DEPARTMENT OF
ECOLOGY
State of Washington

Technical Support Document for Prevention of Significant Deterioration Permit

for

PSD-03-03, Amendment 2
Cardinal FG Company
Winlock, Washington

October 7, 2010

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1. EXECUTIVE SUMMARY

Cardinal FG Company (Cardinal) is requesting that conditions be put into the PSD permit to allow glass furnace emissions to be bypassed around the spray drier and electrostatic precipitator air pollution controls (APC) for up to five days per year. This will allow annual maintenance to be done on them while keeping the glass plant operating. Many glass plants do not have these modern controls, so this is how they operate year round. Cardinal modeled the impacts of these increased short-term emissions. The emissions bypass capability is already designed into the process. No new construction or modifications to existing equipment are requested.

The Washington State Department of Ecology (Ecology) finds that Cardinal has satisfied all requirements for approval of the proposed permit amendment of PSD-03-03 and now sends the proposed amended permit for public comment.

2. INTRODUCTION

2.1. The PSD Process

The Prevention of Significant Deterioration (PSD) procedure is established in Title 40, Code of Federal Regulations (CFR), Part 52.21 and in Washington Administrative Code 173-400-700. Federal rules require PSD review of all new or modified air pollution sources that meet certain overall size, and pollution rate criteria. The objective of the PSD program is to prevent serious adverse environmental impact from emissions into the atmosphere by a proposed new or modified source. PSD rules require that an applicant use the most effective air pollution control equipment and procedures after considering environmental, economic, and energy factors. The program sets up a mechanism for evaluating and controlling air emissions from a proposed source to minimize the impacts on air quality, visibility, soils, and vegetation.

The United States Environmental Protection Agency (EPA) delegated the authority to implement the PSD program described in title 40 C.F.R. 52.21 and its supporting guidance and procedures documents to the Engineering Unit staff[1] of Ecology's Air Quality Program.[2]

2.2. The Project

2.2.1. The Site

Cardinal operates a flat glass plant near Napavine, Washington (Lewis County). The facility uses "float" technology where the flat glass is formed on the surface of liquid tin in a natural gas-fired furnace. The plant's capacity is rated at a nominal 650 tons per day of flat glass. The glass plant is located in the Napavine Industrial Park near the intersection of Avery Road and Highway 603. The site is approximately 30 miles (48 kilometers) south of Olympia and five miles (eight

[1] An organizational unit in the Science and Engineering Section.
[2] Agreement for the Delegation of the Federal Prevention of Significant Deterioration (PSD) Regulations by the United States Environmental Protection Agency, Region 10 to the State of Washington Department of Ecology (February 23, 2005).

kilometers) south of Chehalis. The site's coordinates are approximately N 46° 32' 20", E 122° 56' 10" (UTM coordinates 504804E 5153907N).

2.2.2. The NO_X and CO Proposal (withdrawn)

The Cardinal plant in Winlock was issued a Prevention of Significant Deterioration air quality permit in 2004. The Best Available Control Technology (BACT) analyses concluded that the *3R Process* represented BACT for the control of NO_X emission from the float glass furnace, (called Process P02 on plant diagrams). As a part of this application, Cardinal originally requested that enhancements it had made to the glass furnace combustion system be considered as a new technology separate form 3R. Further investigation by Ecology resulted in the strong possibility that the glass oven was still operating under the conditions claimed by Pilkington for their 3R process patent. Cardinal withdrew this request.

2.2.3. The Annual Air Pollution Control Maintenance Shutdown Proposal

The primary air pollution source at the plant is the natural gas-fired 650 ton per day float glass furnace designated Process P02. While many float glass furnaces operate without air pollution control equipment, the Cardinal furnace is equipped with control systems for SO_2 and PM (i.e. PM_{10} and $PM_{2.5}$) consisting of a spray drier scrubber (scrubber) followed by an electrostatic precipitator (ESP).

To assure compliance with approved emissions limitations, the plant conducts routine annual maintenance on the scrubber and ESP pollution controls. Maintenance is more thorough if the glass furnace flue gases are temporarily routed through a bypass duct directly to the stack, allowing internal cleaning and repairs to be conducted on the scrubber and ESP. The maintenance shutdown usually takes 2 to 3 days, but may take as long as five days, depending on the results of the internal inspection. The shutdown of the scrubber and ESP for annual maintenance is already approved and conducted at two other Cardinal plants located in Portage and Menomonie, Wisconsin, by their respective air regulatory agencies.

In 2004, the Cardinal plant in Winlock was issued Permit PSD-03-03 by Ecology and Air Discharge Permit 04-2568 by SWCAA. Neither of these permits allowed a maintenance shutdown of the scrubber and ESP. The PSD permit has had one administrative amendment since then. The current air quality permits for the plant need to be amended to allow these uncontrolled emissions during the maximum 5-day maintenance shutdown period.

2.3. PSD Applicability and Air Pollutant Emissions

Cardinal is an existing major source[3] of a regulated pollutant.[4] It has an existing major source PSD permit issued by Ecology. It has a minor new source review permit, and the Southwest Clean Air Agency is developing a Title V air permit.

Additions and modifications to the plant that increase emissions above prescribed PSD Significant Emission Rates (SERs) are considered "major modifications" subject to the PSD permitting process. This is not the case with this modification to the Cardinal PSD permit. The increases that are proposed are less than the PSD regulated pollutant significance levels.

A change in emission limits that does not cause a significant increase in annual emissions, but does allow increased short-term emissions of regulated pollutants from a currently PSD permitted emission unit triggers PSD permitting requirements for minor modifications to an existing PSD permit. Modeling and evaluation of the short-term emission impact increases are the major permitting requirements.

Determination of PSD Applicable Pollutants

Pollutants to be regulated under PSD for the glass furnace were determined in the original permitting action to be nitrogen oxides (NO_X), carbon monoxide (CO), sulfur dioxide (SO_2), particulates less than 10 microns in diameter (PM_{10}), and particulates of any diameter (PM). $PM_{2.5}$ was analyzed as PM_{10} using the surrogate policy in place at that time. For Amendment 2, an evaluation of short-term glass furnace emissions of SO_2 and particulates are added for the limited time each year when they are bypassed during maintenance of the glass furnace's SO_2 and particulate pollution controls.

Emissions During the Annual Air Pollution Control Maintenance Shutdown

During the maintenance shutdown, the emissions of PM, SO_2, and opacity increase to the levels experienced at uncontrolled glass furnaces. The NO_X and CO emissions are unaffected. Table 1 compares the controlled emissions currently approved for the outlet of the air pollution equipment, and the uncontrolled emissions, which will occur when this equipment is shutdown.

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[3] Glass plants are a major source under PSD regulations if they, in total, have the potential to emit more than 250 tons per year of a pollutant regulated by the PSD permitting program. WAC 173-400-720(4)(a)(v) and 40 CFR 52.21(b)(1)(i)(a).

[4] The PSD program directly regulates a list of specific pollutants listed in 40 CFR 52.21(b)(23). These are referred to as "regulated pollutants." PSD regulates other pollutants indirectly through the broad categories of "regulated" pollutants such as VOC and particulates. In Washington State, the local air authority issues its own permit that complements the PSD permit and includes all emissions regulated by state and local regulations. WAC 173-400-113.

Table 1. Glass Furnace Uncontrolled & Controlled Emissions/Changes Due to the Project

Pollutant	Uncontrolled Emission Factor (lb/ton)	Uncontrolled Emission Rate (lb/hr)	Controlled Emission Factor (lb/ton)	Controlled Emission Rate (lb/hr)	Emissions Δ for 5 Days (tons)
PM_{10} (front-half)	1.00	27.1	0.09	2.55	1.47
PM_{10} (back-half)	0.85	23.1	0.85	23.1	0.00
PM_{10} (total)	1.85	50.2	0.94	25.7	1.47
$PM_{2.5}$	0.91	24.6	0.47	12.1	0.75
SO_2	3.30	89.4	0.63	16.3	4.39

2.4. New Source Performance Standards

New Source Performance Standards (NSPS) are nationally uniform standards applied to specific categories of stationary sources that are constructed, modified, or reconstructed after the standard was proposed. NSPS are found in Title 40, Part 60 of the Code of Federal Regulations (CFR). NSPS usually represent a minimum level of control that is required on a new source. NSPS that are applicable include Subpart A–General Provisions (40 CFR Part 60.1-60.19) and the following NSPS:

Subpart CC–Standards of Performance for Glass Manufacturing Plants (40 CFR Part 60.290-.296)

Air emissions of filterable particulate material from flat glass manufacturing are regulated by the NSPS under 40 CFR Part 60.291. Cardinal is subject to the requirements under Section 60.292. This limits filterable PM emissions from the furnace to 0.45 lb/ton of glass produced as measured by the front-half of the EPA Method 5 test method. The filterable PM/PM_{10} emission limit in Cardinal's existing PSD permit for the melting furnace is 0.09 lb/ton. This is more restrictive than the NSPS requirement. There are no NSPS requirements for other pollutant emissions or processes in glass making. Amendment 2 does not trigger any new NSPS requirements.

2.5. State Regulations

Cardinal is subject to Notice of Construction (NOC) permitting requirements under Washington State regulations Chapters 173-400 and 173-460. SWCAA is the permitting authority for all air emission regulatory requirements not included in PSD permitting. This includes the NSR permitting of air toxics issues under federal MACT and state 173-460 WAC, and Title V permitting requirements.

SWCAA will be responsible for enforcement of all provisions of the PSD permit after they are included in the facility's Title V permit, and in the interim between permit issuance and that time.

3. DETERMINATION OF BEST AVAILABLE CONTROL TECHNOLOGY

All new and significantly modified sources are required to use BACT, which is defined in 40 CFR 52.21(b)(12) as an emissions limitation based on the maximum degree of reduction for each pollutant subject to regulation, emitted from any proposed major stationary source or major modification, on a case-by-case basis, taking into account cost effectiveness, economic, energy, environmental, and other impacts.

The "top down" BACT process starts by considering the most stringent form of emissions reduction technology possible, then determines if that technology is technically feasible and economically justifiable. If the technology is proven infeasible or unjustifiable, then the next less stringent level of reduction is considered. When an emission reduction technology meets the stringency, and technical and economical feasibility criteria, it is determined to be BACT.

As determined in Section 2.3, for this amendment, the short-term SO_2 and particulate emissions during the annual APC maintenance shutdown are subject to PSD permitting.

This permitting action is a result of Cardinal's application to rectify the oversight in the original permit that the glass furnace emissions needed to bypass the pollution controls during their annual maintenance.

3.1. Annual APC Maintenance Shutdown Emissions Discussion

As discussed in Section 2.3, the spray drier scrubber and electrostatic precipitator pollution controls require annual maintenance. This maintenance usually takes about three days, but can take up to five days. To do this maintenance properly, these units need to be taken out of service. Since the glass-melting furnace is the source of the emissions, and it is never intentionally shut down, its emissions must be diverted around the pollution control units. SO_2 and particulate emissions are not being treated, so they rise to uncontrolled levels. NO_X and CO emissions are unaffected.

The controlled and uncontrolled emissions are presented in Section 2.3 in Table 1. Since many older glass-melting furnaces regularly operate without these newer pollution controls, it is logical that this plant could be allowed to bypass glass furnace emissions for the limited time of the annual maintenance. Modeling of the impacts of the expected emissions is presented in Section 4 of this document.

The emissions during the shutdown period bypass the existing controls, and do not have any alternative treatment options. It might be possible to implement work practices to minimize

these emissions. The glass furnace cannot be shut down during the maintenance period, so that is ruled out. Glass production rates do not follow annual cyclical patterns, so there is not a normal yearly period of minimum glass production to schedule the maintenance in. Minimizing glass production during the maintenance period to that required for process purposes and product demand might reduce the uncontrolled emissions at their source because of lower fuel usage. The glass furnace has a large thermal mass, so changes to glass furnace melting rates must be made slowly and carefully, requiring a period of days of small adjustments to raise or lower production even by a small percentage. Since the furnace runs most efficiently at a steady rate that satisfies business needs, it is not anticipated that production level could or would be significantly reduced for the short three to five day maintenance period, especially if the environmental impacts of the emissions are determined to be acceptable according to modeling.

3.2. Ecology's Decision Regarding Emission Rates

For the annual maintenance period of the spray dryer and ESP, new emission terms for PM_{10} and SO_2 will be included based on the values in Table 1, and with averaging times equal to the existing short-term limit. Since this increase is only for five days, the potential tons per year (tpy) increase for PM_{10} are about 1.5 tons and SO_2 about 4.4 tons. These are very small, and as the modeling results in Section 4 show, they are acceptable to Ecology.

4. AIR QUALITY IMPACTS ANALYSIS

The PSD permitting program requires that an Ambient Air Quality Impacts Analysis (AQIA) be made for pollutants emitted in significant quantities. The AQIA determines if emissions of any pollutant will cause or contribute to an exceedance of a National Ambient Air Quality Standard (NAAQS). It also determines if the change in air quality since the applicable baseline dates is greater than the Class I and Class II PSD Increment Levels.

An air quality analysis can include up to three parts: Significant Impact analysis, NAAQS analysis, and PSD Increment analysis. The first step in the air quality analysis is to determine if emissions from the proposed project result in impacts greater than the modeling Significant Impact Levels (SILs). Then, for those pollutants and averaging periods that have impacts greater than their SIL, a cumulative full impacts analysis is used to determine if the proposed project will cause or contribute to an exceedance of a NAAQS. A PSD Increment analysis for those pollutants is also used to determine if the change in the air quality since the applicable baseline dates is greater than the Class I and Class II PSD Increment Levels.

This section will discuss the AQIA of the nearby Class II area. The AQIA for the Class I areas will be discussed along with the Air Quality Related Values (AQRVs) in Section 5.

4.1. Model Selection and Procedures

The updated modeling analysis was conducted using the latest version of the AERMOD (07026) modeling system approved by Ecology and EPA, including the recently released version of AERMAP (09040). Building downwash was evaluated using an updated building and stack location and dimensions, and the BPIP-PRIME model.

The majority of the terrain elevations in the Class II area modeling domain are below the top of the shortest stack. The site elevation is approximately 146 meters (479 feet). Directly north and south of the site, elevations remain below 150 meters (492 feet) within 10 kilometers. Elevations rise to 175 meters (574 feet) just east of Mary's Corner approximately 10 kilometers east of the site. The greatest increase in elevations occurs approximately 5 kilometers west of the site where at this point the elevation is 250 meters (820 feet) with a peak of 454 meters (1490 feet) at Sam Henry Mountain.

The updated modeling analysis used the same meteorological data as the original 2004 analysis. This was obtained from on-site weather, which was monitored for one year for the PSD air quality permit for a gas turbine project in nearby Chehalis, Washington. Additional weather monitoring was also conducted at the Ed Carlson Memorial Field, South Lewis County Airport (formerly the Toledo-Winlock Airfield). In 2004, Ecology evaluated the available meteorological data and approved the use of the Chehalis data.

The on-site meteorological data were processed using AERMET. The data were supplemented with Seattle surface data and upper air data from Quillayute. Land use in the surrounding area is rural.

The glass furnace typically operates at or near full capacity. However, the air quality impacts of the glass furnace were evaluated at lower furnace load capacities to verify maximum air quality impacts when stack parameters vary. All other facility sources are not expected to operate with emissions or stack parameters, which reflect less than 100 percent capacity operation. The results of the air quality modeling analyses were predicted using three furnace loads and associated stack parameters and emissions – 50, 75, and 100 percent.

4.2. SILs Analysis and Determination of SIA

PSD modeling requires that a preliminary analysis be done that compares impacts from the project to a standard called a SIL. EPA has established SILs for NO_X, SO_2, and PM_{10} at various averaging periods. If modeling indicates a SIL will be exceeded, then the area where the impact is greater than the SIL is called the Significant Impact Area (SIA). Then a full impacts analysis must be done which considers other nearby sources that may impact the SIA.

Cardinal plant emissions during the maintenance shutdown were modeled to determine which air pollutants exceeded their respective SIL and to determine the radius of the SIA. For each air pollutant, the maximum concentration at each receptor was used to determine the plant impacts. The results are presented in Table 2. PM_{10}, $PM_{2.5}$, and SO_2 each exceeded their respective SIL. The SIA for each pollutant was used to screen non-Cardinal sources in the region to determine if they should be included in the modeling analysis to verify compliance with the PSD increments and AAQS.

Table 2. Maximum Model-Predicted Short-Term SO_2 Concentrations (µg/m^3)

Pollutant	Averaging Period	Maximum Predicted Concentration (µg/m^3)	EPA SIL	SIL Exceeded?	SIA (km)
PM_{10}	24-hour	9	5	Yes	0.6
$PM_{2.5}$	24-hour	2.2	1.2[a]	Yes	1.8
SO_2	24-hour	8.6	5	Yes	7.0
	3-hour	40.2	25	Yes	5.0

a. The most conservative of the options for the $PM_{2.5}$ modeling SIL for Class II areas proposed in the September 21, 2007 federal register.

4.3. Increment Analysis

Cardinal plant emissions during the maintenance shutdown were modeled with other sources in the region to verify compliance with the PSD increments. For PM_{10} and SO_2, the maximum 2nd high concentration at each receptor was used to determine compliance. For $PM_{2.5}$, the maximum 8th high concentration at each receptor was used to determine compliance.

The results are presented in Table 3. Compliance with the PSD increments for each of the air pollutants was shown.

Table 3. PSD Increment Compliance Analysis

Pollutant	Averaging Period	Maximum Predicted Concentration (µg/m^3)	PSD Increment (µg/m^3)	Complies With Increment?
PM_{10}	24-hour	9	30	Yes
$PM_{2.5}$	24-hour	1.6	9[a]	Yes
SO_2	24-hour	63	91	Yes
	3-hour	236	512	Yes

a. The option for $PM_{2.5}$ increment proposed in the September 21, 2007 federal register.

It should be noted that when selecting regional sources to include in this analysis, no steps were taken to eliminate sources, which were constructed prior to the PSD increment baseline date. These sources do not consume increment and typically would not be included in this analysis. For this reason, the results of this analysis may overestimate impacts compared to the PSD increment. Refer to Section 6.0 of the April 20, 2009, permit application for the procedures used to identify other sources in the region, which were included in the increment analysis.

4.4. NAAQS/WAAQS Analysis

Cardinal plant emissions during the maintenance shutdown were modeled with other sources in the region to verify compliance with the Ambient Air Quality Standards (AAQS). These include the National Ambient Air Quality Standards (NAAQS) and the Washington State Ambient Air Quality Standards (WAAQS). For PM_{10} and SO_2, the maximum 2nd high concentration at each receptor was used to determine compliance. For $PM_{2.5}$, the maximum 8th high concentration at each receptor was used to determine compliance. Refer to Section 6.0 of the April 20, 2009, permit application for the procedures used to identify other sources in the region, which were included in the NAAQS/WAAQS analysis.

The maximum predicted concentrations were added to background concentrations, and the total was compared with the AAQS. The background concentrations were provided by Ecology in an e-mail dated March 5, 2009.

The results are presented in Table 4. Compliance with the AAQS for each of the air pollutants, except the 1-hour WAAQS for SO_2 was shown. Additional evaluation demonstrated that emissions from the Cardinal plant did not contribute significantly to the exceedence of the WAAQS for SO_2.

Table 2 compares the sum of predicted concentrations due to industrial sources and the maximum background concentrations with ambient air quality standards. All predicted 3-hour and 24-hour cumulative concentrations are less than the lowest applicable standards.

Table 4. NAAQS Compliance Analysis

Criteria Pollutant	Averaging Period	Maximum Concentrations ($\mu g/m^3$)		Total[b]	NAAQS ($\mu g/m^3$)	WAAQS ($\mu g/m^3$)
		Cardinal and Other Regional Industrial Sources	Background[a]			
PM_{10}	24-hour	9	37.2	46.2	150	-
$PM_{2.5}$	24-hour	1.6	18.6	20.2	35	-
SO_2	24-hour	63	34	97	365	262
	3-hour	236	190	426	1,300	-
	1-hour[a]	506.7	190	696.7	-	1,068
	1-hour[a]	488.9	190	678.5	-	655

a. Not to be exceeded more than once per year.
b. Not to be exceeded more than once per seven consecutive days.

The 1-hour average SO_2 WAAQS is 655 μg/m3, not to be exceeded more than once per seven consecutive days. Ecology staff provided a SIL for this 1-hour standard of 20 μg/m3. Compliance with this standard was evaluated using the following steps:

a. All receptor-concentration combinations above the WAAQS were determined. There were 15 combinations.
b. Exceedences that occurred at the same receptor within seven days of each other were identified. There was one exceedence.
c. This 2-hour period was rerun to determine the maximum contribution of the Cardinal sources to this exceedence. The impact of Cardinal sources was < 0.01 $\mu g/m^3$, which is well below the Washington State SIL for the 1-hour period of 20 $\mu g/m^3$. Therefore, the Cardinal plant is considered not culpable for the predicted exceedence of the WAAQS.

4.5. Toxic Air Pollutants

PSD rules require the applicant to consider emissions of toxic air pollutants. Washington State regulations (Chapter 173-460 WAC) require an ambient air quality analysis of Toxic Air Pollutant (TAP) emissions, which usually serves the purpose of PSD toxics review in Washington State. The Notice of Construction issued by the Southwest Clean Air Agency, in conjunction with the original PSD permit for this site, fulfilled all requirements of WAC 173-460. Amendment 2 does not trigger any new requirements.

5. CLASS I AREA IMPACT ANALYSIS

Federal[5] and Washington State[6] PSD regulations require the impact of a proposed facility on federal Class I areas be analyzed. Class I areas are areas of special national or regional value from a natural, scenic, recreational, or historic perspective and are afforded the highest level of protection under the PSD rules. They include certain national parks, national wilderness areas, and national memorial parks. The AQRVs of concern include visibility and deposition.

Air pollutant impacts to Class I areas were evaluated extensively for the original permit and were determined to be acceptable. As discussed in Section 2.3, the current permitting action allows a small potential increase in SO_2 emissions (up to 4.39 tpy) and potential particulate emissions (up to 1.47 tpy) due to bypassing the spray dryer scrubber and ESP for up to five days to allow maintenance on them. Ecology determined that this small increase was not significant enough to require additional impacts modeling on Class 1 areas. The increased impact on annual deposition and visibility in the nearest Class I areas (Olympic National Park and Mt. Rainier National Park) should be minimal if measurable at all. The National Park Service and U.S. Forest Service land managers were consulted and had no concerns with this permitting action.

5.1. Conclusion Concerning AQRVs

Ecology determines that increased emissions from the project are not expected to significantly impact AQRVs in the Olympic National Park, Mt. Rainier National Park, or any other Class I area.

6. ADDITIONAL IMPACTS ANALYSIS

Under 40 CFR 52.21(o), PSD applications must provide "an analysis of the impairment to visibility, soils, and vegetation that would occur as a result of the source or modification and general commercial, residential, industrial and other growth associated with the source or modification." In accordance with these requirements, the following analysis of additional impacts from the proposed project has been prepared.

Growth Analysis: This permitting action does not authorize any new expansion of Cardinal. It will not increase or decrease the area's growth.

Soils and Vegetation Analysis: The emissions from Cardinal meet all environmental standards and are not expected to significantly impact the soils and vegetation in the area surrounding the plant site.

Visibility Impairment Analysis: Stack emissions should not have any visibility impacts due to pollutants. Only natural gas is combusted as fuel. As with all combustion emissions, the stack

[5] 40 CFR 52.21 (p)
[6] WAC 173-400-117

gases can form a visible steam plume under certain meteorological conditions. A steam plume is condensed water droplets, and disappears when these droplets evaporate in the atmosphere.

7. CONCLUSION

The proposed permit amendment will have no significant adverse impact on air quality or air quality related values. The Washington State Department of Ecology finds the applicant, Cardinal FG Company, has satisfied all requirements for approval of their application for a PSD permit amendment.

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