Trinity Consultants

MEMORANDUM

To: Aaron Manley, Olympic Region Clean Air Agency

cc: Michael Nolan, Jack Carter, and Angela Cameron, Weyerhaeuser NR Company

From: Nancy Liang and Matt Goldman, Trinity Consultants

Date: November 15, 2023

RE: Weyerhaeuser Raymond NOC Application Addendum (23NOC1614)

On October 10, 2023, Weyerhaeuser NR Company (Weyerhaeuser) received a data request from Aaron Manley, P.E. from the Olympic Region Clean Air Agency (ORCAA) regarding its Notice of Construction (NOC) application #23NOC1614. The NOC application was submitted to approve the installation of a direct-fired continuous dry kiln (CDK) at the Raymond facility (the "Facility"). Weyerhaeuser received a second ORCAA data request on October 12, 2023, to address the BACT analysis. This memo serves as an addendum to the NOC permit application and provides the data requested by ORCAA.

Data Request 1, Question 1 – PTE Emission Calculations

ORCAA: Potential To Emit (PTE) Calculations. The emissions calculations in the permit application did not appear to assume true PTE (i.e. continuous 8,760 hours per year) operation for all aspects of the operation. ORCAA can limit or cap the facility's operations and emissions to the production levels proposed in the application. However, if your facility decides to operate more than at the rates proposed in the application, it would require a permit modification prior to making those operational changes. If Weyerhaeuser would like to operate more than the hours proposed in the permit application, please recalculate emissions at the desired level of production (up to 8,760 hours per year) and resubmit PTE calculations and modeling. Otherwise, ORCAA will assume you're satisfied with the operational hours and material usage rates proposed in the permit application and include the appropriate additional monitoring, record keeping, and reporting requirements in the permit.

Response: Weyerhaeuser has updated the PTE emission calculations to reflect continuous operation of 8,760 hours on the CDK and sawmill cyclones. The following emissions are changed:

- CDK Annual Emissions calculated based on emission factors in lb/MMBtu, e.g. VOC (combustion), SO_2, CO_2e, HAP/TAP (combustion).
- Added CDK startup and idling emissions for normal operations with emission factors in lbs/MMBF, e.g. PM, PM_{10}, $PM_{2.5}$, CO, NO_X, and HAP/TAP.
- Green Sawdust Fuel Annual Throughput (relates hourly CDK fuel rating and operating hours)
  - Green sawdust sawmill drop point annual PM emission rates.
- Cyclone Operating Hours (now set to 8,760)
  - Annual PM emission rates from the Fuel Silo Cyclone, Bark Cyclone, and Dry Chip Cyclone/Baghouse.
- Added an existing fire pump to the facility-wide emissions calculation assuming annual operation of 100 hours.

Weyerhaeuser has also unlinked the annual and hourly emission calculations for the CDK. This allows the annual emissions to be based on the maximum annual operating hours of 8,760 and keep maximum hourly emissions based on the CDK's expected annual operating hours of 8,400; this approach provides a more conservative estimate of short-term emission rates. Additionally, Weyerhaeuser updated annual CDK

20819 72nd Ave S, Ste 610, Kent, WA 98032
P 253.867.5600 / F 253.867.5601

HAP/TAP emission rates to reference 8,760 operating hours for the combustion component and the annual production rate for the drying component.

Weyerhaeuser modified the green sawdust sawmill drop point PM emission calculations by adding a green sawdust maximum hourly throughput, so emissions are no longer based on operating hours, but just the CDK burner's fuel rating. This lowered hourly and daily emissions.

Based on recent discussions with the CDK vendor, Weyerhaeuser has updated the maximum dry bulb temperature of heated air from 200 °F to 220 °F. The facility's current batch kilns operate at <200 °F, but the CDK will be required to maintain a higher temperature to minimize condensation-related structural corrosion. This update resulted in an increase in drying emissions for pollutants whose emission factors are dependent on temperature, e.g. VOC, formaldehyde, and methanol.

Data Request 1, Question 2 – Electronic Copies of PTE

ORCAA: Electronic copies of the spreadsheets used to calculate criteria, TAP and GHG emissions provided in the application. The electronic spreadsheets must be in an unprotected format to enable equations, linkages, emissions factors, and assumptions to be seen.

Response: Weyerhaeuser has attached the emission calculations to this addendum in Attachment A and is attaching the Excel file to the submission email.

Data Request 1, Question 3 – Modeling

Response to Data Request 1, Question 3 will be submitted under a separate cover.

Data Request 1, Question 4 – Startup/Shutdown

ORCAA: Addressing Startup/Shutdown. The application indicates there will be two (2) ten hour shifts operating 5 days a week. Will the CDK shut down during non-shift hours, on the weekend, or will it continue operating continuously, except for during annual/planned maintenance? Also, do you plan to meet BACT limits during Startup/Shutdown?

Response: Weyerhaeuser would like to clarify the referenced two (2) ten hour shifts operating 5 days a week is for the saw mill operation (i.e., the steps to convert logs to green lumber), which is different from the CDK lumber drying operations. The CDK will operate on a continuous basis with infrequent startups and shutdowns.

The CDK has two types of stacks, the main stacks (i.e., the Vapor Extraction Modules, VEM) and the abort/bypass stack. From the CDK vendor specification sheet, Weyerhaeuser Raymond's gasifier burner system will be equipped with a "factory poured and cured refractory tee and burner abort stack assembly with sleeved intake for pre-heat of gas combustion air and failsafe shutdown" and a "factory poured and cured refractory lined discharge stack for keeping combustion ducts hot during idle periods for quick burner system re-starts." Emissions are released through the abort/bypass stacks during shutdown, idling, or sudden upsets when the burner must be shutdown. The CDK will normally run on a continuous basis with infrequent startups and shutdowns. When the CDK is not actively drying lumber, it operates in the idling mode.

Based on information shared by the CDK vendor, the burner increases to its maximum firing capacity (50 MMBtu/hr) as quickly as possible. Time to reach maximum firing capacity is dependent on ambient conditions and the current temperature of the firing chamber as determined by the time from the previous operation. The startup may last up to 4 hours without wood moving through the CDK but may occur in less than an hour. During startup, all emissions from the green sawdust combustion are routed into the CDK, exhausting at the vapor extraction points and openings at each end of the CDK.

In idling mode, the burner will be firing at a low rate of less than 1 to 10 MMBtu/hr. Emissions from combustion during idling are released through the abort stack and/or bypass stack. The emission calculations conservatively combine emissions from startup, shutdown, upset, and idling operations, assuming the annual heat input for the combined activities is 18,000 MMBtu/yr (50 MMBtu/hr * 360 hr/yr[1]).

Annual emissions from startup, shutdown, upset, and idling conditions are below 4 tpy for all criteria pollutants. Due to the abort/bypass stacks' relatively infrequent operation and minimal emissions, add-on control technology is cost ineffective for criteria pollutant BACT and related tBACT for startup and shutdown. Based on the EPA's proposed updates to 40 CFR 63, Subpart DDDD (discussed further in the response to Data Request 1.1), the EPA is proposing work practice standards as control methods for bypass stacks.[2] Specifically, the EPA proposes an annual burner tune-up and abort/bypass stack usage monitoring and reporting. Weyerhaeuser will incorporate the proposed standards as BACT for CDK startup and shutdown. Emission rates from startup and idling are calculated using emission factors from National Council for Air and Stream Improvement (NCASI) Technical Bulletin 1013 (TB1013) and AP-42, Section 1.6, and Weyerhaeuser proposes the referenced emission factors as the BACT limits.

Data Request 1, Question 5 – CDK Toxics

ORCAA: Pollutants typically associated with hogged fuel combustion such as Mercury, Hydrochloric Acid, Chromium III, and Chromium VI were not addressed in the application. Please use the AP-42 emissions factors or similar and complete the associated Chapter 173-460 WAC toxics review for those TAP.

Response: Weyerhaeuser added organic and metal HAP/TAP combustion emissions based on emission factors found in National Council for Air and Stream Improvement (NCASI) Technical Bulletin 1013 (TB1013) and AP-42, Section 1.6. NCASI's emission factors (median values) were prioritized over AP-42. While most of the NCASI emission factors for organic HAP/TAP were uncontrolled, some pollutants had a footnote expressing a controlled emission factor. If the control was a wet PM control, then NCASI TB1013 was still used due to the CDK's wet scrubber-like features (see Response to Data Request 1.1 below for more details on the wet scrubber-like features). However, if the control was a dry PM control, then AP-42 Section 1.6, Table 1.6-3 emissions factors were used. For metal HAP/TAP, wet scrubber-controlled emission factors were used, also due to the wet-scrubber-like features of the CDK. If only dry PM-controlled emission factors were available, then AP-42 Section 1.6, Table 1.6-4 was used.

Data Request 1, Question 6 – Pollutant Net Out/Offset

ORCAA: Did the application 'net out' or 'offset' any pollutants? It did not appear so, but we mentioned it may be an option in the pre-meeting and we are verifying those techniques were not used.

Response: For any HAP/TAP with project emissions over their respective SQER, Weyerhaeuser is proposing to apply the netting approach to the HAP/TAP emissions. To determine actual emissions from the current

[1] The annual hour estimate is calculated by substracting the expected annual operating hour of 8,400 from 8,760 hours.

[2] "National Emission Standards for Hazardous Air Pollutants: Plywood and Composite Wood Products." Docket ID No. EPA–HQ–OAR–2016–0243. Federal Register 88:96 (May 18, 2023) p. 31856-31887. Available from: https://www.federalregister.gov/d/2023-10067; Accessed 10/31/2023.

batch kilns and hog fuel boiler, operational parameters and emissions rates are acquired from the 2013-2022 Annual Emission Inventories (AEIs). On a pollutant-by-pollutant basis, actual emissions are calculated from the annual average actual emission rates of the highest two consecutive years within the past ten years. For pollutants that do not have previously quantified emissions, it is assumed that emissions associated with combustion are not expected to change and these new pollutants are included due to availability of newer and more comprehensive testing data. Therefore, it is assumed that the same emission factor applies, and the proposed emissions are lower than actual emissions due to the CDK's lower maximum heat input. In these instances, net emissions are set to zero and do not exceed the SQER. Please refer to the emissions calculation spreadsheet for details. The TAPs listed below exceed the SQER and require modeling. A modeling analysis will be provided under a separate cover.

- Formaldehyde
- Benzene
- Arsenic
- Cadmium
- Lead
- Manganese
- Nickel

Data Request 1, Question 7 – CDK PM BACT

ORCAA: CDK BACT for PM. Please provide a narrative for why add-on controls for PM are technically infeasible or update the CDK BACT determination for PM.

Response: See response to Data Request 1.1 below.

Data Request 1.1 – BACT Technical Feasibility

ORCAA: Sections 5.2.1 and 5.2.2 of the application state, " Upon further analysis, all add-on control technologies were deemed to be technically infeasible." However, no explanations were provided to support these conclusions for either VOC or particulate emissions controls listed as "Other Controls" in the application. An explanation needs to be provided for all control technologies used in practice for drying {lumber, veneer, wood chips) even if the control technology does not show up on the RBL clearinghouse list. For example, veneer dryers are a similar drying operation where presumed BACT is an add-on control device. The CDKs proposed by Weyerhaeuser will be equipped with exhaust capture systems, which will capture and exhaust emissions through two sets of stacks. Therefore, it is technically feasible to duct these emissions to an add-on control system. Therefore, for each "Other Control" listed in the application, provide either:

1. *A sound basis or explanation why the add-on control is technically infeasible; or,*
2. *A cost feasibility analysis for the add-on control.*

Response: On May 18, 2023, the EPA released the preamble for the proposed 40 CFR 63, Subpart DDDD, otherwise known as National Emission Standards for Hazardous Air Pollutants (NESHAP) for Plywood and Composite Wood Products (PCWP), which explains the proposed Maximum Available Control Technology (MACT) standards for lumber dry kilns. At a high level, CDKs may be designed with fan-powered stacks, like the Raymond CDK's vapor extraction modules (VEMs), which are able to direct 40-80% of the kiln exhaust upward.[3] As the vendor states in the equipment specifications, the VEMs are installed in order to pull water

[3] "National Emission Standards for Hazardous Air Pollutants: Plywood and Composite Wood Products." Docket ID No. EPA–HQ–OAR–2016–0243. Federal Register 88:96 (May 18, 2023) p. 31856-31887. Available from: https://www.federalregister.gov/d/2023-10067; Accessed 10/31/2023.

vapor up and away from the CDK ends as a method of reducing fog hazard in the loading areas. However, while the stacks are fan-powered, the fans cannot be operated at levels necessary for emission capture and control as this would disrupt the CDK's ability to precondition green lumber with the heat and steam from dried lumber, an essential energy-transfer function.[4] Due to this design constraint, the EPA has determined it to be technically infeasible to "to capture emissions from the openings at each end or directly measure the total gas flow rate from a CDK as needed to prescribe or enforce an emission limit." Additionally, CDKs have a significantly high volumetric fugitive emission rate, so even if emission points could be identified for source testing, only emission concentrations would be able to be measured. These data would have limited practicality as the total volumetric flow rates, and thus emission rates, out of the CDK are indeterminable. NCASI provides further explanation of the design constraints imposed by emission control devices, as well as the technical infeasibility of stack testing in Attachment B.

In discussing emission controls, it is important to note the CDK's inherent "wet scrubber" effect. Hot air from the combustion unit is first drawn into the CDK's central drying zone and is then recirculated throughout the kiln by a number of internal fans. Excess high-moisture exhaust travels toward both ends of the CDK, passing through the energy recovery zones. In these energy recovery zones, heat from the heated dried lumber is transferred to the cooler green lumber traveling in the opposite track direction. As the green lumber absorbs the heat, the temperature of the circulated air in the energy recovery zones decreases, which condenses water vapor onto the green lumber and absorbs water vapor into the dry lumber. The condensate will include pollutants such as condensable PM, PM_{10}, $PM_{2.5}$, and water-soluble TAP/HAP, and therefore reduce their air emissions.

In its evaluation of VOC and organic HAP emission controls, the EPA determined that add-on control technology was technically and cost infeasible.[5] Their assessment included "oxidizers (RTO and RCO), carbon adsorption, condensation, biofilters, and wet scrubbers," where "RTO" means either regenerative or recuperative thermal oxidation and "RCO" means either regenerative or recuperative catalytic oxidation. Among Best Available Control Technology (BACT) analyses, the EPA does note that should an RTO be attempted, a facility will likely need to install "duct heaters and a WESP" in order to "prevent resin buildup" in ductwork and protect the RTO's thermal media or the RCO's catalytic media. For PCWP MACT's implications on direct-fired CDKs, the EPA proposes the following work practice standards:

1. Operation and maintenance (O&M) plan
2. Burner tune-up
3. Over-drying prevention methods:
   a. Operate below a maximum temperature setpoint;
   b. Conduct in-kiln moisture monitoring; or,
   c. Follow a "site-specific plan (for temperature and lumber moisture monitoring)"
4. Set dried lumber minimum moisture content limits

Weyerhaeuser will incorporate these work practice standards as VOC and PM BACT for the CDK, as well as the related tBACT.

In addition to the earlier explanation about the infeasibility of emission control devices, the following are explanations of the technical infeasibility for VOC control technologies mentioned in the Raymond CDK NOC Application report:

- Adsorption

[4] Ibid.

[5] Ibid.

- The kiln exhaust contains the water vapor that has evaporated from the lumber as it is dried and will have a relative humidity over 100%. At high moisture contents, the water molecules and hydrocarbons in the exhaust stream will compete for active adsorption sites, reducing the efficiency of an adsorption system. Therefore, adsorption is technically infeasible for VOC control.

► Biofiltration
- The microorganisms used in biofiltration cannot survive at temperatures exceeding 105 °F. The kiln exhaust stream will have a minimum temperature of approximately 140 °F. Furthermore, the primary constituent of the VOC in the exhaust stream is terpenes, which are highly viscous and would cause the biofilter to easily foul. Because of the nature of the long-chained hydrocarbons in the exhaust stream, a biofilter with a reasonable footprint/retention time, will have a reduced control efficiency relative to a unit treating streams with large concentrations of methanol or formaldehyde. The microorganisms require a much longer retention time/size of a unit in order to provide an increased efficiency. For example, engineering firms have previously noted that to increase the control efficiency an additional 5% at these removal levels would essentially require a biofilter twice as large.

► Condensation
- Condensation requires that the exhaust stream be cooled to a low enough temperature for the vapor pressure to be lower than the VOC concentration. The primary constituent of the VOC in the exhaust stream from the lumber kilns is terpenes, which would require the temperature of the exhaust stream to be lowered to well below 0 °F in order to have a low enough vapor pressure to use condensation. Temperatures this low would cause the water vapor in the stream to freeze, and the ice would clog the unit. Therefore, condensation is technically infeasible for VOC control.

► Thermal and Catalytic Oxidation
- The high moisture content and low exit temperature of the exhaust stream would likely make an RTO technically infeasible. While RCOs can operate at lower temperatures than the RTO, the exit temperature of the exhaust stream from the CDK is still too low for this option to be feasible. Furthermore, the particulate matter and other contaminants in the exhaust stream would cause a loss of catalytic activity. Therefore, oxidation is technically infeasible for VOC control.

► Wet Scrubber
- While some VOCs that will be present in the exhaust stream are highly soluble in water, other VOCs, most notably α-pinene, are only very slightly soluble in water due to the lower Henry's Law constant as described in Perry's Chemical Engineer's Handbook. Lower Henry's Law constant VOCs would require much longer residence time within a scrubber packed column and would eliminate this as a technically viable solution for the constant stream that would need to be handled by a continuous dry kiln. Therefore, a wet scrubber is technically infeasible for VOC control.

Similar to VOC, in addition to the earlier explanation about the infeasibility of emission control devices, the following are explanations of the technical infeasibility for PM control technologies mentioned in the Raymond CDK NOC Application report:

► Baghouse
- CDK exhaust is sufficiently laden with moisture and resinous compounds, so condensation in a baghouse frequently occurs. Condensation of resinous compounds on the baghouse filters leads to blinding, the phenomenon when air cannot pass through the cake buildup. Therefore, a baghouse is technically infeasible for PM control.

► Cyclone
- CDK exhaust is sufficiently laden with moisture and resinous compounds, so condensation in a cyclone frequently occurs. Condensation of resinous compounds leads to buildup of residue in the cyclone, preventing airflow and reducing efficiency. Therefore, a cyclone is technically infeasible for PM control.

► Scrubber

  - Scrubbers remove pollutants by inertial or diffusional impaction, reaction with a sorbent or reagent slurry, or adsorption into a liquid solvent. In addition to VOCs, scrubbers can be used to control PM emissions; however, they are limited to inlet concentrations between 1 and 115 grams per cubic meter.[6] Typical dry kiln exhaust concentrations are on the order of 0.01 grams per cubic meter[7], which is below the scrubber's design constraint. Therefore, a scrubber is technically infeasible for PM control.
- Dry Electrostatic Precipitator (Dry ESP)
  - Dry ESPs are not designed to operate under conditions in which the gas stream contains water vapor or other moist/sticky elements, so it would be expected to see particulate agglomeration on dry ESPs. Therefore, a dry ESP is technically infeasible for PM control.
- Wet Electrostatic Precipitator (WESP)
  - Wire-plate WESPs typically manage inlet concentrations between 2 and 110 grams per cubic meter, but typical dry kiln exhaust concentrations are on the order of 0.01 grams per cubic meter.[8] Additionally, WESPs require a large amount of space, which, upon review of the site plan, is not feasible for the Raymond facility. Therefore, a WESP is technically infeasible for PM control.

[6] EPA (2003). "Air Pollution Control Technology Fact Sheet: Venturi Scrubber." https://www3.epa.gov/ttncatc1/dir1/fventuri.pdf

[7] The calculated exhaust PM concentration for the proposed CDK at the Raymond facility is 0.028 g/m^3.

[8] EPA (2003). "Air Pollution Control Technology Fact Sheet: Wet Electrostatic Precipitator (ESP) - Wire Plate Type." https://www3.epa.gov/ttnchie1/mkb/documents/fwespwpl.pdf

Attachment A

Emissions Calculations

Project Inputs and Assumptions

Parameter	Value	Units	Source Notes
CDK			
Total Kiln Heat Input	50	MMBtu/hr	Per vendor specification sheet received on May 16, 2023.
CDK Maximum Annual Operating Hours	8,760	hrs/yr	Assumed value for PTE basis.
CDK Expected Annual Operating Hours	8,400	hrs/yr	Per vendor specification sheet received on May 16, 2023.
Annual Production	310	MMBF/yr	Per vendor specification sheet received on May 16, 2023.
Maximum Hourly Production	3.69E-02	MMBF/hr	Calculated by the following: Hourly Production (MMBF/hr) = Annual Production (MMBF/yr) / CDK Expected Annual Operating Hours (hrs/yr).
Truck Bins			
Bark Annual Throughput	121,186	tpy	See Fugitive PM tab.
Green Chips Annual Throughput	414,070	tpy	See Fugitive PM tab.
Planer Shavings Annual Throughput	58,212	tpy	See Fugitive PM tab.
Sawmill Operation - Hours per Day	20	hours/day	Per conversation with client, the sawmill operates in two 10-hour shifts.
Sawmill Operation - Days per Week	5	days/week	Per conversation with client, the sawmill operates Monday - Friday
Sawmill Operation - Weeks per Year	52	weeks/year	Per conversation with client, the sawmill operates 52 weeks per year.
Sawmill Operation - Annual Operating Hours	5,200	hours/year	Calculated by the following: Annual Operating Hours = (Hours/Day) * (Days/Week) * (Weeks/Year).
Fugitive Emissions - Green Sawdust			
Wet Green Sawdust Higher Heating Value	3,500	Btu/lb	Per the HHV of wet fuel in Weyerhaeuser's Greenville facility's CDK PTE calculations.
Green Sawdust Fuel Maximum Annual Throughput	62,571	tpy	Calculated by the following: Annual Green Sawdust Fuel (tpy) = Total Kiln Heat Input (MMBtu/hr) * CDK Maximum Annual Operating Hours (hrs/yr) * 10^^{6} (Btu/MMBtu) / HHV (Btu/lb) / 2000 (lb/ton).
Green Sawdust Fuel Maximum Hourly Throughput	14,286	lb/hr	Calculated by the following: Max Hourly Green Sawdust Fuel (lb/hr) = Total Kiln Heat Input (MMBtu/hr) * 10^^{6} (Btu/MMBtu) / HHV (Btu/lb).
Sawdust Surge - Hours per Week	100	hours/week	Per conversation with client, the operational surge is 100 hrs/wk (Monday - Friday).
Sawdust Surge - Days per Week	5	days/week	Assumed value, since the sawmill operates Monday - Friday.
Sawdust Surge - Hours per Day	20	hours/day	Calculated by the following: Hours per Day = (Hours/Week) / (Days/Week).
Sawdust Surge - Annual Operating Hours	5,200	hours/year	Calculated by the following: Annual Operating Hours = (Hours/Week) * (Weeks/Year).
Cyclones			
Cyclone Annual Operating Hours	8,760	hrs/yr	Assumed value for PTE basis.
Fuel Silo Cyclone Exhaust Flow Rate	6,227	scfm	Per vendor specs, received June 29, 2023. Per email with Angela Cameron on July 11, 2023, the stream is at ambient temperature and is assumed to be in standard conditions.
Bark Cyclone Exhaust Flow Rate	8,564	scfm	Per Table 3.0 in the TSD for 12AOP915 (Cyclone #11). The stream is assumed to be at ambient conditions.
Dry Chip Cyclone Exhaust Flow Rate	5,150	scfm	Per Table 3.0 in the TSD for 12AOP915 (Cyclone #21). The stream is assumed to be at ambient conditions.
Dry Chip Baghouse Control Efficiency	99%	--	Based on the 2021 ORCAA AEI workbook, baghouses are assumed to maintain a control efficiency of 99%.
Cyclone PM Grain Loading Rate	0.03	gr/dscf	Based on the 2021 ORCAA AEI workbook, the PM grain loading rate comes from FIRE 6.23 October 2000, SCC 30700804, 30700805, which is also in Table 10.4.1 AP-42, p. 10.4-2 (2/80).

Table F-1. Project-Wide Potential Emissions — Criteria Pollutant Summary

Emission Unit	Fugitive?	Potential Annual Emissions (tpy)							
		Total PM	Total PM_{10}	Total $PM_{2.5}$	SO_2	NO_X	VOC	CO	CO_2e
CDK	N	24.82	18.95	17.76	5.48	44.40	224.66	116.39	45,893
Chip and Bark Truck Bins	Y	9.45	4.47	0.68	--	--	--	--	--
Fugitive Emissions - Green Sawdust	Y	0.24	0.11	0.02	--	--	--	--	--
Haul Roads	Y	0.90	0.18	0.04	--	--	--	--	--
Cyclones	N	16.72	6.69	6.69	--	--	--	--	--
	Total:	**52.12**	**30.39**	**25.18**	**5.48**	**44.40**	**224.66**	**116.39**	**45,893**

Table F-2. Facility-Wide Potential Emissions — Criteria Pollutant Summary

Emission Unit	Fugitive?	Potential Annual Emissions (tpy)							
		Total PM	Total PM_{10}	Total $PM_{2.5}$	SO_2	NO_X	VOC	CO	CO_2e
Wood Waste Collection - Cyclones[2]	N	18.36	7.36	7.36	--	--	--	--	--
Fugitive Emissions - Roads[3]	Y	0.90	0.18	0.04	--	--	--	--	--
Log Debarking[4]	Y	6.5	3.6	0.5	--	--	--	--	--
CDK	N	24.82	18.95	17.76	5.48	44.40	224.66	116.39	45,893
Chip and Bark Truck Bins	Y	9.45	4.47	0.68	--	--	--	--	--
Fugitive Emissions - Green Sawdust	Y	0.24	0.11	0.02	--	--	--	--	--
Fire Pump Engine	N	0.03	0.03	0.03	0.02	0.37	0.03	0.08	13.73
Total Emissions (with fugitives):		**60.29**	**34.70**	**26.38**	**5.50**	**44.77**	**224.69**	**116.47**	**45,906**
Total Emissions (without fugitives):		**43.21**	**26.34**	**25.14**	**5.50**	**44.77**	**224.69**	**116.47**	**45,906**
PSD Major Source Thresholds:		**250**	**250**	**250**	**250**	**250**	**250**	**250**	**100,000**
PSD Threshold Exceeded [1] (Yes/No):		**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

[1] PSD is only applicable for GHG if the PSD threshold is exceeded for it and another pollutant.
[2] "Wood Waste Collection - Cyclones" includes new cyclones added as part of the project and existing cyclones that remain unchanged.
[3] Vehicle usage has been updated as part of the project, so fugitive road emissions have been recalculated.
[4] "Log Debarking" emissions remain unchanged from the value included in Table 4.2 of the TSD to the current AOP (12AOP915). The PM value was estimated based on the PM/PM10 relationship displayed in ORCAA's 2021 AEI - Debarking tab.

Table F-3. Project-Wide and Facility-Wide Potential Emissions — HAP Summary

Total HAP [1] (tpy):	21.68	
Maximum HAP (tpy):	14.04	Methanol

[1] After completion of the CDK Project, HAP emissions at the Facility will only be emitted from the CDK.

Table F-4. Project-Wide Potential Emissions — HAP/TAP Summary

Pollutant	CAS #	HAP?	TAP?	CDK Emissions (lb/hr)	CDK Emissions (tpy)	Averaging Period	SQER[1] (lb/avg. period)	Project Emissions without netting (lb/avg. period)	Exceed SQER without netting?	Actual Emissions [2] (lb/avg. period)	Net Emissions [2] (lb/avg. period)	Exceed SQER with netting?
Formaldehyde	50-00-0	Yes	Yes	0.42	1.76	year	27	3518.08	Yes	288.09	3,229.99	Yes
Benzene	71-43-2	Yes	Yes	0.21	0.92	year	21	1839.60	Yes	474.03	1,365.57	Yes
Arsenic	7440-38-2	Yes	Yes	5.05E-04	2.21E-03	year	0.049	4.42	Yes	0.11	4.31	Yes
Cadmium	7440-43-9	Yes	Yes	1.55E-04	6.77E-04	year	0.039	1.35	Yes	0.08	1.28	Yes
Lead	7439-92-1	Yes	Yes	1.75E-03	7.64E-03	year	14	15.29	Yes	0.13	15.16	Yes
Manganese	7439-96-5	Yes	Yes	6.35E-03	0.03	24-hr	0.022	0.15	Yes	0.02	0.13	Yes
Nickel	7440-02-0	Yes	Yes	4.42E-04	1.94E-03	year	0.62	3.87	Yes	0.45	3.42	Yes
				Total HAP (tpy):	21.68							
				Max Individual HAP (tpy):	14.04	Methanol						

[1] The SQER for each TAP is obtained from the 2019 WAC 173-460 TAP list.

[2] For each TAP that initially exceeds its SQER, netting was conducted to determine actual emissions based on the last ten years of annual emissions inventories (AEIs) for the current combustion and lumber drying operations (hog fuel boiler and indirect-heated batch kilns, respectively). The net emissions (proposed emissions - actual emissions) are then compared to the SQER. For pollutants that do not have previously quantified emissions, which are evidenced by "Not Calculated" in the Actual Emissions column, it is assumed that by using the same emission factor, proposed emissions will be lower than actual emissions due to the CDK's lower maximum heat input. In these instances, net emissions are set to zero and do not exceed the SQER.

CDK Maximum Heat Input (MMBtu/yr) = Heat Input Rating (MMBtu/hr) * Annual Hours of Operation (hrs/yr)
= 438,000 MMBtu/yr

Maximum two-year average hog fuel boiler heat input (MMBtu/yr) = 638,917 MMBtu/yr

Table F-5. CDK Parameter Inputs

Parameter	Value	Units	Source Notes
Total Kiln Heat Input	50	MMBtu/hr	Per vendor specification sheet received on May 16, 2023.
CDK Maximum Annual Operating Hours	8,760	hrs/yr	Assumed value for PTE basis.
CDK Expected Annual Operating Hours	8,400	hrs/yr	Per vendor specification sheet received on May 16, 2023.
Annual Production	310	MMBF/yr	Per vendor specification sheet received on May 16, 2023.
Maximum Hourly Production	3.69E-02	MMBF/hr	Calculated by the following: Hourly Production (MMBF/hr) = Annual Production (MMBF/yr) / CDK Expected Annual Operating Hours (hrs/yr).

Table F-6. CDK Criteria Pollutant and GHG Emissions

Pollutant	Normal Operation Emission Factors			Normal Operation Emissions[6]		Startup/Idling Emissions[6]		Total CDK Emissions[6]	
	Emission Factor	Unit	Reference	Max Hourly (lb/hr)	Total Annual (tpy)	Max Hourly (lb/hr)	Total Annual (tpy)	Max Hourly[7] (lb/hr)	Total Annual (tpy)
PM	140	lb/MMBF	1	5.17	21.70	17.35	3.12	17.35	24.82
PM_{10}	104	lb/MMBF	1	3.84	16.12	15.70	2.83	15.70	18.95
$PM_{2.5}$	99	lb/MMBF	1	3.65	15.35	13.39	2.41	13.39	17.76
CO	730	lb/MMBF	1	26.94	113.15	18.00	3.24	26.94	116.39
NO_X	280	lb/MMBF	1	10.33	43.40	10.15	1.00	10.33	44.40
Total VOC	--	--	2	53.48	224.66	--	--	53.48	224.66
VOC (Combustion)	6.19E-03	lb/MMBtu	3	0.31	1.36	--	--	0.31	1.36
VOC (Drying)	1,440.7	lb/MMBF	4	53.17	223.31	--	--	53.17	223.31
SO_2	0.025	lb/MMBtu	1	1.25	5.48	--	--	1.25	5.48
CO_2e	--	lb/MMBtu	5	10,478	45,893	--	--	10,478	45,893
CO_2	207	lb/MMBtu	5	10,340	45,288	--	--	10,340	45,288
N_2O	7.94E-03	lb/MMBtu	5	0.40	1.74	--	--	0.40	1.74
CH_4	1.59E-02	lb/MMBtu	5	0.79	3.48	--	--	0.79	3.48

1 Emissions for PM, CO, NO_X, and SO_X estimated using direct-fired continuous dry kiln emission factors from Georgia EPD's document entitled "EPD Recommended Emission Factors for Lumber Kiln Permitting in Georgia".

2 Emissions for VOC determined by adding together indirect-heated batch dry kiln emission factors for douglas fir and wood-fired combustion emission factors.

3 VOC combustion emission factor based on NCASI Technical Bulletin No. 1013: A Comprehensive Compilation and Review of Wood-Fired Boiler Emissions, Table 5.1. Mean values used. VOC reported as total non-methane hydrocarbons (TNMHC) "as-C", determined using EPA Method 25A, and converted to WPP1[1] per WPP1 Section 8.0 Equation 1: VOC (WPP1) = VOC (as-C) + Methanol + Formaldehyde.

4 VOC drying emission factor as derived by OTM26 based on the "EPA Region 10 HAP and VOC Emission Factors for Lumber Drying, January 2021". Emission Factor (lb/MBF) = 0.01460x - 1.77130, where x = max drying temp of heated air entering the lumber (220 °F).

5 GHG emissions are calculated based on the Global Warming Potentials (GWP) provided in Table A-1 of 40 CFR 98 and emission factors provided in Tables C-1 and C-2 for combustion of wood and wood residuals.

CO_2	1
N_2O	298
CH_4	25

6 Emission rates for pollutants with only 'lb/MMBF' emission factors are based on the CDK's annual throughput of dried lumber [MMBF], so combustion emissions from startup and idling are added in order to determine total CDK emission rates. These startup and idling emissions are calculated in the CDK Startup and Idling tab of the workbook. Emission rates for pollutants with 'lb/MMBtu' emission factors are based on the kiln's maximum firing rate [MMBtu/hr] and continuous operating hours of 8,760 hours per year. Since emissions at the maximum firing rate are the most conservative, the 'lb/MMBtu' emission rates already include combustion emissions from startup and idling.

7 Max hourly emissions represent the maximum emissions from the following three scenarios: normal operation, startup, or idling.

Table F-7. CDK HAP/TAP Emissions

				Normal Operation Emission Factors[1,2]			Normal Operation Emissions[11]		Startup/Idling Emissions[11]		Total CDK Emissions[11]	
Pollutant	CAS #	HAP?	TAP?	Combustion (lb/MMBtu)	Drying (lb/MMBF)	Reference	Max Hourly (lb/hr)	Total Annual (tpy)	Max Hourly (lb/hr)	Total Annual (tpy)	Max Hourly[12] (lb/hr)	Total Annual (tpy)
Acetaldehyde	75-07-0	Yes	Yes	1.57E-04	27.5	2,3	1.02	4.30	--	--	1.02	4.30
Acrolein	107-02-8	Yes	Yes	1.27E-04	0.5	2,3	0.02	0.11	--	--	0.02	0.11
Formaldehyde	50-00-0	Yes	Yes	--	11.33	4	0.42	1.76	0.02	3.39E-03	0.42	1.76
Methanol	67-56-1	Yes	Yes	4.82E-04	89.9	2,3	3.34	14.04	--	--	3.34	14.04
Propionaldehyde	123-38-6	Yes	Yes	2.14E-05	0.3	2,3	0.01	0.05	--	--	1.21E-02	0.05
Carbon monoxide	630-08-0	No	Yes	--	--	--	26.94	113.15	18.00	3.24	26.94	116.39
Nitrogen dioxide	10102-44-0	No	Yes	--	--	5	10.33	43.40	10.15	1.83	10.33	45.23
Sulfur dioxide	7446-09-5	No	Yes	--	--	--	1.25	5.48	--	--	1.25	5.48
Acetophenone	98-86-2	Yes	No	1.84E-06	--	2	9.20E-05	4.03E-04	--	--	9.20E-05	4.03E-04
Benzene	71-43-2	Yes	Yes	4.2E-03	--	7	0.21	0.92	--	--	0.21	0.92
Bis(2-ethylhexyl)phthalate	117-81-7	Yes	Yes	4.65E-08	--	2	2.33E-06	1.02E-05	--	--	2.33E-06	1.02E-05
Bromobenzene	108-86-1	No	Yes	7.67E-06	--	2	3.84E-04	1.68E-03	--	--	3.84E-04	1.68E-03
Bromodichloromethane	75-27-4	No	Yes	5.90E-03	--	2	0.30	1.29	--	--	0.30	1.29
Bromomethane	74-83-9	Yes	Yes	3.67E-06	--	2	1.84E-04	8.04E-04	--	--	1.84E-04	8.04E-04
Carbon Tetrachloride	56-23-5	Yes	Yes	2.55E-06	--	2	1.28E-04	5.58E-04	--	--	1.28E-04	5.58E-04
Carbon-Disulfide	75-15-0	Yes	Yes	1.25E-04	--	2	6.25E-03	0.03	--	--	6.25E-03	0.03
Chlorobenzene	108-90-7	Yes	Yes	1.66E-05	--	2	8.30E-04	3.64E-03	--	--	8.30E-04	3.64E-03
Chloroform	67-66-3	Yes	Yes	2.55E-06	--	2	1.28E-04	5.58E-04	--	--	1.28E-04	5.58E-04
Chloromethane	74-87-3	Yes	Yes	2.66E-05	--	2	1.33E-03	5.83E-03	--	--	1.33E-03	5.83E-03
Cresols (mixed isomers)	1319-77-3	Yes	Yes	2.00E-05	--	2,8	1.00E-03	4.38E-03	--	--	1.00E-03	4.38E-03
Cumene	98-82-8	Yes	Yes	1.77E-05	--	2	8.85E-04	3.88E-03	--	--	8.85E-04	3.88E-03
1,2-Dibromoethane	106-93-4	Yes	Yes	1.83E-06	--	2	9.15E-05	4.01E-04	--	--	9.15E-05	4.01E-04
1,2-Dibromo-3-chloropropane	96-12-8	Yes	Yes	1.10E-06	--	2	5.50E-05	2.41E-04	--	--	5.50E-05	2.41E-04
1,4-Dichlorobenzene	106-46-7	Yes	Yes	2.79E-04	--	2	1.40E-02	0.06	--	--	1.40E-02	0.06
1,1-Dichloroethane	75-34-3	Yes	Yes	2.99E-05	--	2	1.50E-03	6.55E-03	--	--	1.50E-03	6.55E-03
1,2-Dichloroethane	107-06-2	Yes	Yes	2.92E-05	--	2	1.46E-03	6.39E-03	--	--	1.46E-03	6.39E-03
1,2-Dichloropropane	78-87-5	Yes	Yes	1.68E-05	--	2	8.40E-04	3.68E-03	--	--	8.40E-04	3.68E-03
Di-n-Butyl Phthalate	84-74-2	Yes	No	3.33E-05	--	2	1.67E-03	7.29E-03	--	--	1.67E-03	7.29E-03
4,6-Dinitro-2-methylphenol	534-52-1	Yes	No	2.10E-06	--	2	1.05E-04	4.60E-04	--	--	1.05E-04	4.60E-04
2,4-Dinitrophenol	51-28-5	Yes	No	1.31E-07	--	2	6.55E-06	2.87E-05	--	--	6.55E-06	2.87E-05
2,4-Dinitrotoluene	121-14-2	Yes	Yes	9.42E-07	--	2	4.71E-05	2.06E-04	--	--	4.71E-05	2.06E-04
Ethyl Benzene	100-41-4	Yes	Yes	3.13E-05	--	2	1.57E-03	6.85E-03	--	--	1.57E-03	6.85E-03
Hexachlorobenzene	118-74-1	Yes	Yes	1.03E-06	--	2	5.15E-05	2.26E-04	--	--	5.15E-05	2.26E-04
n-Hexane	110-54-3	Yes	Yes	2.88E-04	--	2	1.44E-02	0.06	--	--	1.44E-02	0.06
Hexachlorobutadiene	87-68-3	Yes	Yes	3.65E-07	--	2	1.83E-05	7.99E-05	--	--	1.83E-05	7.99E-05
Hydrogen Chloride	7647-01-0	Yes	Yes	1.11E-04	--	7	5.55E-03	0.02	--	--	5.55E-03	0.02
Hydrogen Fluoride	7664-39-3	Yes	Yes	8.50E-06	--	7	4.25E-04	1.86E-03	--	--	4.25E-04	1.86E-03
Isopropanol	67-63-0	No	Yes	1.10E-03	--	2	0.06	0.24	--	--	0.06	0.24
Methyl Ethyl Ketone	78-93-3	No	Yes	5.39E-06	--	2	2.70E-04	1.18E-03	--	--	2.70E-04	1.18E-03
Methyl Isobutyl Ketone	108-10-1	Yes	Yes	4.45E-04	--	2	0.02	0.10	--	--	0.02	0.10
Methylene Chloride	75-09-2	Yes	Yes	2.82E-05	--	2	1.41E-03	6.18E-03	--	--	1.41E-03	6.18E-03
Naphthalene	91-20-3	Yes	Yes	8.13E-06	--	2	4.07E-04	1.78E-03	--	--	4.07E-04	1.78E-03
4-Nitrophenol	100-02-7	Yes	No	9.41E-08	--	2	4.71E-06	2.06E-05	--	--	4.71E-06	2.06E-05
Pentachlorophenol	87-86-5	Yes	Yes	4.48E-08	--	2	2.24E-06	9.81E-06	--	--	2.24E-06	9.81E-06
Phenol	108-95-2	Yes	Yes	1.53E-05	--	2	7.65E-04	3.35E-03	--	--	7.65E-04	3.35E-03
Styrene	100-42-5	Yes	Yes	1.54E-05	--	2	7.70E-04	3.37E-03	--	--	7.70E-04	3.37E-03
Tetrachloroethene	127-18-4	Yes	Yes	2.46E-05	--	2	1.23E-03	5.39E-03	--	--	1.23E-03	5.39E-03
Toluene	108-88-3	Yes	Yes	3.67E-06	--	2	1.84E-04	8.04E-04	--	--	1.84E-04	8.04E-04
Tribromomethane	75-25-2	Yes	Yes	3.65E-07	--	2	1.83E-05	7.99E-05	--	--	1.83E-05	7.99E-05
1,2,4-Trichlorobenzene	120-82-1	Yes	No	1.10E-04	--	2	5.50E-03	0.02	--	--	5.50E-03	0.02
1,1,1-Trichloroethane	71-55-6	Yes	Yes	3.93E-05	--	2	1.97E-03	8.61E-03	--	--	1.97E-03	8.61E-03
1,1,2-Trichloroethane	79-00-5	Yes	Yes	2.40E-04	--	2	1.20E-02	0.05	--	--	1.20E-02	0.05
Trichloroethylene	79-01-6	Yes	Yes	1.99E-05	--	2	9.95E-04	4.36E-03	--	--	9.95E-04	4.36E-03
2,4,6-Trichlorophenol	88-06-2	Yes	Yes	2.76E-07	--	2	1.38E-05	6.04E-05	--	--	1.38E-05	6.04E-05

Pollutant	CAS #	HAP?	TAP?	Normal Operation Emission Factors[1,2] Combustion (lb/MMBtu)	Drying (lb/MMBF)	Reference	Normal Operation Emissions[11] Max Hourly (lb/hr)	Total Annual (tpy)	Startup/Idling Emissions[11] Max Hourly (lb/hr)	Total Annual (tpy)	Total CDK Emissions[11] Max Hourly[12] (lb/hr)	Total Annual (tpy)
1,2,3-Trichloropropane	96-18-4	No	Yes	2.19E-06	--	2	1.10E-04	4.80E-04	--	--	1.10E-04	4.80E-04
Vinyl Chloride	75-01-4	Yes	Yes	1.84E-05	--	2	9.20E-04	4.03E-03	--	--	9.20E-04	4.03E-03
Xylenes (mixed isomers)	1330-20-7	Yes	Yes	5.22E-06	--	2,9	2.61E-04	1.14E-03	--	--	2.61E-04	1.14E-03
Antimony	7440-36-0	Yes	No	1.47E-06	--	6	7.35E-05	3.22E-04	--	--	7.35E-05	3.22E-04
Arsenic	7440-38-2	Yes	Yes	1.01E-05	--	6	5.05E-04	2.21E-03	--	--	5.05E-04	2.21E-03
Beryllium	7440-41-7	Yes	Yes	4.23E-08	--	6	2.12E-06	9.26E-06	--	--	2.12E-06	9.26E-06
Cadmium	7440-43-9	Yes	Yes	3.09E-06	--	6	1.55E-04	6.77E-04	--	--	1.55E-04	6.77E-04
Chromium	Cr(III)	Yes	Yes	1.00E-05	--	6	5.00E-04	2.19E-03	--	--	5.00E-04	2.19E-03
Chromium, VI	18540-29-9	Yes	Yes	2.35E-07	--	6	1.18E-05	5.15E-05	--	--	1.18E-05	5.15E-05
Cobalt	7440-48-4	Yes	Yes	6.11E-07	--	6	3.06E-05	1.34E-04	--	--	3.06E-05	1.34E-04
Copper	7440-50-8	No	Yes	1.34E-05	--	6	6.70E-04	2.93E-03	--	--	6.70E-04	2.93E-03
Lead	7439-92-1	Yes	Yes	3.49E-05	--	6	1.75E-03	7.64E-03	--	--	1.75E-03	7.64E-03
Manganese	7439-96-5	Yes	Yes	1.27E-04	--	6	6.35E-03	0.03	--	--	6.35E-03	0.03
Mercury	7439-97-6	Yes	Yes	8.26E-07	--	6	4.13E-05	1.81E-04	--	--	4.13E-05	1.81E-04
Nickel	7440-02-0	Yes	Yes	8.84E-06	--	6	4.42E-04	1.94E-03	--	--	4.42E-04	1.94E-03
Phosphorus	7723-14-0	Yes	Yes	9.85E-05	--	6	4.93E-03	0.02	--	--	4.93E-03	0.02
Selenium	7782-49-2	Yes	Yes	1.03E-06	--	6	5.15E-05	2.26E-04	--	--	5.15E-05	2.26E-04
Vanadium	7440-62-2	No	Yes	9.8E-07	--	10	4.90E-05	2.15E-04	--	--	4.90E-05	2.15E-04

1 Emissions for HAP determined by adding together indirect-heated batch dry kiln emission factors for douglas fir and wood-fired combustion emission factors, except for formaldehyde, which uses a calculated direct-fired emission factor.

2 Organic HAP combustion emission factors based on NCASI Technical Bulletin No. 1013: A Comprehensive Compilation and Review of Wood-Fired Boiler Emissions, Table 4.1. Median values used. When a median is not available, the maximum value is used.

3 HAP drying emission factors for acetaldehyde, acrolein, methanol, and propionaldehyde based on the emission factor summary table in "EPA Region 10 HAP and VOC Emission Factors for Lumber Drying, January 2021" and the methanol EF is based on max drying temp of heated air entering the lumber (220 °F).

4 Due to formaldehyde's dependence on direct or indirect heating, the emission factor was scaled up from the value listed in the "EPA Region 10 HAP and VOC Emission Factors for Lumber Drying, January 2021," where x = max drying temp of heated air entering the lumber (220 °F). The value was scaled by the proportion of direct to indirect mean batch kiln emission factors for formaldehyde in the NCASI Wood Products Air Emission Factor Database – 2013 Update, which is shown below:

NCASI Direct-Fired Batch Kiln EF:	7.35E-02	lb/MBF	EPA Region 10 Indirect-Heated Batch Kiln EF:	2.36	lb/MMBF
NCASI Indirect-Heated Batch Kiln EF:	1.53E-02	lb/MBF			
Ratio of Direct-to-Indirect:	4.80				

5 It is conservatively assumed that all NO_X is converted to NO_2.

6 Trace metal HAP combustion emission factors based on NCASI Technical Bulletin No. 1013: A Comprehensive Compilation and Review of Wood-Fired Boiler Emissions, Table 4.3. Median Wet Scrubber were used. When a median was not available, the maximum value was used.

7 For organic HAP that only had controlled factors in NCASI TB1013, if the control is a wet PM control, then NCASI TB1013 is still used. However, if the control is a dry PM control, then AP-42 Section 1.6, Table 1.6-3 emissions factors were used.

8 In NCASI TB1013, Table 4-1, cresol emission factors are reported separately as m,p-cresol and o-cresol. Since the separate isomers have the same SQER and ASIL as the Cresol (mixed isomer) TAP and the mixed isomer TAP is not reported in TB1013, the two different isomer emission rates are added together in order to assess the mixed isomer toxic. Exceedance of the mixed isomer SQER or ASIL will also dictate exceedances for the individual isomer toxics.

9 In NCASI TB1013, Table 4-1, xylene emission factors are reported separately as m,p-xylene, o-xylene, and xylenes (mixed isomers). Since the separate isomers have the same SQER and ASIL as the Xylene (mixed isomer) TAP and the mixed isomer TAP is reported in TB1013, the mixed isomer toxic is the only emission rate reported here. Exceedance of the mixed isomer SQER or ASIL will also dictate exceedances for the individual isomer toxics.

10 When a trace metal HAP combustion emission factor in NCASI TB1013 did not have a Wet Scrubber value, then AP-42 Section 1.6, Table 1.6-4 emissions factors were used.

11 Emission rates for pollutants with only 'lb/MMBF' emission factors are based on the CDK's annual throughput of dried lumber [MMBF], so combustion emissions from startup and idling are added in order to determine total CDK emission rates. These startup and idling emissions are calculated in the CDK Startup and Idling tab of the workbook. Emission rates for pollutants with 'lb/MMBtu' emission factors are based on the kiln's maximum firing rate [MMBtu/hr] and continuous operating hours of 8,760 hours per year. Since emissions at the maximum firing rate are the most conservative, the 'lb/MMBtu' emission rates already include combustion emissions from startup and idling.

12 Max hourly emissions represent the maximum emissions from the following three scenarios: normal operation, startup, or idling.

Table F-5.1. CDK Startup and Idling - Input Parameters

Parameter	Value	Units	Source Notes
Total Kiln Heat Input	50	MMBtu/hr	Per vendor specification sheet received on May 16, 2023.
CDK Maximum Annual Operating Hours	8,760	hrs/yr	Assumed value for PTE basis.
CDK Expected Annual Operating Hours	8,400	hrs/yr	Per vendor specification sheet received on May 16, 2023.
CDK Maximum Startup and Idling Hours	360	hrs/yr	8,760 hours - Expected operating hours (8,400 hr)
CDK Startup and Idling Maximum Heat Input	18,000	MMBtu/yr	Total Kiln Heat Input * Maximum Startup and Idling Hours

Conservatively, assumed the startup and idling acitivies are occuring anytime beyond 8,400 hours/year (e.g. 360 hours) at burner firing capacity. In idling mode, the burner will be firing at a low rate of less than 1 MMBtu/hr. Emissions calculated are accounting for physical potential capacity to avoid additional restrictions on operating hours.

Note: Emission rates for pollutants with only 'lb/MMBF' emission factors are based on the CDK's annual throughput of dried lumber [MMBF], so combustion emissions from startup and idling are separately calculated here in order to determine total CDK emission rates. CDK emission rates for pollutants with 'lb/MMBtu' emission factors are conservatively based on the kiln's maximum firing rate [MMBtu/hr] and continuous operating hours of 8,760 hours per year, so combustion emissions from startup and idling do not need to be added.

Table F-6.1. CDK Startup and Idling - Added Pollutant Emission Factors

Pollutant	Emission Factor (lb/MMBtu)	Reference
Condensable PM (CPM)	0.017	1
CPM_{10}	0.017	1
$CPM_{2.5}$	0.017	1
Filterable PM (FPM)	0.33	2
FPM_{10}	0.30	2
$FPM_{2.5}$	0.25	2
Total PM (TPM)	0.347	3
TPM_{10}	0.314	3
$TPM_{2.5}$	0.268	3
CO	3.60E-01	4
NO_X	2.03E-01	5
Formaldehyde	3.77E-04	6

[1] Condensable PM combustion emission factor based on AP-42 Section 1.6, Table 1.6-1. Assuming CPM = CPM_{10} = $CPM_{2.5}$.

[2] Filterable PM combustion emission factor based on NCASI Technical Bulletin No. 1013, Table 5.2, value for Wet Wood.

PM_{10} =	90%	of FPM cumulative mass
$PM_{2.5}$ =	76%	of FPM cumulative mass

[3] Total PM = Condensable PM + Filterable PM

[4] CO combustion emission factor based on NCASI Technical Bulletin No. 1013, Table 5.1. Median value for Fuel Cells/Dutch Ovens was used.

[5] NO_X combustion emission factor based on NCASI Technical Bulletin No. 1013, Table 5.1. Median value for Wood w/o Significant UF Resin Content was used.

[6] Formaldehyde combustion emission factor based on NCASI Technical Bulletin No. 1013, Table 4.1. Median value used.

Table F-6.2. CDK Startup and Idling - Criteria Pollutant Emissions

Pollutant	Emission Factor (lb/MMBtu)	Hourly Emissions (lb/hr)	Annual Emissions (tpy)
TPM	0.347	17.35	3.12
TPM_{10}	0.314	15.70	2.83
$TPM_{2.5}$	0.268	13.39	2.41
CO	0.360	18.00	3.24
NO_X	0.203	10.15	1.00

Table F-7.1. CDK Startup and Idling - HAP/TAP Emissions

Pollutant	CAS #	HAP?	TAP?	Emission Factor (lb/MMBtu)	Hourly Emissions (lb/hr)	Annual Emissions (tpy)
Formaldehyde	50-00-0	Yes	Yes	3.77E-04	0.02	3.39E-03
Carbon monoxide	630-08-0	No	Yes	0.360	18.00	3.24
Nitrogen dioxide[1]	10102-44-0	No	Yes	0.203	10.15	1.83

[1] It is conservatively assumed that all NO_X is converted to NO_2.

Note: In order to determine actual emissions from the current batch kilns and hog fuel boiler, operational parameters and emissions rates are acquired from the 2013-2022 Annual Emission Inventories (AEIs). On a pollutant-by-pollutant basis, actual emissions are calculated from the annual average actual emission rates of the highest two consecutive years within the past ten years.

Table F-7.2. Baseline Calculations - Hog Fuel Boiler Heat Input

Year	Heat Input (MMBtu/yr)	Two-Year Period	Two-Year Average Heat Input (MMBtu/yr)
2013	607,432	2013-2014	583,270
2014	559,108	2014-2015	580,756
2015	602,404	2015-2016	616,698
2016	630,993	2016-2017	638,917
2017	646,840	2017-2018	624,346
2018	601,852	2018-2019	554,475
2019	507,098	2019-2020	551,346
2020	595,594	2020-2021	596,827
2021	598,060	2021-2022	521,503
2022	444,945		
		Max Heat Input (MMBtu/yr):	638,917
		Baseline Period:	2016-2017

Table F-7.3. Baseline Calculations - Hog Fuel Boiler NO_2 and SO_2 Emissions

Year	Annual NO_2 Emissions [1] (tpy)	Annual SO_2 Emissions (tpy)	Two-Year Period	Two-Year Average NO_2 Emissions (tpy)	Two-Year Average SO_2 Emissions (tpy)
2013	66.69	0.31	2013-2014	64.04	0.30
2014	61.39	0.29	2014-2015	54.79	1.50
2015	48.19	2.71	2015-2016	39.38	2.22
2016	30.57	1.72	2016-2017	41.16	2.32
2017	51.75	2.91	2017-2018	49.95	2.81
2018	48.15	2.71	2018-2019	44.36	2.50
2019	40.57	2.28	2019-2020	51.40	2.48
2020	62.24	2.68	2020-2021	62.37	2.69
2021	62.50	2.69	2021-2022	53.23	2.35
2022	43.97	2.00			
			Max Annual Emissions (tpy):	64.04	2.81
			Baseline Period:	2013-2014	2017-2018

[1] It is conservatively assumed that all NO_X is converted to NO_2.

Table F-7.4. Baseline Calculations - Lumber Drying TAP Emissions

Pollutant CAS	Acetaldehyde 75-07-0	Acrolein 107-02-8	Formaldehyde 50-00-0	Methanol 67-56-1	Propionaldehyde 123-38-6
Year	***Annual Emissions (lb/yr) - Less than or Equal to 200 °F***				
2013	1.62E+04	2.21E+02	1.98E+02	1.16E+04	1.46E+02
2014	1.47E+04	1.83E+02	1.95E+02	1.01E+04	1.39E+02
2015	1.57E+04	1.96E+02	2.01E+02	1.08E+04	1.50E+02
2016	1.69E+04	2.11E+02	2.31E+02	1.17E+04	1.60E+02
2017	1.46E+04	1.85E+02	2.45E+02	1.04E+04	1.36E+02
2018	1.32E+04	1.69E+02	2.27E+02	9.43E+03	1.23E+02
2019	1.30E+04	1.65E+02	2.13E+02	9.23E+03	1.22E+02
2020	1.37E+04	1.75E+02	2.35E+02	9.77E+03	1.28E+02
2021	1.48E+04	1.89E+02	2.55E+02	1.06E+04	1.39E+02
2022	9.66E+03	1.28E+02	2.34E+02	7.28E+03	8.76E+01
Year	***Annual Emissions (lb/yr) - Greater than 200 °F***				
2013					
2014	1.28E+03	3.50E+01	5.99E+01	2.80E+03	2.13E+01
2015	5.32E+02	1.46E+01	2.50E+01	1.17E+03	8.87E+00
2016					
2017					
2018					
2019					
2020					
2021					
2022					
Year	***Total Annual Emissions (tpy) - All Temperatures***				
2013	8.09E+00	1.10E-01	9.90E-02	5.78E+00	7.28E-02
2014	7.97E+00	1.09E-01	1.27E-01	6.47E+00	8.02E-02
2015	8.14E+00	1.05E-01	1.13E-01	6.00E+00	7.92E-02
2016	8.43E+00	1.06E-01	1.16E-01	5.84E+00	7.98E-02
2017	7.28E+00	9.27E-02	1.23E-01	5.18E+00	6.81E-02
2018	6.61E+00	8.43E-02	1.13E-01	4.71E+00	6.17E-02
2019	6.51E+00	8.27E-02	1.07E-01	4.61E+00	6.10E-02
2020	6.85E+00	8.74E-02	1.18E-01	4.89E+00	6.39E-02
2021	7.42E+00	9.46E-02	1.27E-01	5.29E+00	6.93E-02
2022	4.83E+00	6.39E-02	1.17E-01	3.64E+00	4.38E-02
Two-Year Period	***Two-Year Average Emissions (tpy)***				
2013-2014	8.03E+00	1.10E-01	1.13E-01	6.12E+00	7.65E-02
2014-2015	8.06E+00	1.07E-01	1.20E-01	6.23E+00	7.97E-02
2015-2016	8.29E+00	1.05E-01	1.14E-01	5.92E+00	7.95E-02
2016-2017	7.86E+00	9.91E-02	1.19E-01	5.51E+00	7.39E-02
2017-2018	6.95E+00	8.85E-02	1.18E-01	4.95E+00	6.49E-02
2018-2019	6.56E+00	8.35E-02	1.10E-01	4.66E+00	6.13E-02
2019-2020	6.68E+00	8.50E-02	1.12E-01	4.75E+00	6.25E-02
2020-2021	7.14E+00	9.10E-02	1.22E-01	5.09E+00	6.66E-02
2021-2022	6.12E+00	7.93E-02	1.22E-01	4.47E+00	5.65E-02
Max Annual Emissions (tpy)	**8.29E+00**	**1.10E-01**	**1.22E-01**	**6.23E+00**	**7.97E-02**
Baseline Period	**2015-2016**	**2013-2014**	**2020-2021**	**2014-2015**	**2014-2015**

Table F-7.5. Baseline Calculations - Hog Fuel Boiler TAP Emissions

Pollutant [1]	CAS	Emission Factor [2,3] (lb/MMBtu)	Baseline Period [4]	Max Annual Heat Input (MMBtu/yr)	Max Annual Combustion Emissions (tpy)	Max Annual Combined Emissions [5] (tpy)	Max Annual Combined Emissions [5] (lb/yr)	Max Hourly Combined Emissions [5] (lb/hr)	Max Daily Combined Emissions [5] (lb/day)
Acetaldehyde	75-07-0	1.64E-04	2015-2016	6.17E+05	0.05	8.34	16,674.31	1.94	46.62
Acrolein	107-02-8	3.15E-05	2013-2014	5.83E+05	9.20E-03	0.12	237.74	0.03	0.66
Formaldehyde	50-00-0	7.24E-05	2020-2021	5.97E+05	0.02	0.14	288.09	0.03	0.81
Nitrogen dioxide	10102-44-0		2013-2014		64.04	64.04	128,079.75	14.92	358.06
Sulfur dioxide	7446-09-5		2017-2018		2.81	2.81	5,619.11	0.65	15.71
Benzene	71-43-2	7.42E-04	2016-2017	6.39E+05	0.24	0.24	474.03	0.06	1.33
Bromodichloromethane	75-27-4	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated
1,2-Dibromoethane	106-93-4	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated
1,2-Dibromo-3-chloropropane	96-12-8	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated
1,4-Dichlorobenzene	106-46-7	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated
1,2-Dichloroethane	107-06-2	2.92E-05	2016-2017	6.39E+05	9.33E-03	9.33E-03	18.66	2.17E-03	0.05
Hexachlorobenzene	118-74-1	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated
1,1,2-Trichloroethane	79-00-5	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated
Arsenic	7440-38-2	1.76E-07	2016-2017	6.39E+05	5.62E-05	5.62E-05	0.11	1.31E-05	3.14E-04
Cadmium	7440-43-9	1.21E-07	2016-2017	6.39E+05	3.87E-05	3.87E-05	0.08	9.01E-06	2.16E-04
Chromium, VI	18540-29-9	1.54E-06	2016-2017	6.39E+05	4.91E-04	4.91E-04	0.98	1.14E-04	2.74E-03
Lead	7439-92-1	2.03E-07	2016-2017	6.39E+05	6.49E-05	6.49E-05	0.13	1.51E-05	3.63E-04
Manganese	7439-96-5	1.32E-05	2016-2017	6.39E+05	4.22E-03	4.22E-03	8.43	9.82E-04	0.02
Nickel	7440-02-0	7.06E-07	2016-2017	6.39E+05	2.26E-04	2.26E-04	0.45	5.25E-05	1.26E-03

[1] Pollutants were chosen for baseline analysis due to an exceedance of their respective SQER from project emissions. These do not represent the comprehensive list of TAP pollutants from hog fuel combustion. If a pollutant initially exceeded its SQER but was not included in the former AEIs, emissions are marked as "Not Calculated".

[2] Organic and trace elemental metal TAP emission factors come from Weyerhaeuser's ORCAA Annual Emission Inventories.

[3] NO_2 and SO_2 emissions are calculated in Table F-7.4.

[4] The baseline periods for Acetaldehyde, Acrolein, and Formaldehyde are based on the maximum two-year average lumber drying TAP emission rates since drying emissions are significant comparing to combustion emissions.
The baseline periods for NO_2 and SO_2 are based on the maximum two-year average hog fuel boiler emission rates.
The baseline period for all other TAPs is based on the maximum two-year average hog fuel boiler heat input since the EF remains the same during the 10 year period.

[5] The combined emissions represents both hog fuel combustion and lumber drying emission rates for Acetaldehyde, Acrolein, and Formaldehyde.

[6] Based on a review of prior boiler operating data, the hog fuel boiler is running close to 99% of the time. Therefore, to determine hourly and daily emissions from annual emissions, the boiler is conservatively assumed to have operated 98% of the time, which is approximately:
8584.8 hours per year.

Table F-8. Fugitive PM Input Parameters

Parameter	Value	Units	Source Notes
Truck Bins			
Bark Annual Throughput	121,186	tpy	See Fugitive PM tab.
Green Chips Annual Throughput	414,070	tpy	See Fugitive PM tab.
Planer Shavings Annual Throughput	58,212	tpy	See Fugitive PM tab.
Sawmill Operation - Hours per Day	20	hours/day	Per conversation with client, the sawmill operates in two 10-hour shifts.
Sawmill Operation - Days per Week	5	days/week	Per conversation with client, the sawmill operates Monday - Friday
Sawmill Operation - Weeks per Year	52	weeks/year	Per conversation with client, the sawmill operates 52 weeks per year.
Sawmill Operation - Annual Operating Hours	5,200	hours/year	Calculated by the following: Annual Operating Hours = (Hours/Day) * (Days/Week) * (Weeks/Year).
Fugitive Emissions - Green Sawdust			
Total Kiln Heat Input	50	MMBtu/hr	Per vendor specification sheet received on May 16, 2023.
CDK Maximum Annual Operating Hours	8,760	hrs/yr	Assumed value for PTE basis.
Wet Green Sawdust Higher Heating Value	3,500	Btu/lb	Per the HHV of wet fuel in Weyerhaeuser's Greenville facility's CDK PTE calculations.
Green Sawdust Fuel Maximum Annual Throughput	62,571	tpy	Calculated by the following: Annual Green Sawdust Fuel (tpy) = Total Kiln Heat Input (MMBtu/hr) * CDK Maximum Annual Operating Hours (hrs/yr) * 10^6 (Btu/MMBtu) / HHV (Btu/lb) / 2000 (lb/ton).
Green Sawdust Fuel Maximum Hourly Throughput	14,286	lb/hr	Calculated by the following: Max Hourly Green Sawdust Fuel (lb/hr) = Total Kiln Heat Input (MMBtu/hr) * 10^6 (Btu/MMBtu) / HHV (Btu/lb).
Sawdust Surge - Hours per Week	100	hours/week	Per conversation with client, the operational surge is 100 hrs/wk (Monday - Friday).
Sawdust Surge - Days per Week	5	days/week	Assumed value, since the sawmill operates Monday - Friday.
Sawdust Surge - Hours per Day	20	hours/day	Calculated by the following: Hours per Day = (Hours/Week) / (Days/Week).

Table F-9. Fugitive PM Throughput Data

Material	Annual Throughput [1] 2019	2020	2021	2022	Throughput Unit	Section
Wood Product (Douglas Fir)	99,914.33	125,245.32	143,303.83	166,910.44	MBF	Production
Wood Product (Hemlock)	67,220.85	70,590.17	61,250.57	0	MBF	Production
Bark, Burned for Energy Recovery On-Site	22,230	25,452.75	25,677.39	19,970.65	bdtons	Energy Fuel Sources
Shavings, Burned for Energy Recovery On-Site	12,554	8,484.25	8,558.13	6,656.88	bdtons	Energy Fuel Sources
Chips	93,387	129,120	134,236.57	111,472	bdtons	Production
Hog Fuel Mfg. Res., Otherwise Beneficially Reused	2,751	6,514	33,599.78	12,654	bdtons	Residuals and Waste
Sawdust By-Product sold	19,550	22,651	15,516.09	17,057	bdtons	Residuals and Waste
Shavings By-Product sold	12,554	13,244	9,842.07	6,193	bdtons	Residuals and Waste

Categorized Material	Annual Throughput [1] (bdton) 2019	2020	2021	2022	Components
Bark [2]	24,981	31,966.75	0	32,624.65	Bark, Burned for Energy Recovery On-Site; Hog Fuel Mfg. Res., Otherwise Beneficially Reused
Green Sawdust	19,550	22,651	15,516.09	17,057	Sawdust By-Product Sold
Planer Shavings	25,108	21,728.25	18,400.2	12,849.88	Shavings, Burned for Energy Recovery On-Site; Shavings By-Product sold
Chips	93,387	129,120	134,236.57	111,472	Chips

Categorized Material	Ratio [1] (bdton/MBF produced) 2019	2020	2021	2022	Max Ratio	CDK Project
Bark	0.15	0.16	0.00	0.20	0.20	**121,186**
Green Sawdust	0.12	0.12	0.08	0.10	0.12	72,522
Planer Shavings	0.15	0.11	0.09	0.08	0.15	**58,212**
Green Chips	0.56	0.66	0.66	0.67	0.67	**414,070**

[1] Since fugitive emissions relate to the handling of byproduct and residual materials, exact throughputs have not yet been determined, so the projected post-project throughputs were estimated using annual production values from 2019 through 2022. Materials from Weyerhaeuser's production data were then grouped into the relevant categories for this project: bark, green sawdust, planer shavings, and green chips. Ratios were then calculated to relate annual material throughput to annual wood product production. Of these ratios, the maximum ratio was multiplied by the annual production rate for the CDK project and converted to a wet basis, assuming a moisture content of 50% for bark, green sawdust, and green chips and 20% for planer shaving. Since a green sawdust throughput is already specified for the green sawdust CDK burner (via burner capacity), the value in this table was not used in the PTE calculations.

[2] Due to log yard clean up activities in 2021, the "hog fuel beneficially applied" value does not accurately represent expected annual production rates of bark, so the scaled annual throughput of bark for the CDK project is based on 2019, 2020, and 2022 production rates.

Table F-10. Fugitive PM Emissions

Emission Unit	Material	Origin	Destination	Emission Factors (lb/ton) [1] PM	Emission Factors (lb/ton) [1] PM_{10}	Emission Factors (lb/ton) [1] $PM_{2.5}$	Capture Type	Capture Efficiency (%)	Annual Emissions (tpy) [3] PM	Annual Emissions (tpy) [3] PM_{10}	Annual Emissions (tpy) [3] $PM_{2.5}$	Daily Emissions (lb/day) [4] PM	Daily Emissions (lb/day) [4] PM_{10}	Daily Emissions (lb/day) [4] $PM_{2.5}$	Hourly Emissions (lb/hr) [5] PM	Hourly Emissions (lb/hr) [5] PM_{10}	Hourly Emissions (lb/hr) [5] $PM_{2.5}$
Fugitive Emissions - Green Sawdust																	
Green Sawdust Sawmill Drop	Green Sawdust	Sawmill	Green Sawdust Conveyor	7.55E-03	3.57E-03	5.41E-04	Building Enclosure	See Footnote 1 (Min Wind Speed)	0.24	0.11	0.02	1.08	0.51	0.08	0.05	0.03	3.86E-03
								Fugitive Emissions - Green Sawdust Sub-Total:	*0.24*	*0.11*	*0.02*	*1.08*	*0.51*	0.08	*0.05*	*0.03*	3.86E-03
Truck Bins																	
Bark Bins Truck Loadout	Bark	Bark Bins	Truck	0.064	0.030	4.56E-03	Steel Sidings	50%	1.93	0.91	0.14	14.84	7.02	1.06	0.74	0.35	0.05
Chips Bins Truck Loadout [6]	Chips, Planer Shavings	Chip Bins	Truck	0.064	0.030	4.56E-03	Steel Sidings	50%	7.52	3.56	0.54	57.83	27.35	4.14	2.89	1.37	0.21
								Truck Bins Sub-Total:	*9.45*	*4.47*	*0.68*	*72.67*	*34.37*	*5.20*	*3.63*	*1.72*	*0.26*
								Total:	9.68	4.58	0.69	73.75	34.88	5.28	3.69	1.74	0.26

[1] Methods from AP-42 Section 13.2.4, Aggregate Handling and Storage Piles, are used to determine the emission factors and total emissions from raw material handling.
Uncontrolled Emission Factor (lb/ton) = $0.0032 \times (k) \times (U / 5)^{1.3} / (M / 2)^{1.4}$, where:

Particle Size Multiplier (k) =	0.74	for PM	
	0.35	for PM_{10}	
	0.053	for $PM_{2.5}$	
Mean Wind Speed (U) =	6.7	mph	This wind speed is used for outdoor emission calculations from truck bin loadout. Source: Western Regional Climatological Center, Olympia, WA station
Minimum Wind Speed (U) =	1.3	mph	This wind speed is used for the indoor emission calculations from the green sawdust drop. Source: AP-42 Section 13.2.4.
Material Moisture Content (M) =	25%		While the internal moisture of the wood particles may be around 50%, this variable (M) accounts for surface moisture. The lower end moisture content was chosen as a conservative estimate of annual surface moisture.

[2] The truck bins will be fitted with steel sidings, which prevent approximately 50% of fugitive emissions.

[3] Annual Emissions = Emission Factor (lb/ton) x Qty Unloaded (ton/yr) / 2000 (lb/ton) * (100% - Capture Efficiency (%))

[4] Daily Emissions = Hourly Emissions (lb/hr) * Hours per Day

[5] For green sawdust sawmill drop, Hourly Emissions = Emission Factor (lb/ton) x Qty Unloaded (lb/hr) / 2000 (lb/ton).
For truck loadout, Hourly Emissions = Emission Factor (lb/ton) x Qty Unloaded (ton/yr) / Annual Operating Hours (hours/yr) * (100% - Capture Efficiency (%)). For the purpose of these calculations, it is assumed that the hourly truck loadout rate is equivalent to the hourly rate of material sent to the truck bin.

[6] While the planer shavings are blown to a cyclone on top of the chips bins that exausts to a baghouse, all planer shavings are assumed to be sent down into the truck bins in order to have a conservative estimate of the material transfer PM emissions from truck loadout.

Table F-11. Cyclones Input Parameters

Parameter	Value	Units	Source Notes
Cyclone Annual Operating Hours	8,760	hrs/yr	Assumed value for PTE basis.
Fuel Silo Cyclone Exhaust Flow Rate	6,227	scfm	Per vendor specs, received June 29, 2023. Per email with Angela Cameron on July 11, 2023, the stream is at ambient temperature and is assumed to be in standard conditions.
Bark Cyclone Exhaust Flow Rate	8,564	scfm	Per Table 3.0 in the TSD for 12AOP915 (Cyclone #11). The stream is assumed to be at ambient conditions.
Dry Chip Cyclone Exhaust Flow Rate	5,150	scfm	Per Table 3.0 in the TSD for 12AOP915 (Cyclone #21). The stream is assumed to be at ambient conditions.
Dry Chip Baghouse Control Efficiency	99%	--	Based on the 2021 ORCAA AEI workbook, baghouses are assumed to maintain a control efficiency of 99%.
Cyclone PM Grain Loading Rate	0.03	gr/dscf	Based on the 2021 ORCAA AEI workbook, the PM grain loading rate comes from FIRE 6.23 October 2000, SCC 30700804, 30700805, which is also in Table 10.4.1 AP-42, p. 10.4-2 (2/80).

Table F-12. Cyclones Emissions

Emission Unit	Potential Operation	Exhaust Flow Rate	Loading Rate [1] (gr./dscf)			Control Efficiency	Filterable PM Emissions [2,3,4]		Filterable PM_{10} Emissions [2,3,4]		Filterable $PM_{2.5}$ Emissions [2,3,4]	
	(hr/yr)	(scfm)	PM	PM_{10}	$PM_{2.5}$	(%)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
Fuel Silo Cyclone	8,760	6,227	0.03	0.012	0.012	0%	1.60	7.01	0.64	2.81	0.64	2.81
Bark Cyclone	8,760	8,564	0.03	0.012	0.012	0%	2.20	9.65	0.88	3.86	0.88	3.86
Dry Chip Cyclone / Baghouse	8,760	5,150	0.03	0.012	0.012	99%	1.32E-02	0.06	5.30E-03	0.02	5.30E-03	0.02
						Total:	3.82	16.72	1.53	6.69	1.53	6.69

[1] Based on the 2021 ORCAA AEI workbook, the FIRE 6.23 October 2000, SCC 30700804, 30700805 and EPA factor book 450/4-90-003 p. 144 assume that Filterable PM_{10} is approximately equal to 40% of Filterable PM. It is also conservatively assumed that Filterable PM_{10} = Filterable $PM_{2.5}$. As this source does not involve combustion units, it is assumed that condensable emissions are negligible.

[2] As a conservative measure, emissions of $PM_{2.5}$ are assumed to be equal to emissions of PM_{10}.

[3] Potential hourly PM emissions (lb/hr) = Exhaust Grain Loading Rate (gr./dscf) x Exhaust Air Flow Rate (dscf/min) x (60 min/hr) x (lb/7,000 gr.) x (100% - Control Efficiency (%)).

[4] Potential annual emissions (tpy) = Hourly Emission Rate (lb/hr) * Annual Operating Hours (hrs/yr) / 2000 (lb/ton).

Table F-13. Pre-Project Wood Waste Collection (Cyclones) Emissions

Emission Unit	Potential Operation (hr/yr)	Exhaust Flow Rate (scfm)	Loading Rate [1] (gr./dscf) PM	PM_{10}	$PM_{2.5}$	Control Efficiency (%)	Filterable PM Emissions [2,3,4] (lb/hr)	(tpy)	Filterable PM_{10} Emissions [2,3,4] (lb/hr)	(tpy)	Filterable $PM_{2.5}$ Emissions [2,3,4] (lb/hr)	(tpy)
Dry Chip Cyclone / Baghouse [5]	8,760	5,150	0.03	0.012	0.012	99%	1.32E-02	0.06	5.30E-03	0.02	5.30E-03	0.02

[1] Based on the 2021 ORCAA AEI workbook, the FIRE 6.23 October 2000, SCC 30700804, 30700805 and EPA factor book 450/4-90-003 p. 144 assume that Filterable PM_{10} is approximately equal to 40% of Filterable PM. It is also conservatively assumed that Filterable PM_{10} = Filterable $PM_{2.5}$. As this source does not involve combustion units, it is assumed that condensable emissions are negligible.

[2] As a conservative measure, emissions of $PM_{2.5}$ are assumed to be equal to emissions of PM_{10}.

[3] Potential hourly PM emissions (lb/hr) = Exhaust Grain Loading Rate (gr./dscf) x Exhaust Air Flow Rate (dscf/min) x (60 min/hr) x (lb/7,000 gr.) x (100% - Control Efficiency (%)).

[4] Potential annual emissions (tpy) = Hourly Emission Rate (lb/hr) * Annual Operating Hours (hrs/yr) / 2000 (lb/ton).

[5] Parameters for the existing emission unit based on Table 4.2 in the TSD for 12AOP915. PTE was calculated assuming 8,760 hour/year operation.

Table F-14. Pre- and Post-Project Wood Waste Collection (Cyclones) Emission Comparison

Emission Unit	PTE Emissions [1] (tpy) PM	PM_{10}	$PM_{2.5}$
Pre-Project Wood Waste Collection			
Dry Chip Cyclone / Baghouse	0.06	0.02	0.02
All Other Existing Cyclones	1.64	0.68	0.68
Pre-Project Total:	1.7	0.7	0.7
Post-Project Wood Waste Collection			
Dry Chip Cyclone / Baghouse	0.06	0.02	0.02
All Other Existing Cyclones	1.64	0.68	0.68
Fuel Silo Cyclone	7.01	2.81	2.81
Bark Cyclone	9.65	3.86	3.86
Post-Project Total:	18.36	7.36	7.36

[1] Parameters for existing emission units based on Table 4.2 in the TSD for 12AOP915. PM Emissions were estimated using methods presented in ORCAA's 2021 AEI workbook.

Table F-15. Haul Roads Input Parameters

Vehicle Name	Class	Vehicle Weight (Avg of Loaded + Unloaded) (tons)	Number of Trips per Day	Number of Days per Week	Number of Weeks per Year	Miles Round Trip (Paved)	Vehicle Miles Traveled per Day (VMT/day)	Vehicle Miles Traveled per Year (VMT/yr)
Chip	Trucks	34	12	5	52	0.5	6	1560
Sawdust	Trucks	34	0	0	52	0.5	0	0
Lumber	Trucks	26	16	5	52	0.5	8	2080
Hog Fuel	Trucks	34	8	6	52	0.5	4	1248
Production Stackers	Stacker	75	75	6	52	0.1	7.5	2340
Production Forklifts	Forklifts	15	380	5	52	0.1	38	9880
Co. Pickups	Co. Pickups	2.5	8	6	52	0.5	4	1248
Sales/Service	Vendor	2.5	3	5	52	0.1	0.3	78
Shavings	Trucks	34	2	6	52	1	2	624
On-site transfers	Trucks	26	1	5	52	0.5	0.5	130
Log Delivery	Trucks	26	95	5	52	0.2	19	4940
						Total:	89.3	24128

Table F-16. Haul Roads Emissions

Vehicle Name	Weight (tons)	Vehicle Miles Traveled per Year (VMT/yr)	Vehicle Miles Traveled per Day (VMT/day)	Emission Factor, E [1] (lb/VMT) PM	PM_{10}	$PM_{2.5}$	Annual Controlled Emissions [2] (tpy) PM	PM_{10}	$PM_{2.5}$	Daily Controlled Emissions [3] (lb/day) PM	PM_{10}	$PM_{2.5}$
Chip	34	1,560	6	0.44	0.09	0.02	0.08	0.02	3.73E-03	0.66	0.13	0.03
Sawdust	34	0	0	0.44	0.09	0.02	0	0	0	0	0	0
Lumber	26	2,080	8	0.33	0.07	0.02	0.08	0.02	3.78E-03	0.67	0.13	0.03
Hog Fuel	34	1,248	4	0.44	0.09	0.02	0.06	1.21E-02	2.98E-03	0.44	0.09	0.02
Production Stackers	75	2,340	8	0.98	0.20	0.05	0.26	0.05	1.25E-02	1.84	0.37	0.09
Production Forklifts	15	9,880	38	0.19	0.04	0.01	0.21	0.04	1.02E-02	1.80	0.36	0.09
Co. Pickups	2.5	1,248	4	0.03	0.01	0.00	4.24E-03	8.48E-04	2.08E-04	0.03	6.11E-03	1.50E-03
Sales/Service	2.5	78	0	0.03	0.01	0.00	2.65E-04	5.30E-05	1.30E-05	2.29E-03	4.58E-04	1.12E-04
Shavings	34	624	2	0.44	0.09	0.02	0.03	6.07E-03	1.49E-03	0.22	0.04	1.07E-02
On-site transfers	26	130	1	0.33	0.07	0.02	4.81E-03	9.62E-04	2.36E-04	0.04	8.32E-03	2.04E-03
Log Delivery	26	4,940	19	0.33	0.07	0.02	0.18	0.04	8.97E-03	1.58	0.32	0.08
						Total:	0.90	0.18	0.04	7.28	1.46	0.36

[1] Emission factor E is calculated according to AP-42 Section 13.2.1 for emissions from paved roads, equation 1:

E (lbs/VMT) = Paved Road Emission Factor, [$k * (sL)^{0.91} * (W)^{1.02}$]

0.011 = k, PM size multiplier (lb/VMT) from AP-42 Table 13.2.1-1.

0.0022 = k, PM_{10} size multiplier (lb/VMT) from AP-42 Table 13.2.1-1.

0.00054 = k, $PM_{2.5}$ size multiplier (lb/VMT) from AP-42 Table 13.2.1-1.

1.1 = sL, roadway surface silt loading (g/m^2) AP-42 13.2.1, Table 13-2.1-3. The average silt loading value for corn wet mills is used because the sawmill is expected to store materials with a similar texture and moisture content.

[2] Emissions account for natural mitigation due to precipitation according to AP-42 Section 13.2.1 equation 2:

Annual emissions (tpy) = E * (1-P/4N)*(1-C)*[VMT/yr]/[lb/ton]

161.6 = P, mean number of days per year with measurable precipitation from Western Regional Climatological Center, Olympia, WA station.

365 = N, number of days in period for annual rainfall mitigation effect

75% = C, control efficiency applied for watering and sweeping.

Paved roads are watered and vacuumed quarterly as control measures. Control efficiency from ORCAA's AEI workbook.

[3] Daily emissions (lb/day) are calculated in the same manner as annual emissions, but with the daily Vehicle Miles Traveled per Day and not taking credits for precipitation.

Table F-17. Fire Pump Input Parameters

Parameter	Value	Units	Source Notes
Fire Pump Engine Rated Capacity	238	bhp	From the 2022 ORCAA Annual Emissions Inventory.
Fire Pump Engine Annual Hours of Operation	100	hrs/yr	Assumed value for PTE basis.

Table F-18. Fire Pump Emissions

Emission Unit	Emission Factor [1,4]	Emissions	
	(lb/hp-hr)	Max Hourly (lb/hr)	Total Annual (tpy)
PM [2]	2.20E-03	0.52	0.03
PM_{10}	2.20E-03	0.52	0.03
$PM_{2.5}$ [2]	2.20E-03	0.52	0.03
CO	6.68E-03	1.59	0.08
NO_X	0.031	7.38	0.37
VOC [3]	2.51E-03	0.60	0.03
SO_2	2.05E-03	0.49	0.02
CO_2e	--	274.63	13.73
CO_2	1.15	273.70	13.69
N_2O	9.26E-06	2.20E-03	1.10E-04
CH_4	4.63E-05	1.10E-02	5.51E-04

[1] Criteria pollutant and CO_2 emission factors for diesel industrial engines from AP-42, Table 3.3-1.
HAP/TAP Pollutants with an emission factor rating of C, D, or E are not included.

[2] Assuming PM = PM_{10} = $PM_{2.5}$.

[3] VOC emissions are equal to the sum of exhaust, evaporative, crankcase, and refueling TOC emissions.

[4] CH_4 and N_2O emission factor is from 40 CFR 98, Subpart C, Table C-2. Global warming potential (GWP) for CH_4 is 25 and N_2O is 298 for estimating CO_2e emissions (40 CFR 98, Subpart A, Table A-1).

CH_4 and N_2O emission factors assume the following average break-specific fuel consumption (BSFC), based on AP-42, Table 3.3-1, Footnote 'a'.

Average BSFC = 7,000 Btu/hp-hr

Attachment B

NCASI's Control Device and Stack Testing Feasibility Assessment

November 8, 2023

TO: Weyerhaeuser NR Company

CC: Michelle Vinson, Michael Nolan, and Jack Carter

FROM: Ric Law, NCASI

SUBJECT: Considerations on the Feasibility of Conducting EPA Reference Air Test Methods at the Weyerhaeuser Raymond CDK

Introduction

Weyerhaeuser is seeking a Notice of Construction Application (NOA) from the Olympic Region Clean Air Agency for a project at their Raymond WA sawmill that will replace an existing hog fuel boiler and eight indirectly heated batch kilns with a single direct-fired continuous dry kiln (CDK). As part of this NOA, Weyerhaeuser has asked the National Council for Air and Stream Improvement, Inc. (NCASI) to assess and comment on the feasibility of collecting CDK process emissions with EPA reference air test methods.

NCASI is a non-profit environmental technical studies organization focusing on environmental and sustainability topics relevant to the forest products industry. Over its 80-year history, NCASI has conducted studies in a variety of areas including air emissions and emission measurement methods and worked extensively on developing emissions data used for multiple forest products industry Maximum Achievable Control Technology (MACT) rulemakings. NCASI staff have wide-ranging experience in pulp and paper and wood products manufacturing processes and control technologies, stack testing, stack test report review, emissions data analysis, and emission factor development for pulp and paper mill and wood products plant emission sources.

Lumber Kilns and Characteristics of Process Air Emissions

The Wood Products industrial sector produces a variety of manufactured products at panel plants, engineered wood plants, and sawmills. All of these products require some form of wood drying activity. For panel plants, other than plywood, the primary process unit used to dry wood furnish is either a rotary or tube dryer. These dryers require a hot gas stream to be mixed with green wood furnish prior to entering the dryer system. The hot gas stream transports the wood furnish through the dryer to the product cyclone where the wood furnish is separated from the dryer gas stream. For each dryer there is a dedicated conveyance system that is enclosed from the dryer inlet to the product cyclone. Prior to environmental regulations, most dryer systems exhausted to the atmosphere at the product cyclones. When particulate air emissions began to be regulated, it was a relatively easy task to combine the exhaust outlets of each product cyclone and duct the combined gas stream to a particulate control device and then later to an organic air emission control device where applicable. While there were some challenges to overcome with adding pollution controls to dryer systems, the actual operations of dryer systems were not significantly impacted when air flow through the dryers, product cyclones, and air emission control devices is maintained under normal operating conditions. Since the isolated gas stream from each product cyclone is combined, contained, and conveyed to an air emission control device, there is a single point of exhaust to the atmosphere for dryer systems. This single emission point can be designed to meet EPA criteria for obtaining representative air emission concentrations and flowrates to derive accurate and repeatable mass emission rates.

The primary objective of the lumber kiln is the same as a wood furnish dryer, i.e., to dry a product from a high moisture content to a lower moisture content. Both process units have an inlet and outlet for the product and an inlet and outlet for the associated gas stream. The fundamental design difference between lumber kilns and wood furnish dryer systems is the direction of the air flow relative to the product. As previously mentioned, dryer systems rely on air flow to move the product, which means that the direction of air flow is parallel to the product. Lumber kilns, on the other hand, do not rely on air flow to move product, instead, the drying process within a lumber kiln requires an air flow direction that is perpendicular to the direction of product flow. This means that there is no inherent operational design criteria to isolate, contain, and convey the associated gas stream to meet product separation requirements.

Historically, lumber kilns have been designed as a batch process. A charge of green lumber is pushed into the inlet side of a kiln, the doors are shut, and the kiln is heated up from ambient to various setpoint temperatures according to a "*drying schedule*." Batch kilns are designed as long rectangular structures with two tracks inside running parallel to the length of the kiln. Since the air flow in the kiln is perpendicular to the flow of the product[1], multiple vents are required down the length of the kiln roof to allow fresh air into the kiln and moisture laden gas out of the kiln. Internal fans are used to move air flow across the charge. The direction of the air flow into and out of the kiln typically changes every 2 to 3 hours to achieve even drying on both sides of the kiln. For steam-heated kilns, the internal fans blow air across heating elements to reheat the air prior to passing through the charge. The alternative method for heating a kiln is direct-fired. The heat source for direct-fired kilns is either a dry wood suspension burner or a green sawdust slope grated gasifier. For direct-fired units, the hot gas supplied by the heat source is mixed with recycled kiln gas and the re-heated air is sent back into the kiln. The kiln air is reheated in a blend box that is attached to the side of the kiln and a large fan is used to circulate the air from the kiln into a blend box and back to the kiln.

The primary challenges associated with testing batch kilns are (1) most sawmills have multiple kilns which are typically constructed side-by-side on site making it difficult to isolate the emissions from one kiln to another and (2) the lack of a single release point that conveys the total kiln exhaust flow. This configuration poses a significant challenge to obtaining accurate total kiln flow rates and representative samples by established EPA reference air test methods.

Continuous dry kilns (CDKs) offer an alternative to the batch kiln design. While CDKs are also rectangular in dimension, these kilns are much longer than batch kilns. While there are also two parallel tracks traversing the length of the kiln, the product flow for CDKs is a continuous counter-current movement of lumber through the kiln. At one end of the kiln, green lumber is entering on one track and dry lumber exiting on the other track, while at the opposite end of the kiln, there is a corresponding dry end track exiting and a green end track entering. CDKs have a central main hot zone where the active drying of lumber on both tracks occurs. The drying zone is bracketed by two lumber equilibration zones, also referred to as energy recovery zones, where no active drying takes place. The intent of the equilibrium zones is to transfer heat from the hot, dried lumber exiting the drying zone to the cool green lumber entering the drying zone. The result is the delivery of uniformly pre-heated green lumber to the drying

[1] Note for batch kilns: the charge (1) is pushed into the kiln initially, (2) remains static during the drying process, and then (3) is pushed out of the kiln on completion of the drying schedule. This constitutes the "product flow" for batch kilns.

zone on both tracks. Pre-heated green lumber lowers the amount of heat input required to reach the drying schedule's setpoint (minimizing combustion rates) and promotes more uniform drying conditions (minimizing over drying of the charge). The dry lumber passing through the equilibrium zones exit the CDK having been conditioned to a uniform exiting moisture content, thus also minimizing the need to over dry the kiln charge.

When CDKs are operating under normal conditions, the only source of inlet air for the CDK is from the burner air. Burner air is injected into the kiln at a temperature close to 2,000 °F where it is mixed with recirculated kiln air from the drying zone. The re-heated kiln air is then sent back into the kiln. The drying zone has multiple internal fans to move air perpendicular to the flow direction of lumber traveling through the kiln. Since CDKs typically do not have any active roof vents within the drying zone, baffles at both ends of the drying zone control the release of excess moisture laden gas into the energy recovery zones. The amount of excess gas delivered to each energy recovery zone can vary depending on operating conductions and product requirements. Each of the energy recovery zones also have internal fans to maintain the movement of air perpendicular to the counter-current flow of lumber but a spiral flow pattern is also established as the air moves towards the kiln ends. The intent of the energy recovery zones is to transfer heat from the dry lumber track (hot) to the green lumber track (cool). This process gradually lowers the temperature of the circulated gas stream as the green lumber absorbs heat. As the temperature drops, water vapor condenses on the green lumber as well as being absorbed by the dry lumber. The drop in temperature between the dry zone and the kiln ends can be 75 to 100 °F.

CDKs are designed to release excess kiln process gas through the two end openings. The flow pattern that results at the kiln ends is complex because of the confined space between the kiln walls and the entering and exiting lumber. Ambient air is also drawn into the kiln ends because of the positive and negative pressure created by the internal fans close to the kiln ends. Ambient air is drawn into the kiln on the negative side (dry lumber exiting) and kiln gas is forced out on the positive side (green lumber entering). This inherent air flow characteristic has made CDKs with open ends unsuitable for conducting EPA reference air test methods.

One characteristic of CDKs is that a significant amount of steam builds up at the kiln ends which poses as a safety hazard to the forklift operations associated with continuous loading and unloading of the lumber. Hoods have been added to the ends of existing CDKs, as well as incorporated into the design of new CDKs, to alleviate this workplace safety hazard. Some hoods are equipped with a single centralized vertical exhaust duct situated at the peak of the hood while other hood designs place a vertical exhaust duct over each track. Furthermore, some retrofitted hoods only rely on convection to channel steam up and out of the hood while others are fan driven. When hoods are added to kiln ends, the kiln gas must exit the kiln prior to entering the hood space, meaning that the exhausted gas stream will be forced to change both velocity and direction as the gas enters the hood and subsequently mixed with ambient air that is also being drawn into the hood. The resulting gas collected within the hood is then partitioned between venting out the vertical exhaust duct(s) and the hood opening.

NCASI Comments on the Feasibility of Conducting EPA Reference Air Test Methods at the Weyerhaeuser Raymond CDK

The Weyerhaeuser Raymond CDK will have proprietary Vapor Extraction Modules (VEMs) to divert a portion of the steam exiting the kiln to elevated release points away from the loading and unloading areas on each end of the kiln. The VEMs are designed to be an integral part of the kiln meaning that the kiln gas leaving the energy recovery zones directly enters the VEMs. Each VEM will be equipped with two fan-driven short stacks. The VEM stacks are designed specifically for releasing kiln water vapor and the design specifications do not satisfy the necessary criteria required to conduct representative air emissions testing. A detailed evaluation of the VEMs is provided below with an emphasis on the ability to conduct EPA reference air emission test methods.

1. **Vapor Extraction Modules**

   Each VEM is an extension added to the energy recovery zone at each end of the kiln. This is a different design than retrofitted hoods because the kiln gas remains inside the kiln when entering the VEM.

   The green-side track will be the positive side of the internal fans that circulate air within the energy recovery zones. The pattern of flow for the kiln gas exiting the energy recover zone, therefore, will be along the upper portion of the kiln where the gas is expected to be forced into the upper corner of the kiln above the green-side track, as shown in Figure 1. At this point, a portion of the gas is exhausted out of the two stacks with the remaining gas forced down and out the end of the kiln. The flow pattern of the kiln exhaust in the area over the green-side track is expected to be very turbulent. Baffles that line the edges of the kiln ends and rest on the lumber entering and exiting the kiln are also expected to have an impact on the exhaust flow pattern from the kiln.

2. **VEM Stacks**

   Figure 1 shows that each VEM section has two stacks situated side-by-side in a parallel orientation to the entrance of the green-side track. According to the design schematics, the four stacks are identical with an approximate diameter of 3 ft and a height of 6 ft. There is a 36-in diameter fan installed within each stack. The center of the stack that is furthest from the kiln side is 11 ft inboard. The paired stacks are approximately 5.5 ft apart centerline to centerline and the release points for each stack is approximately 46ft above grade.

   The kiln vendor has reported that the target designed vapor capture for the VEM stacks is 80%. This design target will be difficult to confirm. Confirmation by visually assessing the amount of moisture vapor exiting the kiln can be misleading due to differences in pressure and temperature. Designing the VEM stacks to capture and release the entire kiln exhaust (both water vapor and dry gas) is operationally not an option. The capture of all kiln exhaust would require an excessive negative pressure within the kiln that would impact drying efficiency, extract heat from the drying zone, and short circuit the energy recovery zone. All of these issues would counteract the intended design benefits provided by CDKs. As a consequence, the VEM stacks are not intended to capture and convey the entire kiln's process gas stream in a manner that meets EPA reference air test methods.

3. **Location of Staging Area for Sampling Operations**

   Figure 1 shows that the location of the VEM stacks are above the entrance of the green-side track at each end of the kiln. The kiln ends of CDKs are zones where a significant amount of activity occurs during continuous kiln operations. This is unlike batch kilns, where the loading zone for the kiln charge cycles through periods of activity. There is a significant amount of activity when the batch charge is being built and a period of inactivity after the charge is pushed into the kiln. CDKs, on the other hand, operate continuously with loading and unloading operations ongoing on both ends of the kiln. Staging a sampling effort within the congested area around the kiln ends is expected not to meet the criteria as a safe working zone for most sawmill operations.

4. **Alternative Method for Selection of Measurement Site**

EPA Method 1 describes the criteria for measurement site selection. The VEM stacks do not meet the Method 1 criteria for optimum measurement site location. Method 1 does, however, allow for alternative site location criteria.

The first option allowed by Method 1 is to place the sample ports at a minimum of 0.5 duct diameters upstream and 2 duct diameters downstream from nearest disturbances. To utilize these minimum distances, however, there needs to be an absence of cyclonic flow. Since each VEM stack is equipped with a fan, it is assumed that cyclonic flow conditions will be present at a sample port location 2 duct diameters from the outlet of the fan.

The second option, detailed in EPA's Method 5D, is to construct a temporary stack extension with flow straightening vanes. Figure 2 provides an example of how a Method 5D flow straightening vane stack extension could be configured. The stack extension in this example has a total height of 5ft making the sample port approximately 50 ft above grade. Each stack extension would have to be fitted and secured to the top of each existing stack and be required to structurally support the measurement equipment.

The temporary stack extension option is expected to pose a work-site safety issue. Assuming that the challenges associated with accessing all sample ports is possible, the release point for the process gas exhausted from the shortened stack extensions will be at or below head level of the sample crew working from a manlift or from a temporary sample platform (assuming one could be safety installed). There is a significant potential that steam and process gas will envelop the measurement work site and impact the ability to safely conduct sampling.

5. **Number of Traverse Points Required**

To use the flow straightening vane stack alternative, reference test methods require a total of 24 traverse points (12 on each stack diameter). Table 1 lists the traverse point locations along a 3 ft stack diameter that would be required and the proximity between traverse points. For example, the distance from the stack wall to traverse point A1 is 1 inch and for A2 is 2.2 inches. that means that the measurement system would have to be moved 1.2 inch when traversing from A1 to A2. To achieve this level of incremental precision, the measurement system will have to be suspended from a securely attached monorail system.

Table 1. Example of traverse point locations for the 3ft VEM stacks.

	inches across traverse	Δd for points	
wall	0		
A1	1	1.0	
A2	2.2	1.2	
A3	3.9	1.7	
A4	5.8	1.9	
A5	8.2	2.4	
A6	11.6	3.5	center
A7	21.1	9.4	
A8	24.5	3.5	
A9	26.9	2.4	
A10	28.9	1.9	
A11	30.5	1.7	
A12	31.7	1.2	

Conclusion

The CDK being installed at the Weyerhaeuser Raymond sawmill will incorporate state of the art kiln drying technology that is designed to increase energy efficiency and minimize over drying of lumber. The improvements in lumber drying efficiency offered by CDKs require that a critical design balance be maintained between heat input and the exhaust of moisture vapor generated from drying lumber. For the Raymond CDK, a portion of the generated water vapor will be exhausted through four short fan driven stacks. These stacks are designed to elevate the point of vapor release to alleviate a workplace safety issue associated with process steam build up that occurs at the loading and unloading zones at each end of the CDK. Dry kilns, whether of the batch or CDK design, are not designed such that the entire kiln process exhaust is collected and conveyed to a single point. Any such design applied to CDKs will have negative impacts on drying efficiency, for example, the extraction of excessive heat from the drying zone or short circuiting the energy recovery zone, and counteract other design benefits provided by CDKs. The fundamental design of the Raymond CDK, therefore, is the same as other existing CDKs in that the emission release points are not designed or configured to meet the criteria for EPA air emission reference test methods. For this reason, any effort to determine emission factors for the Raymond CDK will likely only yield an estimate that is expected to be no more accurate than the existing emission factors that have been derived from engineering tests conducted at CDKs outfitted with temporary stacks or kiln end hoods.

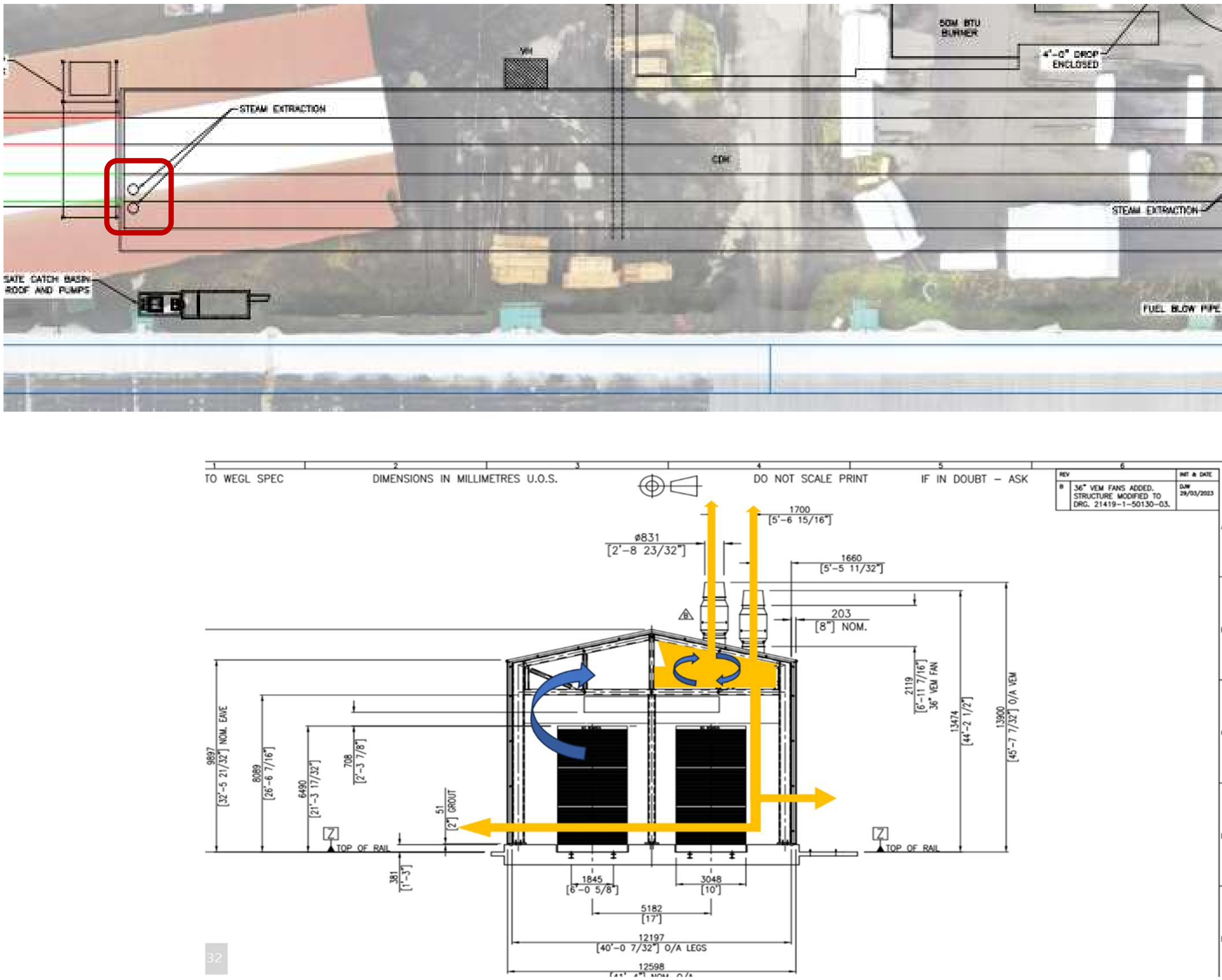

Figure 1. Configuration of the Vapor Extraction Module and Stacks.

outside diameter of shroud top lip =	36	inches				
inside shroud diameter (D) =	32.72	inches				
vane height =	0.45 x D =		14.7	inches		
cell size =	0.2 x D =		6.5	inches		
equivalent dia of vane opening =	(2*L*W)/(L+W) =		6.5	inches		
number of cells across	5					
Method 5D port location:						Enter desired
port location upstream from stack outlet >=	0.5 x D =		16.4	inches	Added	straightenin
port location downstream from vanes >=	2 x equivalent dia				stack	g vane
	of vane opening		13.1	inches	height,	height,
least total stack height with vanes >=	3.7	feet or	44.2	inches	inches	inches
Enter desired rounded total stack height with vanes =	5.0	feet or	60.0	inches	15.8	5.3
Resulting adjusted straightening vane height =	20.0	inches				
Adjusted port location upstream from stack outlet =	21.6	inches	0.66			
Adjusted port location downstream from vanes =	18.4	inches	1.17			
sum of adjusted dimensions =	60.0					

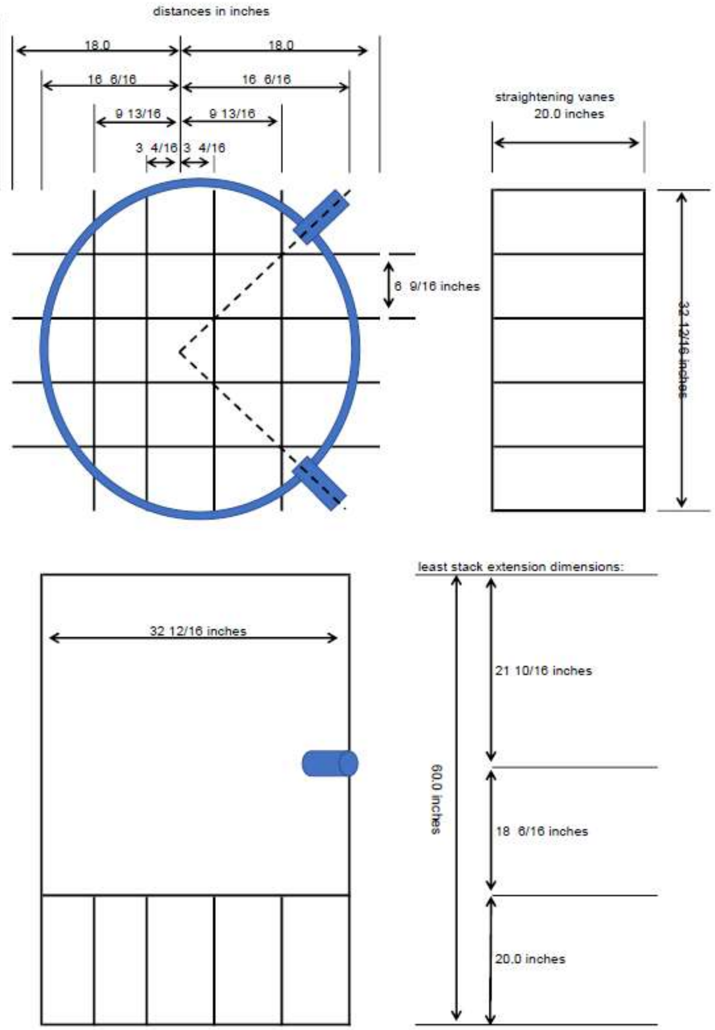

Figure 2. Example Method 5D design specifications for flow straightening vanes for the Raymond CDK VEM stacks