. A material input rate of 793 TPD is anticipated to achieve 650 TPD output.

Raw materials will arrive by rail and trucks. A single below-grade unloading hopper will be installed to receive bulk raw materials in an enclosed steel building. A bucket elevator will move the bulk materials to storage bins.

Raw materials will be withdrawn from the receiving silos for batch mixing. The solids will be conveyed to a batch hopper scale for weighing and preparation of each batch. The materials will then be mechanically mixed and conveyed to a bin for charging to the furnace. All of these operations will vent to baghouses with discharge guarantees of 0.005 gr/DSCF.

Raw materials will be fed to a natural gas fired float furnace with a heat input of 200 MMBTUH. Sand, limestone, cullet, etc., will be charged to a melting section, then refined. NOx emissions will be controlled by the proprietary "3R" (Reaction and Reduction in Regenerators) Process. "3R" involves injecting natural gas into a NOx-laden stream such that the oxygen in NOx becomes the oxygen for combustion of methane in natural gas, leaving nitrogen and carbon dioxide. The furnace is designed for smooth addition of raw materials, minimizing entrainment of particulate which would result from agitation and bubbling, and with air flow to give a chance for particulates to settle out.

Molten glass will be discharged from the furnace into a molten tin bath (tin melts at 452^{o}F; the glass is hotter than 1,800^{o}F). Molten glass floats on molten tin, forming a "ribbon." Tools in the molten bath control the depth and width of the ribbon. Rollers pull the ribbon out of the unit as the glass cools. This operation will utilize a nitrogen and hydrogen atmosphere to minimize oxidation of the tin. Nitrogen and hydrogen will be prepared on-site.

The ribbon proceeds to a cooling section where air is used to remove heat, allowing the glass to harden. The ribbon is then treated by a sulfur dioxide atmosphere; SO_2 is adsorbed onto the glass surface to prevent staining. Solid glass is scored for separating to correct size. Cutting of the glass ribbon involves a mineral spirits lubricant.

The scored ribbon is then "snapped" to break it into correct lengths and widths; the sections are called "lites" in the trade. Any broken or unacceptable glass will be recycled as cullet, while the lites are packaged for shipment.

Two back-up electrical generators will be installed in case of loss of electric power. Each generator will be rated at 2,000 KW and will be used a maximum of 500 hours per year.

In addition to day-to-day operations, once or twice per year, sulfates will need to be removed from refractory heat exchange surfaces. Sulfate deposits are removed by melting with natural gas, then the fallen sulfates are raked. The process takes 10-15 days. NOx controls cannot be operated during this time, and SO_2 emissions will be higher than normal. During sulfate clean-out, emissions are anticipated at 14.5 lb NOx per ton glass produced and 4 lb SO_2 per ton glass produced; the furnace will continue to melt glass during the cleaning.

The facility will include several internal fabric filters. Total capacity is 28,500 ACFM, and the units will serve units such as application of anti-scratch powder. With a maximum discharge loading of 0.001 gr/DSCF, PM emissions will be 0.24 lb/hr and 1.07 TPY.

Mineral spirits (CAS 74741657) will be used to lubricate glass cutting. The organic materials will be kept in portable, 350-gallon tanks. The vapor pressure of the mineral spirits is 0.02 psia.

SECTION III. EQUIPMENT

EUG P01: Melting Furnace

EU	Point	Equipment	MMBTUH	Installed Date
P01	S01	650 TPD Glass Melting Furnace	200	2003

EUG P02: Cullet Return System

EU	Point	Equipment	Capacity	Installed Date
P02	S02	Cullet Return System	27 TPH (44,000 ACFM)	2003

EUG P03: Raw Materials Handling System

EU	Point	Equipment	Capacity	Installed Date
P03	S03	Raw Materials Elevator Bottom	27 TPH (3,600 ACFM)	2003
P05	S03	Raw Materials Elevator Top		2003
P04	S04	Raw Materials Mixing	300 TPH (1,200 ACFM)	2003

EUG P06: Emergency Generators

EU	Point	Description	Capacity	Installed Date
P06A	S06A	Emergency Generator	2,000 KW	2003
P06B	S06B	Emergency Generator	2,000 KW	2003

EUG P07: Annealing Lehr

EU	Point	Equipment	Capacity	Installed Date
P07	ventilation	Annealing Lehr	650 TPD	2003

EUG P08: Glass Cutting

EU	Point	Equipment	Capacity	Installed Date
P08	ventilation	Glass Cutting	650 TPD	2003

EUG P09: Miscellaneous Baghouses

EU	Point	Equipment	Capacity	Installed Date
P09	ventilation	Miscellaneous Processes	28,500 ACFM	2003

SECTION IV. SCOPE OF REVIEW AND EMISSIONS

Since the facility will exceed the 100 TPY PSD threshold and significance levels for NO_X, CO, VOCs, and PM_{10}, the project is subject to full PSD review. Tier III public review, best available control technology (BACT), and ambient impacts analyses are also required.

The project is also subject to NSPS, Subpart CC, for glass melting furnaces. Numerous Oklahoma Air Quality rules affect the new furnace and auxiliary units, rules including Subchapters 19, 25, 31, 33, and 37. Pollutants emitted in minor quantities were evaluated for all pollutant-specific rules, regulations and guidelines.

Emission Factors and References

Point ID	Description	Emission Factors	Factor References
S01	Main Furnace	PM: 1.5 lb/ton glass	NSPS Subpart CC limit (front-half) plus back-half testing at other glass plants
		SO_2: 2 lb/ton glass	proposed limitation (10 lb Na_2SO_4 per 1,000 lbs sand)*
		NOx: 11 lb/ton glass	"3R" Process proposed limitation*
		CO: 10 lb/ton glass	proposed limitation*
		VOC: 0.1 lb/ton glass	AP-42 (1/95), Table 11.15-2
		H_2SO_4: 0.058 lb/ton glass	proposed limitation*
		Fluorides: 0.0245 lb/ton glass	proposed limitation*
		Lead: 297 ppm in PM	stack tests at other glass plant with safety factor applied
S02	Cullet Handling	PM: 0.005 gr/DSCF (44,000 SCFM flow)	proposed limitation*
S03	Raw Materials Receiving	PM: 0.005 gr/DSCF (3,600 SCFM flow)	proposed limitation*
S04	Raw Materials Receiving	PM: 0.005 gr/DSCF (1,200 SCFM flow)	proposed limitation*
S06A S06B	Emergency Generators	PM: 0.0444 lb/MMBTU	Engine mfg.data
		SO_2: 0.0505 lb/MMBTU	AP-42 (10/96), Section 3.4 (0.05% sulfur in diesel fuel)
		NOx: 2.035 lb/MMBTU	Engine mfg.data
		CO: 0.202 lb/MMBTU	Engine mfg.data
		VOC: 0.053 lb/MMBTU	Engine mfg.data
S07	Annealing Lehr	SO_2: 13.2% of SO_2 used	mass balance at similar glass plant
S08	Cutting Ops	VOC: all emitted	mass balance
S01	Main Furnace Sulfate Deposit Removal	NOx: 14.5 lb/ton of glass	stack tests at other glass plant with safety factor applied
		SO_2: 4.0 lb/ton of glass	stack tests at other glass plant with safety factor applied

* stack testing and or continuous emission monitoring will be required to confirm compliance with proposed limitations.

Emissions are based on continuous operations of the glass furnace, cullet operations, raw material operations, annealing lehr, and cutting operations. Emergency generator operations are based on 500 hours per year of operation. Emissions from raw material handling were based on baghouse discharge guarantees. Hazardous and toxic air emissions were estimated based on AP-42 (7/98), Section 1.4 for natural gas combustion in the main furnace, and AP-42 (10/96), Section 3.4 for the diesel engines.

Criteria Pollutant Emissions Summary

Unit ID	Description	PM_{10}		CO		SO_2		NOx		VOC		Lead	
		lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
S01	Main Furnace	40.63	177.94	270.83	1186.25	54.17	237.25	297.92	1304.88	2.71	11.86	0.01	0.05
S02	Cullet Handling	1.89	8.26	--	--	--	--	--	--	--	--	--	--
S03	Raw Materials Handling	0.15	0.68	--	--	--	--	--	--	--	--	--	--
S04	Raw Materials Handling	0.05	0.23	--	--	--	--	--	--	--	--	--	--
S06	Emergency Generators	1.82	0.46	8.28	2.07	2.07	0.52	83.44	20.86	2.17	0.54	--	--
P07	Annealing Lehr	--	--	--	--	0.81	3.56	--	--	--	--	--	--
P08	Cutting	--	--	--	--	--	--	--	--	10.00	43.80	--	--
P09	Miscellaneous Operations	0.24	1.07										
	TOTALS	44.78	188.62	279.12	1188.32	57.06	241.33	381.35	1325.73	14.93	56.41	0.01	0.05

Stack Parameters

Stack ID	Operation Served	Height, Feet	Diameter, Inches	Temperature, ºF	Flow, ACFM
S01	Main Furnace	175	106	580	113,000
S02	Cullet Operations	100	34	68	44,000
S03	Raw Materials Mixing	155	12	68	3,600
S04	Raw Materials Elevator	158	7	68	1,200
S06	Emergency Generators	50	18	973	34,600

Hazardous/Toxic Air Pollutant Emissions

		Toxic	De Minimis		Emissions	
Pollutant	**CAS**	**Category**	**lb/hr**	**TPY**	**lb/hr**	**TPY**
*Acenaphthene	83329	A	0.57	0.60	0.001	0.001
*Acenaphthylene	208968	A	0.57	0.60	0.001	0.001
*Acetaldehyde	75070	B	1.1	1.2	0.001	0.001
*Acrolein	107028	A	0.57	0.60	0.001	0.001
*Anthracene	120127	A	0.57	0.60	0.001	0.001
*Arsenic	7440382	A	0.57	0.60	0.052	0.230
*Barium	7440393	B	1.1	1.2	0.001	0.004
*Benzene	71432	A	0.57	0.60	0.032	0.008
Benzo-a-anthracene	56553	A	0.57	0.60	0.001	0.001
Benzo-a-pyrene	50328	A	0.57	0.60	0.001	0.001
Benzo-b-fluoranthene	205992	A	0.57	0.60	0.001	0.001
Benzo-(g,h,i)-perylene	191242	B	1.1	1.2	0.001	0.001
Benzo-k-fluoranthene	207089	A	0.57	0.60	0.001	0.001
*Beryllium	7440417	A	0.57	0.60	0.001	0.001
*Cadmium	7440439	A	0.57	0.60	0.034	0.149
*Chromium	7738945	A	0.57	0.6	0.026	0.112
*Cobalt	7440484	A	0.57	0.60	0.001	0.001
Chrysene	218019	A	0.57	0.60	0.001	0.001
Copper	7440508	B	1.1	1.2	0.001	0.001
Dibenzo-a,h-anthracene	53703	A	0.57	0.60	0.001	0.001
*Dichlorobenzene	541731	B	1.1	1.2	0.001	0.001
Fluoranthene	206440	C	5.6	6.0	0.001	0.001
Fluorene	86737	A	0.57	0.60	0.001	0.001
Fluorides	16984488	B	1.1	1.2	**0.660**	**2.920**
*Formaldehyde	50000	A	0.57	0.60	0.018	0.067
*Hexane	110543	C	5.6	6.0	0.360	1.577
Indeno(1,2,3-c,d)pyrene	193395	A	0.57	0.60	0.001	0.001
*Manganese	7439965A	C	5.6	6.0	0.001	0.001
*Mercury	7439976	A	0.57	0.60	0.001	0.001
Methylnaphthalene	1321944	C	5.6	6.0	0.001	0.001
Mineral spirits	64741657	C	5.6	6.0	10.000	43.800
Molybdenum	7439987	C	5.6	6.0	0.001	0.001
*Naphthalene	91203	B	1.1	1.2	0.005	0.001
*Nickel	7440020	A	0.57	0.60	0.008	0.034

* HAPs **Bold** = above de minimis levels

Hazardous/Toxic Air Pollutant Emissions
(Continued)

		Toxic	De Minimis		Emissions	
Pollutant	**CAS**	**Category**	**lb/hr**	**TPY**	**lb/hr**	**TPY**
*Phenanthracene	85018	A	0.57	0.60	0.001	0.001
*Pyrene	129000	A	0.57	0.60	0.001	0.001
*Selenium	7782492	C	5.6	6.0	0.001	0.001
Silica	60676860	A	0.57	0.60	**0.300**	**1.360**
Sulfuric Acid	7664939	A	0.57	0.60	**1.580**	**6.960**
*Toluene	108883	C	5.6	6.0	0.012	0.003
Vanadium	7440622	A	0.57	0.60	0.001	0.002
*Xylene	1330207	C	5.6	6.0	0.008	0.002
Zinc	7440666	C	5.6	6.0	0.006	0.025

* HAPs **Bold** = above de minimis levels

As shown in the emission summary below, the proposed facility will have potential emissions above the PSD significance levels for NO_X, CO, VOC, and PM_{10} and are reviewed below.

Emissions Compared To PSD Levels Of Significance

Pollutant	Emissions, TPY	PSD Levels of Significance, TPY	PSD Review Required?
NO_X	1325.73	40	Yes
CO	1188.32	100	Yes
VOC	56.41	40	Yes
SO_2	241.33	40	Yes
PM/PM_{10}	188.62	25/15	Yes
H_2SO_4	6.96	7	No
Fluorides	2.93	3	No

Full PSD review of emissions consists of the following:

A. Determination of best available control technology (BACT)
B. Evaluation of existing air quality
C. Evaluation of PSD increment consumption
D. Analysis of compliance with National Ambient Air Quality Standards (NAAQS)
E. Pre- and post-construction ambient monitoring
F. Evaluation of source-related impacts on growth, soils, vegetation, visibility
G. Evaluation of Class I area impact

SECTION V. BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

The pollutants subject to review under the PSD regulations, and for which a BACT analysis is required, include nitrogen oxides (NO_X), sulfur dioxide (SO_2), carbon monoxide (CO), volatile organic compounds (VOC), and particulates less than or equal to 10 microns in diameter (PM_{10}). The BACT review follows the "top-down" approach recommended by the EPA.

The EPA-required top-down BACT approach must look not only at the most stringent emission control technology previously approved, but it also must evaluate all demonstrated and potentially applicable technologies, including innovative controls, lower polluting processes, etc. Cardinal FG identified these technologies and emissions data through a review of EPA's RACT/BACT/LAER Clearinghouse (RBLC), as well as EPA's NSR and CTC websites, recent DEQ BACT determinations for similar facilities, and vendor-supplied information.

Summary of Proposed BACT

Pollutant	Main Furnace	Cullet / Raw Materials Handling Operations	Emergency Generators
NO_X	3R Process	--	combustion design
CO	no add-on control	--	no add-on control
VOC	no add-on control	--	no add-on control
PM_{10}	modified process	baghouse	no add-on control
SO_2 / H_2SO_4	limited salt cake usage natural gas fuel	--	low-sulfur fuel

A. NO_X BACT Review

Nitrogen oxides (NO_X) are formed during the fuel combustion process. There are three types of NO_X formations: thermal NO_X, fuel-bound NO_X, and prompt NO_X. Thermal NO_X is created by the high temperature reaction in the combustion chamber between atmospheric nitrogen and oxygen. The amount that is formed is a function of time, turbulence, temperature, and fuel to air ratios within the combustion flame zone. Fuel-bound NO_X is created by the gas-phase oxidation of the elemental nitrogen contained within the fuel. Its formation is a function of the fuel nitrogen content and the amount of oxygen in the combustion chamber. Fuel NO_X is temperature-dependent to a lesser degree; at lower temperatures, the fuel-bound nitrogen will form N_2 rather than NO_X. The fuel specification for the main furnace, natural gas, has inherently low elemental nitrogen, so the effects of fuel NO_X are insignificant in comparison to thermal NO_x.

Prompt NO_X occurs primarily in combustion sources that use fuel rich combustion techniques. The formation of prompt NO_X occurs through several early reactions of nitrogen molecules in the combustion air and hydrocarbon radicals from the fuel. The reactions primarily take place within fuel rich flame zones and are usually negligible when compared to the formation of NO_X by the thermal NO_X process. Prompt NO_X is not deemed a significant contributing factor towards NO_X emissions.

Recent BACT Determinations for NOx Emissions from Flat Glass Plants

Facility	Process	BACT
Cardinal FG Portage, WI 12/13/99 650 TPD Plant	Float Glass Furnace	Low-NOx burners (400 lb/hr)
	Diesel Generator	No add-on controls (47.5 lb/hr)
Cardinal FG Mooresville, NC 10/29/98 600 TPD Plant	Float Glass Furnace	3R Process (11 lb/ton first year, 9 lb/ton second year, 7 lb/ton third year)
Guardian Industries Geneva, NY 8/11/97 700 TPD	Float Glass Furnace	3R Process (1.23 lb/MMBTU, 6.5 lb/ton)
AFG Industries Richmond, KY 6/9/97 600 TPD	Melting Furnace	3R Process (11 lb/ton start-up, 7 lb/ton third year)
	Diesel Generator	No add-on controls (11.7 TPY)
PPG Industries Fresno, CA 2/15/96	Flat Glass Furnace	Supplemental burner system (240 lb/hr)
Guardian Industries DeWitt, IA 3/28/95 700 TPD	Flat Glass Furnace	325 lb/hr (no control listed)
Cardinal FG Portage, WI 11/23/94	Float Glass Furnace	Proper furnace design (400 lb/hr)
	Diesel Generator	67.5 lb/hr (no control listed)

1. Main Furnace

a) Identification of Control Techniques

The application identified five potential NOx control technologies:

- Furnace design (including low-NOx burners)
- "3R" Process (Reaction and Reduction in Regenerators)
- Selective non-catalytic reduction (SNCR)
- Selective catalytic reduction (SCR)
- Oxygen-enriched air staging (OEAS)

Flame-quenching technologies including steam or water injection were not analyzed. Since the furnace must operate at 2,700°F and hotter, any technology which would preclude the flame from achieving this temperature is not technologically feasible.

AP-42 (1/95), Section 11.15, shows NOx emissions from flat glass manufacturing at 8.0 lb/ton (range of 5.6 to 10.4). The application indicated significantly higher NOx would be expected, 17 lb/ton. The application listed 9 recent permits for glass plants in Wisconsin, North Carolina, Kentucky, New York, Iowa, California, and Illinois, each allowing as BACT significantly higher emissions than AP-42 indicated.

Furnace Design

Furnace design seeks to reduce operating temperatures, residence time, and oxygen concentrations in the flame zone. These techniques are of limited effectiveness in a glass melting furnace given the high temperatures which must be achieved. The operator's experience has shown that low-NOx burners will reduce NOx emissions from 17 lb/ton to 14.8 lb/ton, only a 13% reduction.

"3R" Process

Natural gas (up to 15% additional gas over and above furnace usage) is injected into exhausts to create a reducing atmosphere. This is similar to the "natural gas reburning" technology developed for utility boilers. NOx emissions reductions down to 7.0 lb/ton can be achieved. This reduction represents a reduction of 13% compared to AP-42 average values or 59% compared to operator data.

Selective Non-Catalytic Reduction (SNCR), Thermal DeNO$_X$™

SNCR is based on the principle that ammonia or urea reacts with NO_X in the flue gas to form N_2 and H_2O. In practice, the technology has been applied in boilers by injecting ammonia into the high temperature (e.g., 1,300 °F to 2,000 °F) region of the exhaust stream. Incorrect location of injection points, insufficient residence times and miscalibration of injection rates may result in excess emissions of ammonia (ammonia slip), a toxic air pollutant. When successfully applied SNCR has shown reduction in NO_x emissions from boilers of 35 to 60 percent.

Thermal DeNO$_X$ is a high temperature selective non-catalytic reduction (SNCR) of NO_X using ammonia as the reducing agent. Thermal DeNO$_X$ requires the exhaust temperature to be above 1,800 °F.

Selective Catalytic Reduction (SCR)

SCR systems selectively reduce NO_X by injecting ammonia (NH_3) into the exhaust gas stream upstream of a catalyst. NO_X, ammonia, and oxygen react on the surface to form molecular nitrogen (N_2) and water. The catalyst, comprised of parallel plates or honeycomb structures, is installed in the form of rectangular modules.

SCR uses ammonia as a reducing agent in controlling NO_X emissions. The portion of the unreacted ammonia passing through the catalyst and emitted from the stack is called ammonia slip. The ammonia is injected into the exhaust gases prior to passage through the catalyst bed. Selective catalytic reduction can typically achieve NO_X emission reductions in the range of about 80 to 95 percent.

Oxygen-Enriched Air Staging (OEAS)

This technique is commonly referred to as "Oxy-firing." Combustion is conducted with nearly-pure oxygen rather than air. By separating out most of the nitrogen from the oxygen, less inert material is present to absorb heat, therefore, less fuel must be consumed.

b) Technical Feasibility of The Control Techniques

Furnace Design

This technique yields minimal reductions in NOx emissions, and will not be analyzed further in comparison with more effective technologies.

Selective Non-Catalytic Reduction (SNCR), Thermal DeNO$_X$™

The only known commercial applications of Thermal DeNO$_X$™ are on heavy industrial boilers, large furnaces, and incinerators that consistently produce exhaust gas temperatures above 1,800ºF. There are no known applications on or experience with glass furnaces. Temperatures of 1,800ºF require alloy materials constructed with very large piping and components since the exhaust gas volume would be increased. This option has not been demonstrated on glass furnaces. Thus, this control technology is not considered technically feasible and will be precluded from further consideration in this BACT analysis.

Selective Catalytic Reduction

The exhaust gas must contain a minimum amount of oxygen and be within a particular temperature range in order for the selective catalytic reduction system to operate properly. The temperature range is dictated by the catalyst, which is typically made from noble metals, base metal oxides, or zeolite-based material. The typical temperature range for base-metal catalysts is 570 to 800°F. Keeping the exhaust gas temperature within this range is important. If it drops below 600°F, the reaction efficiency becomes too low and increased amounts of NO_X and ammonia will be released out the stack. If the reaction temperature becomes too high, the catalyst may begin to decompose. Melting furnace exhaust is generally below 600°F due to heat recovery design.

In a system with significant particulate matter, catalysts are susceptible to fouling, rendering them ineffective. The glass furnace will have significant PM, making successful emissions reductions unlikely.

Oxygen-Enriched Air Staging (OEAS)

Testing was done on the oxy-firing process in 1994 by EPA. Although adequate results were obtained for container and pressed/blown glass, flat glass was of unacceptable quality. It therefore cannot be considered a demonstrated technology for the flat glass industry.

“3R” Process

3R is an innovative control technology transfer. This has been proposed by the applicant as BACT. A sliding limitation has been requested: 11.0 lb/ton first year, 9.0 lb/ton second year, and 7.0 lb/ton for subsequent years. NOx emissions will be continuously monitored to ensure compliance with emissions limitations. The sliding limitation gives the facility the opportunity to “fine-tune” the process and gather experience in its operation.

c) Selection of BACT

The innovative control process, “3R,” is acceptable as BACT for NOx emissions from the Main Furnace.

2. Backup Diesel Generator

Only two emissions controls were identified for the backup generators:

- Limiting hours of operation
- Combustion design

A check of EPA’s RBLC did not show any add-on controls (SCR, SNCR, etc.) having been used for diesel engines. Therefore, add-on controls may be dismissed as not being demonstrated for diesel engines.

Uncontrolled NO_X emissions of 2.035 lb/MMBTU for the backup diesel generators are based on manufacturer’s data and AP-42, respectively, and are proposed as BACT. The proposed BACT has no adverse environmental or energy impacts. DEQ agrees that engine design and a limitation on hours of operation is acceptable as BACT.

B. CO BACT Review

Carbon monoxide is formed as a result of incomplete combustion of fuel. Control of CO is accomplished by providing adequate fuel residence time and high temperature in the combustion zone to ensure complete combustion. These control factors also tend to result in high NO_X emissions. Conversely, a low NO_X emission rate achieved through flame temperature control can result in higher levels of CO emissions. Thus a compromise is established whereby the flame temperature reduction is set to achieve lowest NO_X emissions rate possible while also optimizing CO emission rates.

CO emissions are a function of oxygen availability (excess air), flame temperature, residence time at flame temperature, combustion zone design, and turbulence. Alternative CO control methods include exhaust gas cleanup methods such as catalytic oxidation, and front-end methods such as combustion control wherein CO formation is suppressed within the combustors.

Recent BACT Determinations for CO Emissions from Flat Glass Plants

Facility	Process	BACT
Cardinal FG Portage, WI 12/13/99 650 TPD Plant	Float Glass Furnace	No add-on controls (51.3 lb/hr)
	Diesel Generator	No add-on controls (12.4 lb/hr)
Guardian Industries Geneva, NY 8/11/97 700 TPD	Float Glass Furnace	0.1 lb/MMBTU (no controls listed)
Libbey Owens Ford Lathrop, CA 5/6/96	Flat Glass Furnace	1,000 lb/day (no controls listed)
Cardinal FG Portage, WI 11/23/94	Float Glass Furnace	Proper furnace design (51.3 lb/hr)
	Diesel Generator	12.35 lb/hr (no controls listed)

1. Main Furnace

a) Identification of Control Techniques

Two control technologies were identified for CO:

- Efficient combustion in the furnace
- Catalytic oxidation

A third potential control, secondary combustion, was dismissed as working in opposition to NOx controls (3R Process).

With a stack flow of 113,000 ACFM at 580^{o}F and a proposed CO emission limitation of 270.83 lb/hr, CO concentrations will be approximately 1,083 ppm at discharge.

AP-42 (1/95), Section 11.15, shows CO emissions from flat glass manufacturing at 0.1 lb/ton. The application indicated significantly higher CO would be expected, 10 lb/ton. The application listed 9 recent permits for glass plants in Wisconsin, North Carolina, Kentucky, New York, Iowa, California, and Illinois, each allowing as BACT significantly higher emissions than AP-42 emission rates.

Efficient Combustion

Efficient combustion in the main furnace will be achieve by high operating temperatures with sufficient oxygen present. These same conditions favor creation of NOx, which will be controlled by the 3R Process.

Catalytic Oxidation

The most stringent CO control level available would be achieved with the use of an oxidation catalyst system, which can remove approximately 80 percent of CO. This system also would be expected to control a small percent (5-40%) of hydrocarbon (VOC) emissions.

b) Technical Feasibility of The Control Techniques

Catalytic Oxidation

As with SCR catalyst technology for NO_x control, oxidation catalyst systems seek to remove pollutants from the exhaust gas rather than limiting pollutant formation at the source. Unlike an SCR catalyst system, which requires the use of ammonia as a reducing agent, oxidation catalyst technology does not require the introduction of additional chemicals for the reaction to proceed. Rather, the oxidation of CO to CO_2 utilizes the excess air present in the exhaust; the activation energy required for the reaction to proceed is lowered in the presence of the catalyst. Technical factors relating to this technology include the catalyst reactor design, optimum operating temperature, back pressure loss to the system, catalyst life, and potential collateral increases in emissions of PM_{10}.

As with SCR, CO catalytic oxidation reactors operate in a relatively narrow temperature range. Optimum operating temperatures for these systems generally fall into the range of 700°F to 1,100°F. At lower temperatures, CO conversion efficiency falls off rapidly. Since the expected discharge temperature is 580^{o}F, the glass furnace is below the temperature range at which efficient function of an oxidative catalyst is expected. There would be a fuel penalty for re-heating the exhaust stream to 700^{o}F or hotter.

Catalyst systems are subject to loss of activity over time. Since the catalyst itself is the most costly part of the installation, the cost of catalyst replacement should be considered on an annualized basis. Catalyst life may vary from the manufacturer's typical 3-year guarantee to a 5 to 7 year predicted life. Periodic testing of catalyst material is necessary to predict actual catalyst life for a given installation. In a system with significant PM concentrations, a short catalyst lifespan is anticipated.

According to the list of glass plants in the RACT/BACT/LAER Clearinghouse with limits on CO, oxidation catalyst systems have not been required as BACT for CO emissions control.

c) Control Technology Effectiveness and Impacts

A CO catalyst also will oxidize other species within the furnace exhaust. For example, SO_2 is further oxidized to SO_3 across a catalyst (30% conversion is assumed). SO_3 will then be emitted and/or combined to form H_2SO_4 (sulfuric acid mist) from the exhaust stack. These sulfates condense in the gas stream or within the atmosphere as additional PM_{10} (and $PM_{2.5}$). Thus, an oxidation catalyst would reduce emissions of CO and to some extent VOC, but would increase emissions of PM_{10} and $PM_{2.5}$. The increased backpressure of the catalyst bed would require additional energy to overcome the pressure drop.

There is no “Bright Line” cost effectiveness threshold for CO; rather, the cost presented for a specific project for control of CO are compared with the cost per ton that have been required of other sources in the same geographical area. For example, a project located in a rural attainment area where dispersion modeling shows less than significant air quality impacts would have a different cost criteria than a project located in or near an urban CO non-attainment area where there is a legitimate need to minimize emissions of CO. It should also be noted that cost effectiveness is a pollutant specific standard. For instance, the cost effectiveness of controlling the more pervasive pollutant NO_X (an acid rain pollutant, a precursor to the formation of regional haze, and a precursor to the formation of ozone) is appropriately higher than for the more benign stack level emissions of CO. Areas of CO non-attainment are primarily urban and exceedances of the CO NAAQS are dominated by ground level releases due to automobiles. CO emitted from a glass furnace stack is quickly dispersed (as shown in the modeling analysis) and is an unstable molecule that naturally is converted to CO_2 in the atmosphere.

d) Selection of BACT

The use of an oxidation catalyst to control emissions of CO would result in collateral increases in PM_{10} (and $PM_{2.5}$) emissions and is not considered technologically feasible for the glass furnace. BACT is acceptable as furnace design in which high operating temperatures and oxygen content minimize CO emissions.

2. Backup Diesel Generator

The control technologies for CO emissions evaluated for use on the backup diesel generators and the diesel-powered fire water pump are catalytic oxidation and proper design to minimize emissions. Because of the intermittent operation and low emissions, add-on controls would be prohibitively expensive. Thus, engine design is acceptable as BACT for controlling the CO emissions from the backup diesel generator and the diesel-powered fire water pump. A review of the RBLC indicates that this type of equipment has not been required to install additional CO controls because of intermittent operation. Good combustion practices have been determined as BACT resulting in CO emissions of 0.202 lb/MMBTU for the backup diesel generators. The proposed BACT will not have any adverse environmental or energy impacts.

C. VOC BACT Review

VOC emissions result from the main furnace and the emergency generators.

Recent BACT Determinations for VOC Emissions from Flat Glass Plants

Facility	Process	BACT
Cardinal FG Portage, WI 12/13/99 650 TPD Plant	Diesel Generator	No add-on controls (1.2 lb/hr)
Libbey Owens Ford Lathrop, CA 5/6/96	Flat Glass Furnace	3.4 ppm @ 15% oxygen
Cardinal FG Portage, WI 11/23/94	Diesel Generator	1.2 lb/hr

1. Main Furnace

a) Identification of Control Techniques

Two control technologies were identified for VOC:

- Efficient combustion in the furnace
- Catalytic oxidation

Numerous VOC control technologies were rejected preemptively: adsorption, absorption, biofiltration, etc. The discharge temperature (580°F) precludes low-temperature VOC emissions control technologies. None of these controls were shown in the RACT/BACT/LAER Clearinghouse, therefore, cannot be considered demonstrated controls.

The most stringent VOC control level would be achieved through secondary combustion or catalytic oxidation which also could be used for CO control. An oxidation catalyst designed to control CO would provide a side benefit of controlling, in the range of 5 to 40 percent, VOC emissions. The next level of control is combustion controls where VOC emissions are minimized by optimizing fuel mixing, excess air, and combustion temperature to assure complete combustion of the fuel. These conditions will exist inside a glass furnace.

b) Technical Feasibility of The Control Techniques

The same technical factors that apply to the use of oxidation catalyst technology for control of CO emissions (narrow operating temperature range, loss of catalyst activity over time, and system pressure losses) apply to the use of this technology for collateral control of VOC.

Since an oxidation catalyst has been shown to not be demonstrated or feasible, good combustion practices have been determined to represent BACT for VOC controls for the glass furnace.

c) Selection of BACT

BACT is acceptable as efficient combustion in the furnace (no add-on controls). Secondary combustion would be redundant and would interfere with NOx controls, while oxidative catalysts are not feasible given operating temperatures and particulate matter concentrations in exhaust gases.

2. Backup Diesel Generators

A review of the RBLC indicates that this type of equipment has not been required to install additional VOC controls because of intermittent operation. DEQ agrees that engine design is acceptable as BACT.

D. PM_{10} BACT Review

All significant units will have finite PM emissions.

Recent BACT Determinations for PM Emissions from Flat Glass Plants

Facility	Process	BACT
Cardinal FG Portage, WI 12/13/99 650 TPD Plant	Float Glass Furnace	ESP (25.5 lb/hr)
	Cullet Handling	Baghouse (0.02 gr/DSCF)
	Batch Plant & Elevators	Baghouse (0.02 gr/DSCF)
	Diesel Generator	No add-on controls (4.75 lb/hr)
Cardinal FG Mooresville, NC 10/29/98 600 TPD Plant	Glass Furnace	Modified process (1.5 lb/ton)
	Cullet Return & Raw Materials Handling	Baghouse (0.0067 gr/DSCF)
Guardian Industries Geneva, NY 8/11/97 700 TPD	Float Glass Furnace	1 lb/ton (no control listed)

Recent BACT Determinations for PM Emissions from Flat Glass Plants (Continued)

Facility	Process	BACT
AFG Industries Richmond, KY 6/9/97 600 TPD	Melting Furnace	1 lb/ton (no control listed)
	Raw Materials Handling	Baghouses (0.021-0.429 lb/hr)
	Cutting Line	0.031 lb/hr
	Diesel Generator	No add-on controls (0.34 TPY)
PPG Industries Fresno, CA 2/15/96	Flat Glass Furnace	ESP and supplemental burner system
Guardian Industries DeWitt, IA 3/28/95 700 TPD	Flat Glass Furnace	Minimize excess air, maximize cullet
	Cullet Silos	Baghouses (0.076 lb/hr/silo)
Cardinal FG Portage, WI 11/23/94	Float Glass Furnace	ESP (25.5 lb/hr)
	Diesel Generator	26.5 hours per year operation
	Cullet Handling	Baghouse (0.02 gr/DSCF)
	Batch Mix and Transfer	Baghouse (0.02 gr/DSCF)
	Elevators Transfer Ops	Baghouse (0.02 gr/DSCF)

1. Main Furnace

Total suspended particulates (TSP) and particulate matter less than 10 micrometers will occur from the combustion of natural gas and charging/melting operations. PM_{10} emission rates from natural gas combustion are inherently low because of very high combustion efficiencies and the clean burning nature of natural gas.

a) Identification of Control Techniques

Four control technologies were identified for PM from the main furnace:

- “Modified process” furnace design
- Electrostatic precipitators
- Baghouses
- Wet scrubbers

Modified Process

“Modified process” is defined in NSPS, Subpart CC, to include any technique to minimize emissions without the use of add-on controls. Here, the furnace will be designed to minimize particle entrainment from adding raw materials and allow for settle of PM which has been generated.

Baghouses

Baghouses utilize fabric filters to remove particulate matter. Along with ESPs, baghouses are the most efficient PM control devices. Control efficiency depends on tightness of fabric weave and resultant pressure drops, but efficiencies of 99% and higher are normal. The controls are available in a wide range of capacities (ACFM), but even with the use of fiberglass fabric, the maximum temperature recommended is 500°F (APTI Course SI:431: "Air Pollution Control Systems for Selected Industries").

Wet Scrubbers

There are several types of wet scrubber designs, including Venturis, packed beds, and spray towers. All wet scrubbers depend on impaction of particulates with water droplets. Pressure differentials depend on the type of scrubber and necessary efficiency. When used with a caustic reagent, wet scrubbers can control acid gas pollutants such as SO_2.

Electrostatic Precipitators (ESPs)

ESPs utilize a corona discharge to impart an electrostatic charge onto particulates, a charge which attracts the particles to an oppositely-charged collection system. The efficiency of the system depends on applied voltage and the resistivity of the particles, with maximum efficiency in the range of 10^{10} – 10^{11} ohm-cm. Particles with lower resistivity tend to absorb the charge, not having it on the surface to provide the collection force; particles with higher resistivity retain the charge at the collection plates and are repelled from collection by the charges on other, similar particles. ESPs are usable over a wide range of gas temperatures and compositions.

b) Technical Feasibility of The Control Techniques

Modified Process

"Modified process" controls are feasible, preventing PM from being created at the raw material charging and melting operations.

Baghouses

The expected discharge temperature (580°F) is hotter than the maximum recommended temperature for baghouses (500°F). Although it may be possible to cool the exhaust stream somewhat, glass furnaces are prone to significant swings in temperature and flows; temperatures may swing to a point where the capability of the fabric is exceeded. The restriction on flows may impair product quality, necessitating additional operation of the furnace to achieve the same output. The feasibility of baghouses is questionable for this facility.

Wet Scrubbers

There is no usage of wet scrubbers listed by EPA on glass furnaces. Although potentially feasible, it is not a demonstrated technology. It is possible that high pressure drops may restrict flow from the furnace and compromise product quality.

Electrostatic Precipitators

ESPs are technologically feasible controls for glass plants, and have been required for other facilities. The application seeks to reject ESPs from an economic basis.

Control system costs have been estimated using the procedures of EPA's *OAQPS Cost Control Manual* and *Estimating Costs of Air Pollution Control Equipment* (M. Vatavuk). ESP size is depending primarily on exhaust flow. The annualized cost of equipment was estimated at $1,009,483 to achieve an 80% reduction in PM from the uncontrolled level of 177.9 TPY to 35.6 TPY (142.3 TPY PM removed), or $7,093 per ton. These costs are excessive.

c) Selection of BACT

BACT is acceptable for the main furnace as modified process to minimize generation of PM emissions. Wet scrubbers are not demonstrated, and baghouses are not technically feasible. ESPs are rejected on the basis of excessive cost.

2. <u>Cullet and Raw Materials Handling Systems</u>

The BACT analysis only identified one control technology: baghouses. Baghouses are among the most efficient PM controls, and are the proposed BACT, with PM emissions of 0.005 gr/DSCF. No further analysis is warranted.

3. <u>Backup Diesel Generators</u>

These units emit particulates consisting of ash in the fuel and residual carbon and hydrocarbons caused from incomplete combustion. The applicant's review of RBLC shows that good combustion control and/or good engine design is the most stringent requirement for this application. An emission rate of 0.0444 lbs/MMBTUfor the backup generators is proposed for BACT. The proposed BACT will not have any adverse environmental or energy impacts. DEQ has agreed that combustion control and good engine design are acceptable as BACT, without further analysis.

E. SO_2 / H_2SO_4 Control Techniques

SO_2 is produced from combustion of fuel and from smelting of sulfur-laden materials in the melting process (sodium sulfate to sulfur dioxide). SO_2 will oxidize to SO_3, and combine with water to form H_2SO_4.

Recent BACT Determinations for SO_2 Emissions from Flat Glass Plants

Facility	Process	BACT
Cardinal FG Portage, WI 12/13/99 650 TPD Plant	Float Glass Furnace	Dry scrubber (17.6 lb/hr)
	Diesel Generator	Low-sulfur fuel (0.6 lb/hr)
Cardinal FG Mooresville, NC 10/29/98 600 TPD Plant	Glass Furnace	2.0 lb/ton (10 lbs salt cake per 1,000 pounds sand)
	Annealing Lehr	Usage limited to 25 TPY
Guardian Industries Geneva, NY 8/11/97 700 TPD	Float Glass Furnace	2.07 lb/ton (60 lb/hr)
	Annealing Lehr	Wet scrubber (0.014 lb/ton)
AFG Industries Richmond, KY 6/9/97 600 TPD	Melting Furnace	2.0 lb/ton (10 lbs salt cake per 1,000 pounds sand)
	Annealing Lehr	0.106 lb/hr (no control listed)
	Diesel Generator	No add-on controls (0.79 TPY)
Guardian Industries DeWitt, IA 3/28/95 700 TPD	Flat Glass Furnace	60 lb/hr (10 lbs salt cake per 1,000 pounds sand)
	Annealing Lehr	Caustic scrubber (0.4 lbs/hr)
Cardinal FG Portage, WI 11/23/94	Float Glass Furnace	Dry scrubber (15 lb/hr)
	Diesel Generator	Low-sulfur fuel (0.7 lb/hr)

1. Main Furnace

a) Identification of Control Techniques

Three control technologies were identified for SO_2 from the main furnace:

- Reduced sulfur content in raw materials and fuel
- Spray driers
- Wet scrubbers

There are numerous add-on control technologies available for SO_2. However, these are intended primarily for coal-fired units where SO_2 concentrations are one to two orders of magnitude above concentrations anticipated resulting from sweet natural gas combustion.

b) Technical Feasibility of The Control Techniques

Reduced Sulfur Content

Sodium sulfate is used as a flux material in the melt to help remove bubbles in the molten glass. As the glass hardens, the bubbles would be trapped, rendering the glass partially opaque. By reducing the amount of sulfate material charged to the furnace, SO_2 emissions may be reduced. This technology is in common use across the U.S.

Natural gas fuel is normally supplied by pipelines at 4 ppm or less sulfur. Any other fuel would have significantly higher SO_2 emissions, with resultant increased H_2SO_4 emissions.

Spray Driers

Spray driers operate by injection of lime (CaO) or limestone ($CaCO_3$) into the exhaust gas. Sulfur compounds are removed as calcium sulfite and calcium sulfate. The reaction is not very efficient; large excesses of alkaline material must be injected to achieve 90% control of SO_2. This technology requires additional PM emissions controls to collect both reacted sulfur compounds and unreacted alkaline reagents. This technology is currently being used at glass plants in California and Wisconsin.

The annualized cost of a spray driers has been stated at $1,057,344, achieving 72% reduction in SO_2 emissions, or controlling 171 TPY. Control costs are calculated at $6,138 per ton, which is excessive.

Wet Scrubbers

Wet scrubbers can utilize alkaline reagents (sodium hydroxide or calcium hydroxide) to react with SO_2. Control efficiencies of 70% - 90% can be achieved depending on scrubber size, energy (pressure drop), and alkaline strength of the scrubber liquor. This technology has been demonstrated for coal-fired boilers but has not been demonstrated for glass plants.

c) Selection of BACT

BACT for SO_2/H_2SO_4 is acceptable as requiring pipeline-quality natural gas fuel and a limitation on “salt cake” (sodium sulfate) usage.

2. Emergency Diesel Generators

The applicant proposes BACT for SO_2 emissions from the stationary engines to be distillate fuel with 0.05% sulfur. This level is equivalent to road diesel sulfur, and the lowest sulfur distillate fuel normally available. The units are too small to consider add-on controls for SO_2.

Distillate fuel with 0.05% sulfur will have SO_2 emissions of approximately 0.05 lb/MMBTU. This represents a 94% reduction from the applicable limit and baseline of 0.8 lb/MMBTU.

SECTION VI: AIR QUALITY IMPACTS ANALYSIS

Prevention of Significant Deterioration (PSD) is a construction permitting program designed to ensure air quality does not degrade beyond the National Ambient Air Quality Standards (NAAQS) or beyond specified incremental amounts above a prescribed baseline level. The PSD rules set forth a review procedure to determine whether a source will cause or contribute to a violation of the NAAQS or maximum increment consumption levels. If a source has the potential to emit a pollutant above the PSD significance levels, then they trigger this review process. EPA has provided modeling significance levels for the PSD review process to determine whether a source will cause or contribute to a violation of the NAAQS or consume increment. Air quality impact analyses were conducted to determine if ambient impacts would be above the EPA defined modeling and monitoring significance levels. If impacts are above the modeling significance levels, a radius of impact is defined for the facility for each pollutant out to the farthest receptor at or above the significance levels. If a radius of impact is established for a pollutant, then a full impact analysis is required for that pollutant. If the air quality analysis does not indicate a radius of impact, no further air quality analysis is required for the Class II area.

Modeling conducted by the applicant and reviewed by the DEQ demonstrated that emissions from the facility will not exceed the PSD modeling significance levels for CO. However, the PSD modeling significance levels for NO_2 and SO_2 were exceeded. Therefore, a full impact analysis was completed for these pollutants.

VOC is not limited directly by NAAQS. Rather, it is regulated as an ozone precursor. EPA developed a method for predicting ozone concentrations based on VOC and NO_X concentrations in an area. The ambient impacts analysis utilized the tables from "VOC/NO_X Point Source Screening Tables" (Richard Scheffe, OAQPS, September, 1988). The Scheffe tables utilize increases in NO_X and VOC emissions to predict increases in ozone concentrations. Even though emissions of VOC are above the significance level for PSD, VOC emissions are below the modeling significant impact level of 100 TPY. Background ozone concentrations were estimated at 0.04 ppm (78 ug/m^3), while the Scheffe tables showed added ozone impacts of 0.012 ug/m^3 (24 ug/m^3) for total ozone concentrations of 102 ug/m^3. These impacts are in compliance with the NAAQS limit of 235 ug/m^3.

Modeling Methodology

The dispersion modeling for the Cardinal FG plant was conducted in two phases. First, a screening analysis was performed to determine the operating load that would result in the highest predicted impact for each pollutant and averaging period. Three load scenarios were evaluated: 50%, 75%, and 100%. Emissions during start-up and shutdown were not included in the modeling analyses, nor were sulfate-deposit clean-out. Maximum impacts were determined at 100% operations, so this scenario was used in all subsequent analyses.

The refined air quality modeling analyses employed USEPA's Industrial Source Complex (ISC3) (Version 00101) model (USEPA, 1995a). The ISC3 model is recommended as a guideline model for assessing the impact of aerodynamic downwash (40 CFR 40465-40474). The regulatory default option was selected such that USEPA guideline requirements were met.

The stack height regulations promulgated by USEPA on July 8, 1985 (50 CFR 27892), established a stack height limitation to assure that stack height increases and other plume dispersion techniques would not be used in lieu of constant emission controls. The regulations specify that Good Engineering Practice (GEP) stack height is the maximum creditable stack height which a source may use in establishing its applicable State Implementation Plan (SIP) emission limitation. For stacks uninfluenced by terrain features, the determination of a GEP stack height for a source is based on the following empirical equation:

$$H_g = H + 1.5L_b$$

where:

H_g = GEP stack height;

H = Height of the controlling structure on which the source is located, or nearby structure; and

L_b = Lesser dimension (height or width) of the controlling structure on which the source is located, or nearby structure.

Both the height and width of the structure are determined from the frontal area of the structure projected onto a plane perpendicular to the direction of the wind. The area in which a nearby structure can have a significant influence on a source is limited to five times the lesser dimension (height or width) of that structure, or within 0.5 mile (0.8 km) of the source, whichever is less. The methods for determining GEP stack height for various building configurations have been described in USEPA's technical support document (USEPA, 1985).

Since downwash is a function of projected building width and height, it is necessary to account for the changes in building projection as they relate to changes in wind direction. Once these projected dimensions are determined, they can be used as input to the ISC3 model.

In October 1993, USEPA released the Building Profile Input Program (BPIP) to determine wind direction-dependent building dimensions. The BPIP algorithms as described in the User's Guide (USEPA, 1993), have been incorporated into the commercially available BPIP View program.

The BPIP program builds a mathematical representation of each building to determine projected building dimensions and its potential zone of influence. These calculations are performed for 36 different wind directions (at 10 degree intervals). If the BPIP program determines that a source is under the influence of several potential building wakes, the structure or combination of structures that has the greatest influence ($H + 1.5 L_b$) is selected for input to the ISCST3 model. Conversely, if no building wake effects are predicted to occur for a source for a particular wind direction, or if the worst-case building dimensions for that direction yield a wake region height less than the source's physical stack height, building parameters are set equal to zero for that wind direction. For this case, wake effect algorithms are not exercised when the model is run. The building wake criteria influence zone is 5 L_b downwind, 2 L_b upwind, and 0.5 L_b crosswind. These criteria are based on recommendations by USEPA. The input to the BPIP preprocessing program consisted of proposed exhaust stacks and building dimensions.

Due to the relatively high stack heights and the relatively small size of the dominant structures, the building cavity effects that were considered in the modeling analysis were minimal for the CT/HRSGs. For this analysis, the first step was to determine the building cavity height based on the formula:

$$h_c = H + 0.5L_b$$

where:

h_c = GEP stack height;

H = Height of the controlling structure on which the source is located, or nearby structure; and

L_b = Lesser dimension (height or width) of the controlling structure on which the source is located, or nearby structure.

If the stack height was greater than or equal to the cavity height, the cavity effect would not affect the downwind maximum impacts. However, if a cavity effect was possible, the length of the cavity was compared to the distance to the nearest receptor. Due to the smaller stack height of the emergency generator, cavity effects were encountered at some receptors.

The meteorological data used in the dispersion modeling analyses consisted of five years (1986, 1987, 1988, 1990, and 1991) of hourly surface observations from the Oklahoma City, Oklahoma, National Weather Service Station and coincident mixing heights from Oklahoma City (1986-1988) and Norman, Oklahoma (1990 and 1991). Surface observations consist of hourly measurements of wind direction, wind speed, temperature, and estimates of ceiling height and cloud cover. The upper air station provides a daily morning and afternoon mixing height value as determined from the twice-daily radiosonde measurements. Based on NWS records, the anemometer height at the Oklahoma City station during this period was 6.1 meters.

Prior to use in the modeling analysis, the meteorological data sets were downloaded from the USEPA Support Center for Regulatory Air Models (SCRAM) website. This data was scanned for missing data, but no missing data were found. USEPA used the procedures outlined in the USEPA document, "Procedures for Substituting Values for Missing NWS Meteorological Data for Use in Regulatory Air Quality Models," were used to fill gaps of information for single missing days. For larger periods of two or more missing days, seasonal averages were used to fill in the missing periods. The USEPA developed rural and urban interpolation methods to account for the effects of the surrounding area on development of the mixing layer boundary. The rural scheme was used to determine hourly mixing heights representative of the area in the vicinity of the proposed plant.

The urban/rural classification is used to determine which dispersion parameter to use in the model. Determination of the applicability of urban or rural dispersion is based upon land use or population density. For the land use method the source is circumscribed by a three kilometer radius circle, and uses within that radius analyzed to determine whether heavy and light industrial, commercial, and common and compact residential, comprise greater than 50 percent of the defined area. If so, then urban dispersion coefficients should be used. The land use in the area of the proposed facility is not comprised of greater than 50 percent of the above land use types. Most of the land is farm and pasture land, for which rural dispersion coefficients are appropriate.

The refined modeling used a nested Cartesian grid. For CO, PM_{10}, and SO_2, receptors were placed on a 100-meter grid of receptors extended out to 7 kilometers; for NO_2, a 200-meter spacing out to 12 km was used. Receptors were placed on the property since no fence is anticipated to isolate it from the general public's access. All receptors were modeled with actual terrain based on the proposed plant location. The terrain data was taken from United States Geologic Society (USGS) 7.5-minute Digital Elevation Model Files.

Both significant NOx emission point rates were adjusted. Main Furnace NOx emissions were input as 189.6 lb/hr, which is equivalent to 7.0 lb/ton glass NO_2. The EPA "Ambient Ratio Method" would allow modeling of 75% of NOx as NO_2 (223 lb/hr), therefore the rate modeled is lower than would be calculated for first year operation but higher for all subsequent years. Average NOx emissions from the emergency generator were input as 4.8 lb/hr, which is equal to annual emissions divided by 8,760 hours and with no reduction based on NO/NO_2 ratio.

Modeling Results – New Facility Only

The modeling results are shown following. The modeling indicates facility emissions will result in ambient concentrations above the significance levels for NO_2 and SO_2. Therefore, additional modeling for PSD increment and NAAQS compliance is required.

Significance Level Comparisons

Pollutant	Averaging Period	Radius Of Impact (km)	Max. Concentrations ($\mu g/m^3$)	Ambient Significance Level ($\mu g/m^3$)	Monitoring Exemption Level ($\mu g/m^3$)
NO_2	Annual	8.1	2.5	1	14
SO_2	3-hour	0.4	48.5	25	--
	24-hour	0.4	16.5	5	13
	Annual	0.4	3.7	1	--
CO	1-hour	--	82.6	2000	--
	8-hour	--	38.0	500	--
PM_{10}	24-hour	--	4.0	5	10
	Annual	--	0.6	1	--
VOC	N/A	56.4 TPY VOC		100 TPY of VOC	

Ambient impacts of CO and PM are below the PSD ambient levels of significance. Therefore, a radius of impact is not defined and increment is not consumed. A full NAAQS analysis is required for NOx and SO_2.

The predicted maximum ground-level concentrations of pollutants by air dispersion models have demonstrated that the ambient impacts of the facility are below the monitoring exemption levels for PM_{10}, NO_2, and CO. However, the predicted maximum ambient impact of SO_2 exceeds the monitoring exemption levels.

EPA's guidance document, "Guidelines on Air Quality Monitoring," states that ambient monitoring is not always required even when the monitoring exemption level is exceeded.

> If the proposed source or modification will be constructed in an area that is generally free from the impact of other point sources and area sources associated with human activities, then monitoring data from a 'regional' site may be used as representative data. Such a site could be out of the maximum impact area. This site should be characteristic of air quality across a broad region including that in which the proposed source or modification is located.

The Durant site meets the criteria specified for utilizing a regional monitor. The AQD monitoring site at Muskogee, OK, will provide regional air quality data to substitute for pre-construction monitoring. The site will also be acceptable for post-construction monitoring for SO_2. All other ambient impacts are below the monitoring exemption levels.

Compliance with National Ambient Air Quality Standards (NAAQS)

The emissions of NO_X and SO_2 were determined to have significant impacts. All other pollutants were shown to have modeled impacts below significance levels. Based on this determination, a modeling analysis to determine the effect of the proposed emissions on the NAAQS was made.

The full impact analysis to demonstrate compliance with the NAAQS expanded the significance analysis to include existing sources as well as new significant sources within a 50-km radius of the area of impact (AOI) determined in the significance analysis. The AOI is defined as the area circumscribed by a radius extending to the farthest receptor, which exceeds the modeling significance levels. This radius is the radius of impact (ROI).

The ROI for NO_2 was determined to be 8.1 kilometer from the center of the facility. The ROI for all SO_2 average periods was 0.4 km.

In order to eliminate sources with minimal affect on the area of impact, a screening procedure known as the "20D Rule" was applied to the sources on the emission inventory. This is a screening procedure designed to reduce the number of insignificant modeled sources. The rule is applied by multiplying the distance from the sources (in kilometers) by 20. If the result is greater than the emission rate (in tons per year), the source is eliminated. If the result is less than the emission rate, the source is included in the NAAQS analysis. An inventory of sources in Oklahoma was supplied by AQD, while an inventory of sources in Texas was supplied by TNRCC. All sources except two were screened out from modeling: one coal-fired electric generating complex in north Texas (for NOx and SO_2 emissions) and one natural gas processing plant in Oklahoma. The following table lists the background sources and parameters used in the modeling for the NAAQS analysis.

NAAQS Background Sources

Facility	Source ID	UTM Easting	UTM Northing	SO_2 Emission Rate	NOx Emission Rate	Stack Ht.	Stack Temp.	Stack Vel.	Stack Dia.
		M	m	lbs/hr	lbs/hr	ft	ºF	ft/min	ft
Duke Energy Gas Plant	15941	728277	3828438	--	9.92	12	947	4590	0.5
Texas Utility	10	744193	3724084	0.01	1.42	60	600	1732	4.5
Texas Utility	20	744164	3723977	0.59	11.75	50	670	7199	2.50
Texas Utility	30	744204	3724084	1.24	104.61	142	242	1732	10.50
Texas Utility	40	744204	3724084	0.54	182.82	142	242	1732	10.50
Texas Utility	50	744186	3724003	8.84	627.83	142	242	1732	26.00
Texas Utility	60	744151	3723960	1.24	104.61	157	675	2285	23.40

NAAQS Analysis for NO_2 Annual and PM_{10} 24-hour and Annual

Pollutant	Refined Model Maximum	Monitored Background	Refined + Background	NAAQS Limit
	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)
NO_2 Annual[1]	5.4	26.0	31.4	100
SO_2 3-hour[2]	108.4	162.0	270.4	1300
SO_2 24-hour[2]	17.9	57.6	75.5	365
SO2 Annual	4.0	5.2	9.2	80

[1] Tier II impact.

[2] The high 2^{nd} high modeled concentration for the SO_2 3-hour and 24-hour standards was used to demonstrate compliance with the NAAQS.

E. Evaluation of PSD Increment Consumption

The PSD increment analysis compares all increment consuming emission increases in the area of impact since the baseline date against the available increment. The amount of available increment is based on other sources constructed within the area of impact since the baseline date. The minor source baseline date was triggered for Bryan County on November 15, 2002, for SO_2 and July 30, 1990 for NO_2. Minor increases and decreases at existing major facilities may impact the increment consumption prior to the minor source baseline date. This is a conservative look at increment consumption since the modeling was based on the NAAQS modeling and included background sources. Since the modeled-off property emission inventory included PSD sources as well as non-PSD sources (one new source was within the radius of impact for NO_2), the same predicted impacts were used for the PSD increment consumption analysis. This is conservative since non-PSD sources do not consume PSD increments. ODEQ under guidance from EPA allows the use of the "20D Rule" for increment consumption evaluations as well as NAAQS evaluations. The following table presents the results of the increment analysis. The applicant has demonstrated compliance.

Class II Increment Consumption Analysis

Pollutant	Averaging Period	Maximum Concentrations ($\mu g/m^3$)	Max. Allowable Increment Consumption ($\mu g/m^3$)
NO_2	Annual[1]	5.4	25
SO_2	Annual	4.0	17
	24-hour[2]	17.9	30
	3-hour	108.4	512

[1] Tier II impact.

[2] The high 2^{nd} high modeled concentration for the PM_{10} 24-hour standard was used to demonstrate compliance with the Increment.

SO_2 modeling was repeated at 108 lb/hr, the maximum anticipated rate during sulfate clean-out. Results varied by less than 0.1 ug/m^3, indicating that maximum facility impacts are created primarily by the emergency generators instead of the main furnace. Increment consumption, NAAQS compliance, and compliance with OAC 252:100-31 are not affected by the maintenance operation.

SECTION VII. OTHER PSD ANALYSES

Mobile Sources

Current EPA policy is to require an emissions analysis to include mobile sources. In this case, mobile source emissions are expected to be negligible. The fuel for the plant will arrive by pipeline rather than by vehicle. According to Oklahoma Department of Transportation measurements during 2001, US-70 has traffic of 12,000 vehicles per day. Traffic is expected to increase by 150 vehicles per day, a 1.25% increase.

Growth Impacts

The purpose of the growth impact analysis is to quantify the possible net growth of the population of the area as a direct result of the project. This growth can be measured by the increase in residents of the area, the additional use and need of commercial and industrial facilities to assist the additional population with everyday services, and other growth, such as additional sewage treatment discharges or motor vehicle emissions.

There should be no substantial increase in community growth or the need for additional infrastructure. Therefore, it is not anticipated that the project will result in an increase in secondary emissions associated with non-project related activities or growth.

Soils and Vegetation Impact

Procedures for a soils and vegetation impact analysis are shown the in EPA's draft 1990 *New Source Workshop Manual.* Ambient impacts are compared to threshold for vegetation damage as shown in the 1980 EPA publication *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals*.

Pollutant	Averaging Period	Maximum Facility Impacts (μg/m^3)	Background Concentrations (μg/m^3)	Total Impacts (μg/m^3)	Vegetation Screening Levels (μg/m^3)	Screening Criteria Exceeded?
SO_2	1-hour	54	180	234	917	No
	3-hour	48.5	162	211	786	No
	Annual	3.7	5.2	9	18	No
NO_2	4-hour	27.5	286	314	3760	No
	8-hour	21.9	227.5	249	3760	No
	1-month	4.7	48.8	54	564	No
	Annual	2.5	26	29	94-188	No

No sensitive aspects of the soil and vegetation in this area have been identified.

The effects of gaseous air pollutants on vegetation may be classified into three rather broad categories: acute, chronic, and long-term. Acute effects are those that result from relatively short (less than 1 month) exposures to high concentrations of pollutants. Chronic effects occur when organisms are exposed for months or even years to certain threshold levels of pollutants. Long-term effects include abnormal changes in ecosystems and subtle physiological alterations in organisms. Acute and chronic effects are caused by the gaseous pollutant acting directly on the organism, whereas long-term effects may be indirectly caused by secondary agents such as changes in soil pH.

SO_2 enters the plant primarily through the leaf stomata and passes into the intercellular spaces of the mesophyll, where it is absorbed on the moist cell walls and combined with water to form sulfurous acid and sulfite salts. Plant species show a considerable range of sensitivity to SO_2. This range is the result of complex interactions among microclimatic (temperature, humidity, light, etc.), edaphic, phenological, morphological, and genetic factors that influence plant response (USEPA, 1973).

NO_2 may affect vegetation either by direct contact of NO_2 with the leaf surface or by solution in water drops, becoming nitric acid. Acute and chronic threshold injury levels for NO_2 are much higher than those for SO_2 (USEPA, 1971).

The secondary NAAQS are intended to protect the public welfare from adverse effects of airborne effluents. This protection extends to agricultural soil. The modeling conducted, which demonstrated compliance with the Primary NAAQS simultaneously demonstrated compliance with the Secondary NAAQS because the Secondary NAAQS are higher or equal to the Primary NAAQS. Since the secondary NAAQS protect impact on human welfare, no significant adverse impact on soil and vegetation is anticipated due to the proposed power plant.

Visibility Impairment

Visibility is affected primarily by PM and NO_X emissions. The area near the facility is primarily agricultural. Some residences are located east of the site. There are no airports, scenic vistas, or other areas that would be affected by minor reductions in visibility. The project is not expected to produce any perceptible visibility impacts in the vicinity of the plant. EPA computer software for visibility impacts analyses, intended to predict distant impacts, terminates prematurely when attempts are made to determine close-in impacts. It is concluded that there will be minimal impairment of visibility resulting from the facility's emissions. Given the limitation of 20% opacity of emissions, and a reasonable expectation that normal operation will result in 0% opacity, no local visibility impairment is anticipated.

Class I Area Impact Analysis

A further requirement of PSD includes the special protection of air quality and air quality related values (AQRV) at potentially affected nearby Class I areas. Assessment of the potential impact to visibility (regional haze analysis) is required if the source is located within 100 km of a Class I area. The Cardinal FG plant is approximately 205 km from the nearest Class I area, which is the Wichita Mountains Natural Wildlife Refuge (WMNWR), and 216 km from the Caney Creek National Wilderness Area. The Cardinal plant will be at approximately a right angle to the prevailing winds from these two Class I areas, precluding any measurable impact on them.

The applicant has conducted a visibility impact analysis in accordance with guidelines in the Workbook for Estimating Visibility Impairment (EPA-450/ 4-80-031) using EPA's software VISCREEN. A Level 1 screening analysis was performed for the facility's impact at a range of 40 km. All contrast parameters were below the Level I screening values, indicating negligible impairment on visibility at the two nearest Class I areas which are more than 200 km distant.

SECTION VIII. OKLAHOMA AIR POLLUTION CONTROL RULES

OAC 252:100-1 (General Provisions) [Applicable]
Subchapter 1 includes definitions but there are no regulatory requirements.

OAC 252:100-3 (Air Quality Standards and Increments) [Applicable]
Primary Standards are in Appendix E and Secondary Standards are in Appendix F of the Air Pollution Control Rules. At this time, all of Oklahoma is in attainment of these standards. Compliance with the NAAQS are addressed in the "Air Quality Impacts Analysis" section.

OAC 252:100-4 (New Source Performance Standards) [Applicable]
Federal regulations in 40 CFR Part 60 are incorporated by reference as they exist on July 1, 2001, except for the following: Subpart A (Sections 60.4, 60.9, 60.10, and 60.16), Subpart B, Subpart C, Subpart Ca, Subpart Cb, Subpart Cc, Subpart Cd, Subpart Ce, Subpart AAA, and Appendix G. NSPS regulations are addressed in the "Federal Regulations" section.

OAC 252:100-5 (Registration, Emission Inventory, And Annual Fees) [Applicable]
The owner or operator of any facility that is a source of air emissions shall submit a complete emission inventory annually on forms obtained from the Air Quality Division. Since this is construction for a new facility, no emission inventories or fees have previously been paid.

OAC 252:100-7 (Permits for Minor Facilities) [Not Applicable]
Subchapter 7 sets forth the permit application fees and the basic substantive requirements for permits for minor facilities. The current project will be a major source that is subject to Subchapter 8 permitting.

OAC 252:100-8 (Major Source/Part 70 Permits) [Applicable]
Part 5 includes the general administrative requirements for Part 70 permits. Any planned changes in the operation of the facility which result in emissions not authorized in the permit and which exceed the "Insignificant Activities" or "Trivial Activities" thresholds require prior notification to AQD and may require a permit modification. Insignificant activities mean individual emission units that either are on the list in Appendix I (OAC 252:100) or whose actual calendar year emissions do not exceed the following limits:

5 TPY of any one criteria pollutant
2 TPY of any one hazardous air pollutant (HAP) or 5 TPY of multiple HAPs or 20% of any threshold less than 10 TPY for single HAP that the EPA may establish by rule
0.6 TPY of any one Category A toxic substance
1.2 TPY of any one Category B toxic substance
6.0 TPY of any one Category C toxic substance

Emissions limitations have been established for each emission unit based on information from the permit application.

OAC 252:100-9 (Excess Emission Reporting Requirements) [Applicable]
In the event of any release which results in excess emissions, the owner or operator of such facility shall notify the Air Quality Division as soon as the owner or operator of the facility has knowledge of such emissions, but no later than 4:30 p.m. the next working day. Within ten (10) working days after the immediate notice is given, the owner operator shall submit a written report describing the extent of the excess emissions and response actions taken by the facility. Part 70/Title V sources must report any exceedance that poses an imminent and substantial danger to public health, safety, or the environment as soon as is practicable. Under no circumstances shall notification be more than 24 hours after the exceedance.

OAC 252:100-13 (Open Burning) [Applicable]
Open burning of refuse and other combustible material is prohibited except as authorized in the specific examples and under the conditions listed in this subchapter.

OAC 252:100-19 (Particulate Matter) [Applicable]
Subchapter 19 regulates emissions of particulate matter from fuel-burning equipment. Particulate emission limits are based on maximum design heat input rating. The emergency generators are regulated as fuel-burning equipment, while the main furnace is regulated at direct-fired process equipment. The emergency generators will have a heat input of 41 MMBTUH. PM emissions are limited to 17.63 lb/hr (0.43 lb/MMBTU), whereas PM emissions are expected at 1.82 lb/hr, which is in compliance. The process weight rate of the Main Furnace is 33 TPH of raw materials. PM emissions are limited to 40.8 lb/hr. The expected PM emission rate of 40.6 lb/hr is in compliance.

OAC 252:100-25 (Visible Emissions, and Particulates) [Applicable]
No discharge of greater than 20% opacity is allowed except for short-term occurrences, which consist of not more than one six-minute period in any consecutive 60 minutes, not to exceed three such periods in any consecutive 24 hours. In no case shall the average of any six-minute period exceed 60% opacity. Any unit which is subject to an opacity limit under NSPS is not subject to Subchapter 25. All units except for the main furnace are subject to the opacity limitations under Subchapter 25.

OAC 252:100-29 (Fugitive Dust) [Applicable]
No person shall cause or permit the discharge of any visible fugitive dust emissions beyond the property line on which the emissions originated in such a manner as to damage or to interfere with the use of adjacent properties, or cause air quality standards to be exceeded, or to interfere with the maintenance of air quality standards. Conducting unloading of raw materials in an enclosed building achieves compliance with Subchapter 29.

OAC 252:100-31 (Sulfur Compounds) [Applicable]
Part 2 regulates the emissions of sulfur compounds from stationary sources and establishes short-term ambient standards for SO_2. Ambient air quality modeling has demonstrated compliance with these standards.

Compliance With SO_2 Ambient Impacts Limitations

Averaging Period	Ambient SO_2 Impacts Limitation, (μg/m^3)	Modeled SO_2 Impacts (μg/m^3)	Background SO_2 Concentration (μg/m^3)	Total SO_2 Impacts (μg/m^3)
1-Hour	1,200	54.0	292	346
3-Hours	650	48.5	180	228.5
24-Hours	130	16.5	60	76.5

Background SO_2 concentrations were taken from the Muskogee air monitoring site.

Part 5 limits sulfur dioxide emissions from new equipment (constructed after July 1, 1972). For gaseous fuels the limit is 0.2 lb/MMBTU heat input, three-hour average. The permit will require the main furnace to be fired with pipeline-grade natural gas with SO_2 emissions equivalent to 0.0006 lb/MMBTU. The backup diesel generator will fire diesel fuel with a maximum sulfur content of 0.05 % by weight. This fuel will produce emissions of approximately 0.05 lbs/MMBTU, which is well below the allowable emission limitation of 0.8 lb/MMBTU for liquid fuels.

OAC 252:100-33 (Nitrogen Oxides) [Not Applicable]
This subchapter limits new gas-fired fuel-burning equipment with rated heat input greater than or equal to 50 MMBTUH to emissions of 0.2 lb of NO_X per MMBTU. An exclusion from this rule for glass furnaces which install BACT was approved as an emergency rule signed by Governor Brad Henry on March 17, 2003.

OAC 252:100-35 (Carbon Monoxide) [Not Applicable]

None of the following affected processes are located at this facility: gray iron cupola, blast furnace, basic oxygen furnace, petroleum catalytic cracking unit, or petroleum catalytic reforming unit.

OAC 252:100-37 (Volatile Organic Compounds) [Applicable]

Part 3 requires storage tanks constructed after December 28, 1974, with a capacity of 400 gallons or more and storing a VOC with a vapor pressure greater than 1.5 psia to be equipped with a permanent submerged fill pipe or with an organic vapor recovery system. The anticipated diesel tanks will be below the 1.5 psia threshold.

Part 5 limits the VOC content of coatings used in coating lines or operations. This facility will not normally conduct coating or painting operations except for routine maintenance of the facility and equipment, which is exempt.

Part 7 requires fuel-burning equipment to be operated and maintained so as to minimize emissions of VOCs. Temperature and available air must be sufficient to provide essentially complete combustion. The furnace and emergency generators are designed to provide essentially complete combustion of VOCs.

OAC 252:100-41 (Hazardous and Toxic Air Contaminants) [Applicable]

Part 3 addresses hazardous air contaminants. NESHAP, as found in 40 CFR Part 61, are adopted by reference as they exist on July 1, 2001, with the exception of Subparts B, H, I, K, Q, R, T, W and Appendices D and E, all of which address radionuclides. In addition, General Provisions as found in 40 CFR Part 63, Subpart A, and the Maximum Achievable Control Technology (MACT) standards as found in 40 CFR Part 63, Subparts F, G, H, I, L, M, N, O, Q, R, S, T, U, W, X, Y, CC, DD, EE, GG, HH, II, JJ, KK, LL, MM, OO, PP, QQ, RR, SS, TT, UU, VV, WW, YY, CCC, DDD, EEE, GGG, HHH, III, JJJ, LLL, MMM, NNN, OOO, PPP, RRR, TTT, VVV, XXX, CCCC, and GGGG are hereby adopted by reference as they exist on July 1, 2001. These standards apply to both existing and new sources of HAPs. NESHAP regulations are covered in the "Federal Regulations" section.

Part 5 is a state-only requirement governing toxic air contaminants. New sources (constructed after March 9, 1987) emitting any category "A" pollutant above de minimis levels must perform a BACT analysis and, if necessary, install BACT. All sources are required to demonstrate that emissions of any toxic air contaminant that exceeds the de minimis level do not cause or contribute to a violation of the MAAC.

Toxic Air Pollutant	C A S	Maximum 24-Hour Ambient Impacts (μg/m^3)	MAAC (μg/m^3)
Fluorides	16984488	0.05	50
Mineral Spirits	64741657	269	35000
Silica, Crystalline	60676860	0.05	0.5
Sulfuric Acid	7664939	0.12	10

Since silica is particulate matter, BACT for silica is identical to BACT for PM as previously shown in the BACT section. Similarly, BACT for SO_2 constitutes BACT for H_2SO_4 emissions.

OAC 252:100-43 (Sampling and Testing Methods) [Applicable]
All required testing must be conducted by methods approved by the Executive Director under the direction of qualified personnel. All required tests shall be made and the results calculated in accordance with test procedures described or referenced in the permit and approved by the AQD.

OAC 252:100-45 (Monitoring of Emissions) [Applicable]
Records and reports as Air Quality shall prescribe on air contaminants or fuel shall be recorded, compiled, and submitted as specified in the permit.

SECTION IX. FEDERAL REGULATIONS

PSD, 40 CFR Part 52 [Applicable]
The facility is a listed source with emissions greater than 250 TPY. PSD review has been completed in previous sections.

NSPS, 40 CFR Part 60 [Subparts A and CC are Applicable]
Subpart A, General Provisions. This subpart requires the submittal of several notifications for NSPS-affected facilities. Within 30 days after starting construction of any affected facility, the facility must notify DEQ that construction has commenced. A notification of the actual date of initial start-up of any affected facility will be submitted within 15 days after such date. Initial performance tests are to be conducted within 60 days of achieving the maximum production rate, but not later than 180 days after initial start-up of the facility. The facility must notify DEQ at least 30 days prior to any initial performance test and must submit the results of the initial performance tests to DEQ. The facility will comply with the notification requirements set forth in Subpart A.
Subpart CC (Glass Melting Furnaces). Subpart CC affects furnaces which commenced construction, reconstruction, or modification after June 15, 1979. Standards for furnaces "with modified process" (defined as "using any technique designed to minimize emissions without the use of add-on pollution controls") are subject to a PM limitation of 0.5 g/kg glass (1.0 lb/ton glass) as measured by Method 5 (front-half only). Such facilities are required to install continuous opacity monitors and to correlate 6-minute average opacities to emission rates to a 99% confidence interval. The standards of Subpart CC will be incorporated into the permit.
Subpart OOO (Nonmetallic Minerals Processing Plants). Subpart OOO applies to nonmetallic minerals processing operations that commenced construction, reconstruction, or modification after August 31, 1983. The plant is not defined as a nonmetallic minerals processing plant since no crushing nor grinding of sand or limestone is conducted.

NESHAP, 40 CFR Part 61 [Not Applicable]
There are no emissions of any of the regulated pollutants: asbestos, benzene, beryllium, coke oven emissions, radionuclides, or vinyl chloride except for trace amounts of arsenic, benzene, beryllium, and mercury. Subpart J, Equipment Leaks of Benzene, concerns only process streams that contain more than 10% benzene by weight. Analysis of Oklahoma natural gas indicates a maximum benzene content of less than 1%.

NESHAP, 40 CFR Part 63 [Not Applicable At This Time]
There is currently no MACT standard which affects this facility. However, there is a schedule for other MACT standards under 40 CFR Part 63 which may affect this facility: Subpart DDDDD, "Industrial, Commercial, and Institutional Boilers and Process Heaters," scheduled for promulgation by May 2002. Air Quality reserves the right to reopen this permit if any of these standards become applicable.

Chemical Accident Prevention Provisions, 40 CFR Part 68 [Not Applicable at this Time]
The facility will store SO_2, which is subject to Part 68. However, it is not yet known if the amount stored will exceed threshold levels. More information on this federal program is available on the web page: *www.epa.gov/ceppo*.

Stratospheric Ozone Protection, 40 CFR Part 82 [Applicable]
This facility does not produce, consume, recycle, import, or export any controlled substances or controlled products as defined in this part, nor does this facility perform service on motor (fleet) vehicles which involves ozone-depleting substances. Therefore, as currently operated, this facility is not subject to these requirements. To the extent that the facility has air-conditioning units that apply, the permit requires compliance with Part 82.

SECTION X. COMPLIANCE

Tier Classification And Public Review
This application has been determined to be Tier III based on the request for a construction permit for a new major stationary source that emits 250 TPY or more of pollutants subject to regulation. The permittee has submitted an affidavit that they are not seeking a permit for land use or for any operation upon land owned by others without their knowledge. The affidavit certifies that the applicant has notified that landowner and has a signed and dated receipt.

The applicant published the "Notice of Filing a Tier III Application" in the *Durant Daily Democrat*, a daily newspaper in Bryan County, on December 6, 2002. The notice stated that the application was available for public review at the Durant Public Library, Durant, Oklahoma and the Air Quality Division's main office at 707 North Robinson, Oklahoma City, Oklahoma. The facility is within 50 miles of the border with the state of Texas; that state was notified of the draft permit. A "Notice of Draft Tier III Permit" was published in the *Durant Daily Democrat* on December 26, 2002. No adverse comments were received during the public review period; several commenters expressed support for the facility.

A public hearing was held on the permit on January 29, 2003, at the Durant City Hall. No adverse comments were received during the hearing.

The permit proceeded to a 20-day period as a "proposed" permit for public review. permit. A "Notice of Proposed Tier III Permit" was published in the *Durant Daily Democrat* on February 7, 2002. No additional comments were received from either the public or EPA Region VI during the "proposed" permit period.

Fees Paid
Construction permit application fee of $2,000.

SECTION XI. SUMMARY

The applicant has demonstrated the ability to comply with the requirements of the applicable Air Quality rules and regulations. Ambient air quality standards are not threatened at this site. There are no active Air Quality compliance and enforcement issues concerning this facility. Issuance of the permit is recommended.

PERMIT TO CONSTRUCT
AIR POLLUTION CONTROL FACILITY
SPECIFIC CONDITIONS

Cardinal FG Company
Durant Flat Glass Plant **Permit No. 2002-487-C (PSD)**

The permittee is authorized to construct in conformity with the specifications submitted to Air Quality on November 7, 2002, with additional information submitted on December 3 and December 11, 2002 and January 17, 2002. The Evaluation Memorandum dated March 18, 2003, explains the derivation of applicable permit requirements and estimates of emissions; however, it does not contain operating permit limitations or permit requirements. Commencing construction or operations under this permit constitutes acceptance of, and consent to, the conditions contained herein:

1. Points of emissions and emissions limitations for each point: [OAC 252:100-8-6(a)]

A. EUG PO1: Melting Furnace

Unit ID	Description	PM_{10}		CO		SO_2		NOx		VOC	
		lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
S01	650 TPD Main Furnace	40.63	177.94	270.83	1186.25	54.17	237.25	297.92	1304.88	2.71	11.86

i. The Main Furnace is subject to NSPS, Subpart CC, and shall comply with all applicable requirements: [40 CFR Part 60.290 – 296]

a. PM emissions shall not exceed 1.0 lb/ton glass produced (front-half sampling). [40 CFR Part 60.293(b)]

b. Within 180 days of initial start-up, the permittee shall have installed and certified a continuous monitor for measuring the opacity of emissions. [40 CFR Part 60.293(c)]

c. Performance testing to correlate opacity to PM emission rate shall be conducted and a written report submitted within 60 days of achieving maximum production rate, not to exceed 180 days from initial start-up. Performance testing shall be conducted while the furnace is producing glass at a rate within 10% of maximum rate. [40 CFR Part 60.293(c)]

ii. The furnace shall be fueled with pipeline-quality natural gas only. [OAC 252:100-31]

iii. NOx emissions shall not exceed the following levels: [OAC 252:100-8-6(a)]

a. 11.0 lb/ton for the first calendar year of operation.

b. 9.0 lb/ton for the second calendar year of operation

c. 7.0 lb/ton for the third and subsequent calendar years of operation

iv. The permittee shall install and operate a system to inject natural gas into exhaust gases for NOx emissions control.

v. Within 180 days of initial start-up, the permittee shall have installed and certified a continuous monitor for measuring the NOx emissions. The CEM shall be certified using the methods of 40 CFR Part 60, Appendix B, Performance Specification 2. The CEM shall be quality-assured using the methods and procedures of 40 CFR Part 60, Appendix F.

vi. Usage of sodium sulfate or other sulfate materials shall not exceed 10.0 lbs per 1,000 pounds sand.

vii. Within 60 days of achieving maximum glass output from the furnace, not to exceed 180 days from initial start-up, and at other such times as directed by Air Quality, the permittee shall conduct performance testing as follows and furnish a written report to Air Quality. The following USEPA methods shall be used for testing of emissions, unless otherwise approved by Air Quality:
[OAC 252:100-8-6(a)]

Method 1:	Sample and Velocity Traverses for Stationary Sources.
Method 2:	Determination of Stack Gas Velocity and Volumetric Flow Rate.
Method 3:	Gas Analysis for Carbon Dioxide, Excess Air, and Dry Molecular Weight.
Method 4:	Determination of Moisture in Stack Gases.
Method 5:	Determination of Particulate Emissions from Stationary Sources.
Method 8:	Determination of Sulfuric Acid Mist Emissions from Stationary Sources.
Method 10:	Determination of Carbon Monoxide Emissions from Stationary Sources.
Method 6C:	Determination of Sulfur Dioxide Emissions from Stationary Sources.
Method 7E:	Determination of Nitrogen Oxide Emissions from Stationary Sources.
Method 25/25A:	Determination of Non-Methane Organic Emissions From Stationary Sources.

B. EUG P02: Cullet Return System

EU	Point	Equipment	PM10 Emissions	
			lb/hr	TPY
P02	S02	Cullet Return System	1.89	8.26

i. All air discharges from the Cullet Return System shall be processed by fabric filters or equivalent devices which achieve discharge concentrations of 0.005 gr/DSCF or less.
a. [OAC 252:100-8-6(a)]

ii. Baghouses shall be operated at a pressure differential of at least 1 inch WC. The pressure differential shall be monitored and recorded at least once per operating day.

C. EUG P03: Raw Materials Handling System

EU	Point	Equipment	PM10 Emissions	
			lb/hr	TPY
P04	S04	Raw Materials Mixing	0.05	0.23
P03	S03	Raw Materials Elevator Bottom	0.15	0.68
P05	S03	Raw Materials Elevator Top		

i. All air discharges from the Cullet Return System shall be processed by fabric filters or equivalent devices which achieve discharge concentrations of 0.005 gr/DSCF or less. [OAC 252:100-8-6(a)]

ii. Baghouses shall be operated at a pressure differential of at least 1 inch WC. The pressure differential shall be monitored and recorded at least once per operating day. [OAC 252:100-8-6(a)]

D. EUG P06: Emergency Generators

Unit ID	Description	PM_{10}		CO		SO_2		NOx		VOC	
		lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
P06	Emergency Generators, 2000 KW each	1.82	0.46	8.28	2.07	2.07	0.52	83.44	20.86	2.17	0.54

i. The emergency generators shall be fueled with No. 2 diesel with a maximum sulfur content of 0.05 % by weight. [OAC 252:100-8-6(a)]

E. EUG P07: Annealing Lehr

EU	Point	Equipment	SO_2 Emissions	
			lb/hr	**TPY**
P07	building ventilation	Annealing Lehr	0.81	3.56

i. A maximum of 27.0 TPY SO_2 (12-month rolling total) may be injected into this operation. [OAC 252:100-8-6(a)]

F. EUG P08: Glass Cutting

EU	Point	Equipment	VOC Emissions	
			lb/hr	**TPY**
P08	building ventilation	Glass Cutting	10.00	43.80

i. A maximum of 44.0 TPY mineral spirits (12-month rolling total) may be utilized into this operation. [OAC 252:100-8-6(a)]

G. EUG P09: Miscellaneous Operations

EU	Point	Equipment	PM_{10} Emissions	
			lb/hr	**TPY**
P09	ventilation	Miscellaneous Operations	0.24	1.07

i. All air discharges from the Miscellaneous Operations shall be processed by fabric filters or equivalent devices which achieve discharge concentrations of 0.001 gr/DSCF or less. [OAC 252:100-8-6(a)]

ii. Baghouses shall be operated at a pressure differential of at least 1 inch WC. The pressure differential shall be monitored and recorded at least once per operating day. [OAC 252:100-8-6(a)]

2. A serial number or another acceptable form of permanent (non-removable) identification shall be on each engine. [OAC 252:100-8-6(a)]

3. Upon issuance of an operating permit, the permittee shall be authorized to operate this facility continuously (24 hours per day, every day of the year). The backup diesel generators are considered insignificant activities and shall be limited to 500 hours of operation per twelve-month rolling period. [OAC 252:100-8-6(a)]

4. The backup generators shall be fitted with non-resettable hour-meters. [OAC 252:100-8-6(a)]

5. The permittee shall maintain records as listed below. These records shall be maintained on-site for at least five years after the date of recording and shall be provided to regulatory personnel upon request. [OAC 252:100-43]

a. Operating hours for the emergency generator (monthly and 12-month rolling totals).

b. Sulfur content of liquid fuels used in each engine (each shipment).

c. Glass production (tons daily).

d. Sand usage and "salt cake" (sodium sulfate) usage (pounds daily).

e. NOx emissions as measured by the Main Furnace CEM (lb/ton glass produced, 30-day rolling averages).

f. Opacities of the Main Furnace discharges (six-minute averages).

g. SO_2 usage in the Annealing Lehr (monthly and 12-month rolling totals).

h. Mineral spirits usage in the cutting operation (monthly and 12-month rolling totals).

6. When monitoring shows emissions in excess of the limits of Specific Condition No. 1, the owner or operator shall comply with the provisions of OAC 252:100-9 for excess emissions including during start-up, shutdown, and malfunction of air pollution control equipment. Due to technological limitations on emissions during maintenance operations, the owner or operator may submit an initial written notification of this condition and thereafter immediate notice and quarterly reports as provided in Paragraph 3.1(b)(2). Requirements for periods of other excess emissions include prompt notification to Air Quality and prompt commencement of repairs to correct the condition of excess emissions. [OAC 252:100-9]

7. No later than 30 days after each anniversary date of the issuance of this permit, the permittee shall submit to Air Quality Division of DEQ, with a copy to the US EPA, Region 6, a certification of compliance with the terms and conditions of this permit.
[OAC 252:100-8-6 (c)(5)(A) & (D)]

Cardinal FG Company
Attn: Mr. Richard Valtierra
1650 Mohr Road
Portage, Wisconsin 53901

Re: Permit Number 2002-487-C (PSD)
Flat Glass Plant
Section 27 – T6S – R8E
Durant, Bryan County, Oklahoma

Dear Mr. Valtierra:

Enclosed is the permit authorizing construction of the referenced facility. Please note that this permit is issued subject to the certain standards and specific conditions, which are attached. These conditions must be carefully followed since they define the limits of the permit and will be confirmed by periodic inspections.

Thank you for your cooperation. If you have any questions, please refer to the permit number above and contact me at (405) 702-4198.

Sincerely,

David S. Schutz, P.E.
New Source Permits Unit
AIR QUALITY DIVISION

Enclosures

Copy: Durant DEQ Office (Bryan County)

PART 70 PERMIT

AIR QUALITY DIVISION
STATE OF OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY
707 N. ROBINSON STREET, SUITE 4100
P.O. BOX 1677
OKLAHOMA CITY, OKLAHOMA 73101-1677

Issuance Date: ________________________ **Permit Number: 2002-487-C (PSD)**

Cardinal FG Company, having complied with the requirements of the law, is hereby granted permission to construct a 650 TPD capacity flat glass plant in Sec. 27 – T6S – R8E, near Durant, Bryan County

subject to the following conditions, attached:

[X] Standard Conditions dated October 17, 2001

[X] Specific Conditions

In the absence of construction commencement, this permit shall expire 18 months from the issuance date, except as authorized under Section VIII of the Standard Conditions.

____Executive Director