Enviva Greenwood -Technical Response Documents and Excel Workbook

Stephen Stroud <Stephen.Stroud@envivabiomass.com>

Wed 10/7/2020 11:17 AM

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6 attachments (2 MB)

NCASI Wood Products Database Dry Wood Handling.pdf; AP-42 10.6.3 Medium Density Fiberboard Manufacutring.pdf; AP-42 10.6.4 Hardboard and Fiberboard Manufacturing.pdf; Enviva GRE Emissions for SCDHEC (rev2 2020-0928).xlsx; Enviva Greenwood - Response to Major Source Status 2020_1007.pdf; Enviva Pellets Greenwood - Technical Information Request 2020_1007.pdf;

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Jo Anna,

Attached are all documents to support the Enviva Greenwood comments. Please let me know if you are able to open all attachments (Enviva Response Documents, NCASI and AP-42 Emission Factor Documentation and the Revised Enviva GRE PTE excel spreadsheet). If you have trouble with any documents or questions feel free to give me a call.

Sincerely,

Stephen Stroud
Director, Environmental Affairs

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Index Numb	Unique Identifier	Compound	Product	Control Catego	Control Devic	Process Unit Type	Descriptor 1	Number of Mill	Number of Process Units	Number of Sample Runs	Number of Non-Detect Sample Runs	Minimun Non-Detect if "ND"	Minimu	Maximu n Non-Detect if "ND"	Maximu	Media	Mean	Standard Deviatio	Units	Is Emission Factor Non-Detect
57	75070-HB-Uog-Chipper	acetaldehyde	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	8.75E-04	ND	1.59E-03				lb/ODT	Yes
67	67641-HB-Uog-Chipper	acetone	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	8.84E-04	ND	1.62E-03				lb/ODT	Yes
77	107028-HB-Uog-Chipper	acrolein	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	7.82E-04	ND	1.43E-03				lb/ODT	Yes
87	71432-HB-Uog-Chipper	benzene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	3.08E-04	ND	6.15E-04				lb/ODT	Yes
104	78933-HB-Uog-Chipper	methyl ethyl ketone (MEK	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	9.86E-04	ND	1.81E-03				lb/ODT	Yes
114	108101-HB-Uog-Chipper	methyl isobutyl ketone	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	9.56E-04	ND	1.78E-03				lb/ODT	Yes
126	123386-HB-Uog-Chipper	propionaldehyde	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	8.84E-04	ND	1.62E-03				lb/ODT	Yes
138	100425-HB-Uog-Chipper	styrene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	4.10E-04	ND	8.20E-04				lb/ODT	Yes
148	108883-HB-Uog-Chipper	toluene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	3.63E-04	ND	7.26E-04				lb/ODT	Yes
781	120821-HB-Uog-Chipper	1,2,4-trichlorobenzene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	7.15E-04	ND	1.43E-03				lb/ODT	Yes
789	107062-HB-Uog-Chipper	1,2-dichloroethane	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	3.90E-04	ND	7.79E-04				lb/ODT	Yes
797	540590-HB-Uog-Chipper	1,2-dichloroethene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	3.82E-04	ND	7.63E-04				lb/ODT	Yes
807	74839-HB-Uog-Chipper	bromomethane	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	3.74E-04	ND	7.48E-04				lb/ODT	Yes
816	75003-HB-Uog-Chipper	chloroethane	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	2.54E-04	ND	5.08E-04				lb/ODT	Yes
824	75014-HB-Uog-Chipper	chloroethene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	2.46E-04	ND	4.92E-04				lb/ODT	Yes
834	98828-HB-Uog-Chipper	cumene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	9.47E-03	ND	1.89E-02				lb/ODT	Yes
850	106423-HB-Uog-Chipper	m,p-xylene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	4.18E-04	ND	8.36E-04				lb/ODT	Yes
858	75092-HB-Uog-Chipper	methylene chloride	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	3.35E-04	ND	6.69E-04				lb/ODT	Yes
869	95476-HB-Uog-Chipper	o-xylene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	4.18E-04	ND	8.36E-04				lb/ODT	Yes
1735	13466789-HB-Uog-Chipper-HW	3-carene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	1.07E-02	ND	2.15E-02				lb/ODT	Yes
1743	80568-HB-Uog-Chipper-HW	alpha-pinene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	1.07E-02	ND	2.15E-02				lb/ODT	Yes
1751	127913-HB-Uog-Chipper-HW	beta-pinene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	1.07E-02	ND	2.15E-02				lb/ODT	Yes
1759	79925-HB-Uog-Chipper-HW	camphene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	1.07E-02	ND	2.15E-02				lb/ODT	Yes
1767	138863-HB-Uog-Chipper-HW	limonene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	1.07E-02	ND	2.15E-02				lb/ODT	Yes
1775	99876-HB-Uog-Chipper-HW	p-cymene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	1.06E-02	ND	2.11E-02				lb/ODT	Yes
1783	99832-HB-Uog-Chipper-HW	p-mentha-1,5-diene	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	1.07E-02	ND	2.15E-02				lb/ODT	Yes
1791	VOC-HB-Uog-Chipper-HW	VOC as carbon	Hardboard	Uog		Misc Unit	Chipper	1	1	2	0		4.09E-03		4.09E-03	4.09E-03	4.09E-03		lb/ODT	No
2312	67561-HB-Uog-Chipper	methanol	Hardboard	Uog		Misc Unit	Chipper	1	1	2	1		1.03E-03		1.03E-03	1.03E-03	1.03E-03		lb/ODT	No
2322	108952-HB-Uog-Chipper	phenol	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	1.59E-03	ND	2.89E-03				lb/ODT	Yes
2467	50000-HB-Uog-Chipper	formaldehyde	Hardboard	Uog		Misc Unit	Chipper	1	1	2	2	ND	1.85E-04	ND	3.21E-04				lb/ODT	Yes

Index Numb	Unique Identifier	Compound	Product	Control Categor	Process Unit Type	Descriptor 1	Number of Mil	Number of Process Units	Number of Sample Runs	Number of Non-Detect Sample Runs	Minimu n Non-Detect if "ND"	Minimu	Maximu n Non-Detect if "ND"	Maximu	Media	Mean	Standard Deviatio	Units	Is Emission Factor Non-Detect?
393	75070-OSB-Uog-DWMH	acetaldehyde	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	7.60E-04	ND	1.47E-03				lb/MSF 3/8	Yes
402	67641-OSB-Uog-DWMH	acetone	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	3	ND	9.55E-04		1.48E-03	9.80E-04	9.80E-04		lb/MSF 3/8	No
408	107028-OSB-Uog-DWMH	acrolein	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	6.83E-04	ND	1.31E-03				lb/MSF 3/8	Yes
417	71432-OSB-Uog-DWMH	benzene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	2.84E-04	ND	5.15E-04				lb/MSF 3/8	Yes
443	74828-OSB-Uog-DWMH	methane	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	1	3	0		1.43E-03		1.43E-03	1.43E-03	1.43E-03		lb/MSF 3/8	No
448	78933-OSB-Uog-DWMH	methyl ethyl ketone (ME	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	8.62E-04	ND	1.65E-03				lb/MSF 3/8	Yes
454	108101-OSB-Uog-DWMH	methyl isobutyl ketone	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	8.44E-04	ND	1.60E-03				lb/MSF 3/8	Yes
468	123386-OSB-Uog-DWMH	propionaldehyde	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	7.71E-04	ND	1.48E-03				lb/MSF 3/8	Yes
478	100425-OSB-Uog-DWMH	styrene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	3.78E-04	ND	6.87E-04				lb/MSF 3/8	Yes
484	108883-OSB-Uog-DWMH	toluene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	3.35E-04	ND	6.08E-04				lb/MSF 3/8	Yes
1066	120821-OSB-Uog-DWMH	1,2,4-trichlorobenzene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	6.59E-04	ND	1.20E-03				lb/MSF 3/8	Yes
1072	107062-OSB-Uog-DWMH	1,2-dichloroethane	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	3.59E-04	ND	6.53E-04				lb/MSF 3/8	Yes
1078	540590-OSB-Uog-DWMH	1,2-dichloroethene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	3.52E-04	ND	6.40E-04				lb/MSF 3/8	Yes
1084	74839-OSB-Uog-DWMH	bromomethane	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	3.45E-04	ND	6.27E-04				lb/MSF 3/8	Yes
1090	75003-OSB-Uog-DWMH	chloroethane	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	2.34E-04	ND	4.26E-04				lb/MSF 3/8	Yes
1096	75014-OSB-Uog-DWMH	chloroethene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	2.27E-04	ND	4.12E-04				lb/MSF 3/8	Yes
1102	98828-OSB-Uog-DWMH	cumene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	8.73E-03	ND	1.59E-02				lb/MSF 3/8	Yes
1111	106423-OSB-Uog-DWMH	m,p-xylene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	3.85E-04	ND	7.00E-04				lb/MSF 3/8	Yes
1117	75092-OSB-Uog-DWMH	methylene chloride	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	3.08E-04	ND	5.60E-04				lb/MSF 3/8	Yes
1129	95476-OSB-Uog-DWMH	o-xylene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	3.85E-04	ND	7.00E-04				lb/MSF 3/8	Yes
2031	13466789-OSB-Uog-DWMH-Spine	3-carene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	9.89E-03	ND	1.80E-02				lb/MSF 3/8	Yes
2037	80568-OSB-Uog-DWMH-Spine	alpha-pinene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	0		3.18E-02		4.62E-02	3.90E-02	3.90E-02		lb/MSF 3/8	No
2043	127913-OSB-Uog-DWMH-Spine	beta-pinene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	1	3	1		1.58E-02		1.58E-02	1.58E-02	1.58E-02		lb/MSF 3/8	No
2049	79925-OSB-Uog-DWMH-Spine	camphene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	9.89E-03	ND	1.80E-02				lb/MSF 3/8	Yes
2055	138863-OSB-Uog-DWMH-Spine	limonene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	9.89E-03	ND	1.80E-02				lb/MSF 3/8	Yes
2063	99876-OSB-Uog-DWMH-Spine	p-cymene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	9.75E-03	ND	1.77E-02				lb/MSF 3/8	Yes
2069	99832-OSB-Uog-DWMH-Spine	p-mentha-1,5-diene	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	9.89E-03	ND	1.80E-02				lb/MSF 3/8	Yes
2387	67561-OSB-Uog-DWMH	methanol	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	2		7.33E-04		1.54E-03	1.14E-03	1.14E-03		lb/MSF 3/8	No
2400	108952-OSB-Uog-DWMH	phenol	OSB	Uog	Misc Unit	Dry Wood Material Handling	1	2	6	6	ND	1.38E-03	ND	2.67E-03				lb/MSF 3/8	Yes
2508	50000-OSB-Uog-DWMH	formaldehyde	OSB	Uog	Misc Unit	Dry Wood Material Handling	3	8	27	5		6.84E-05		1.12E-03	3.01E-04	4.90E-04	3.98E-04	lb/MSF 3/8	No

10.6.3 Medium Density Fiberboard Manufacturing

10.6.3.1 General[1-2,7] -

The Composite Panel Association defines medium density fiberboard (MDF) as a dry-formed panel product manufactured from lignocellulosic fibers combined with a synthetic resin or other suitable binder. The panels are compressed to a density of from 496 to 801 kilograms per cubic meter (kg/m^3) (31 to 50 pounds per cubic foot [lb/ft^3]) in a hot press. The entire interfiber bond is formed by a synthetic resin or other suitable organic binder.

In contrast to particleboard, MDF has more uniform density throughout the board and has smooth, tight edges that can be machined. It can be finished to a smooth surface and grain printed, eliminating the need for veneers and laminates. Most of the thicker MDF panels (1.27 to 1.91 centimeters [cm]) (1/2 to 3/4 inch [in.]) are used as core material in furniture panels. Medium density fiberboard panels thinner than 1.27 cm (1/2 in.) typically are used for siding.

10.6.3.2 Process Description[2-7]

The general steps used to produce MDF include mechanical pulping of wood chips to fibers (refining), drying, blending fibers with resin and sometimes wax, forming the resinated material into a mat, and hot pressing. Figure 10.6.3-1 presents a process flow diagram for a typical MDF plant.

The furnish for MDF normally consists of wood chips. Wood chips typically are delivered by truck or rail from offsite locations such as sawmills, plywood plants, furniture manufacturing facilities, satellite chip mills, and whole tree chipping operations. If wood chips are prepared onsite, logs are debarked, cut to more manageable lengths, and then sent to chippers. If necessary, the chips are washed to remove dirt and other debris.

Clean chips are softened in a steam-pressurized digester, then transported into a pressurized refiner chamber. In the refiner chamber, single or double revolving disks are used to mechanically pulp the softened chips into fibers suitable for making the board.

From the refiners, the fibers move to the drying and blending area. A rotary predryer may be used for initial drying of relatively wet furnish. Regardless of whether or not a predryer is used, tube dryers typically are used to reduce the moisture content of the fibers to desired levels. Single-stage or multiple-stage tube drying systems are commonly used in MDF manufacture. Most of the multiple-stage tube drying systems incorporate two stages. In multiple-stage tube dryers, there is a primary tube dryer and a second stage tube dryer in series separated by an emission point such as a cyclonic collector. Heat is usually provided to tube dryers by the direct firing of propane, natural gas, or distillate oil or by indirect heating.

The sequence of the drying and blending operations depends on the method by which resins and other additives are blended with the fibers. Urea-formaldehyde (UF) resins are the most common resins used in the manufacture of MDF. Phenolic resins, melamine resins, and isocyanates are also used. Some plants inject resins into a short-retention blender, while most facilities inject resin formulations into a blowline system. If resin is added in a separate blender, the fibers are first dried and separated from the gas stream by a fiber recovery cyclone, then conveyed to the blender. The fibers then are blended with resin, wax, and any other additives and conveyed to a dry fiber storage bin.

If a blowline system is used, the fibers are first blended with resin, wax, and other additives in a blowline, which is a duct that discharges the resinated fibers to the dryer. After drying, the fibers are separated from the gas stream by a fiber recovery cyclone and then conveyed to a dry fiber storage bin.

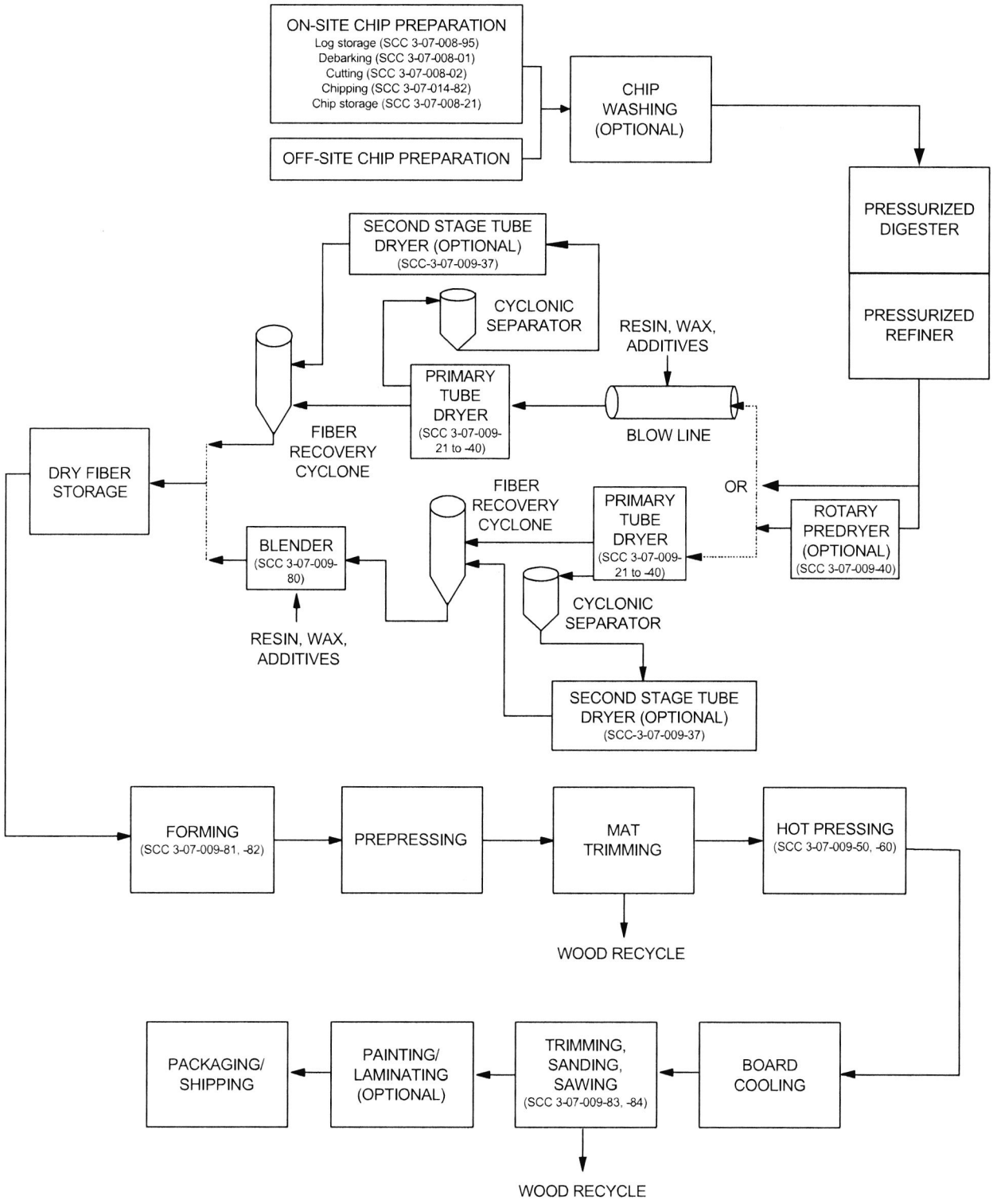

Figure 10.6.3-3. Typical process flow diagram for a medium density fiberboard (MDF) plant.

Air conveys the resinated fibers from the dry storage bin to the forming machine, where they are deposited on a continuously moving screen system. The continuously formed mat must be prepressed before being loaded into the hot press. After prepressing, some pretrimming is done. The trimmed material is collected and recycled to the forming machine.

The prepressed and trimmed mats then are transferred to the hot press. The press applies heat and pressure to activate the resin and bond the fibers into a solid panel. The mat may be pressed in a continuous hot press, or the precompressed mat may be cut by a flying cutoff saw into individual mats that are then loaded into a multi-opening, batch-type hot press. Steam or hot oil heating of the press platens is common in domestic MDF plants. After pressing, the boards are cooled, sanded, trimmed, and sawed to final dimensions. The boards may also be painted or laminated. Finally, the finished product is packaged for shipment.

10.6.3.3 Emissions And Controls[2-18] -

The primary emission sources at MDF mills are fiber dryers and press vents. Other emission sources may include boilers, chip production operations, and finishing operations such as sanding, trimming, and laminate application. Wood storage piles are sources of fugitive PM and VOC emissions.

Most MDF mills have chips delivered from offsite locations. However, in mills where chips are generated onsite, operations such as log debarking, sawing, chipping, and grinding, in addition to panel trimming, sanding, and sawing generate particulate matter (PM) and PM less than 10 micrometers (PM-10) emissions in the form of sawdust and wood particles. In addition, these processes may be sources of PM less than 2.5 micrometers in aerodynamic diameter (PM-2.5) emissions.

The exhaust from dryers first is ducted to a fiber recovery cyclone before being emitted. Emissions can include wood dust and other solid PM, volatile organic compounds (VOCs), and condensible PM. If direct-fired units are used, products of combustion such as carbon monoxide (CO), carbon dioxide (CO_2), and nitrogen oxides (NO_x), are also emitted. The condensible PM and a portion of the VOCs leave the dryer stack as vapor but condense at normal atmospheric temperatures to form liquid particles or mist that creates a visible blue haze. Both the VOCs and condensible PM are primarily compounds evaporated from the wood, with a minor constituent being combustion products. Quantities emitted are dependent on wood species, dryer temperature, fuel used, and other factors including. season of the year, time between logging and processing, and chip storage time.

Emissions from board hot presses are dependent on the type and amount of resin used to bind the wood fibers together, as well as wood species, wood moisture content, wax and catalyst application rates, and press conditions. When the press opens, vapors that may include resin ingredients, such as formaldehyde and other VOCs, are released. The rate at which formaldehyde is emitted during pressing and board cooling operations is a function of the amount of excess formaldehyde in the resin, board thickness, press temperature, press cycle time, and catalyst application rates.

Emissions from finishing operations for MDF are dependent on the type of products being finished. For most MDF products, finishing involves trimming to size, sanding, and in some cases application of laminates. Other products may require sanding or the application of laminate surfaces with spray adhesives. Trimming and sanding operations are sources of PM and PM-10 emissions. In addition, these processes may be sources of PM-2.5 emissions. Limited data are available for MDF sanding and sawing operations. Emission factors for plywood sanding and sawing operations may provide an order of magnitude estimate for similar MDF sanding and sawing operations. Emissions from adhesives used in the application of laminate surfaces are likely to include VOCs.

In MDF mills where wood chips are generated onsite, PM, PM-10, and PM-2.5 emissions from log debarking, sawing, and grinding operations can be controlled through capture in an exhaust system connected to a sized cyclone and/or fabric filter collection system. Emissions of PM, PM-10, and PM-2.5 from sanding and final trimming operations can be controlled using similar methods. These wood dust capture and collection systems are used not only to control atmospheric emissions, but also to recover the dust as a by-product fuel for a boiler or dryer.

Methods of controlling PM emissions from MDF sources include absorption systems (wet scrubbers), fabric filters, wet electrostatic precipitators (WESPs), and oxidation systems (discussed below). The WESP uses electrostatic forces to attract pollutants to either a charged metal plate or a charged metal tube. The collecting surfaces are continually rinsed with water to wash away the pollutants. Wet PM control systems may achieve short-term reductions in emissions of some water-soluble organic compounds (such as formaldehyde). However, the ability of these wet systems to absorb water-soluble compounds diminishes as the recirculating scrubbing liquid becomes saturated with these compounds.

A VOC control technology commonly used in the wood products industry for controlling both dryer and press exhaust gases is regenerative thermal oxidation. Thermal oxidizers destroy VOCs and condensible organics by burning them at high temperatures. Thermal oxidizers also reduce CO emissions in direct-fired dryer exhausts by oxidizing the CO in the exhaust to CO_2 (a product of complete combustion). Regenerative thermal oxidizers (RTOs) are designed to preheat the inlet emission stream with heat recovered from the incineration exhaust gases. Up to 98 percent heat recovery is possible, although 95 percent is typically specified. Gases entering an RTO are heated by passing through pre-heated beds packed with a ceramic media. A gas burner brings the preheated emissions up to an incineration temperature between 788° and 871°C (1450° and 1600°F) in a combustion chamber with sufficient gas residence time to complete the combustion. Combustion gases then pass through a cooled ceramic bed where heat is extracted. By reversing the flow through the beds, the heat transferred from the combustion exhaust air preheats the gases to be treated, thereby reducing auxiliary fuel requirements.

Regenerative catalytic oxidizers (RCOs) are also used to control VOCs from wood products dryers and presses. Regenerative catalytic oxidizers function similar to RTOs, except that the heat recovery beds in RCOs contain catalytic media. The catalyst accelerates the rate of VOC oxidation and allows for VOC destruction at lower temperatures than in an RTO, typically 316° to 538°C (600° to 1000°F), which reduces auxiliary fuel usage.

Thermal catalytic oxidizers (TCOs), which are a combination of an RTO and RCO, are also used in the wood products industry. The TCO operates at a temperature of around 480°C (900°F) and contains catalytic media. However, the heat recovery canisters and fans on the TCO are sized large enough so that the TCO can be operated like an RTO (with non-catalytic ceramic media) if catalyst replacement costs become overly expensive.

In addition to add-on thermal or catalytic oxidizers, exhaust gases from dryers and presses may be routed to the combustion chamber of an onsite boiler or process heater. The VOC and CO emissions in the process exhaust may be incinerated in the combustion chamber provided that the system is designed to allow for sufficient mixing and residence time.

Fugitive PM emissions from road dust and uncovered bark and dust storage piles may be controlled in a number of different ways. Some of these methods include enclosure, wet suppression systems, and chemical stabilization.

Calculating PM-10 emissions from wood products industry emission sources is problematic due to the relationship between PM-10 (or PM) emissions and VOC emissions from these processes. Because the Method 201A train (PM-10) operates with an in-stack cyclone and filter, organic materials that are volatile at stack gas temperatures but that are condensed at back half impinger temperatures (~20°C [~68°F]) are collected as condensible PM-10. However, these materials will also be measured as VOC via Methods 25 and 25A, which operate with a heated or an in-stack filter. Hence, if PM-10 is calculated as the sum of filterable and condensible material, some pollutants will be measured as both PM-10 and VOC emissions. However, if only filterable material is considered to be PM-10, the PM-10 emission factors will be highly dependent on stack gas temperature. In this AP-42 section, PM-10 is reported as front half catch only (Method 201A results only; not including Method 202 results). However, condensible PM results are also reported, and these results can be combined with the PM-10 results as appropriate for a specific application. Measured VOC emissions may be affected by the sampling method and by the quantity of formaldehyde and other aldehydes and ketones in the exhaust; formaldehyde is not quantified using Method 25A. Other low molecular weight oxygenated compounds have reduced responses to Method 25A. Therefore, when VOC emissions are measured using Method 25A, the emission rates will be biased low if low molecular weight oxygenated compounds are present in significant concentrations in the exhaust stream. A more extensive discussion of these sampling and analysis issues is provided in the Background Report for this section.

Guidance from EPA's Emission Factor and Inventory Group (EFIG) indicates that when it is possible, VOC emission factors should be reported in terms of the actual weight of the emitted compound. However, when an actual molecular weight (MW) of the emitted stream is not feasible (as is the case with the mixed streams emitted from wood products industry sources), the VOC should be reported using an assumed MW of 44, and reported "as propane." Each VOC-as-propane emission factor is estimated by first converting the THC from a carbon basis to a propane basis. Propane (MW = 44) includes 3 carbon atoms (total MW of 36) and 8 hydrogen atoms (total MW of 8). Every 36 pounds of carbon measured corresponds to 44 pounds of propane. The ratio of the MW of propane to the MW of carbon in propane is 44/36, or 1.22. The conversion is expressed by the following equation:

$$\text{THC as pounds carbon} \times \frac{\text{44 pounds propane}}{\text{36 pounds carbon}} = \text{THC as pounds propane}$$

or

$$\text{THC as pounds carbon} \times 1.22 = \text{THC as pounds propane}$$

After the THC emission factor has been converted from a carbon to a propane basis, the formaldehyde emission factor is added (where available), then the available emission factors for non-VOC compounds, including acetone, methane, and methylene chloride, are subtracted. This procedure is expressed simply by the following equation:

$$\text{VOC as propane} = (1.22 \times \text{THC as carbon}) + \text{formaldehyde} - (\text{acetone} + \text{methane} + \text{methylene chloride})$$

In cases where no emission factor is available (or the emission factor is reported only as below the test method detection limit, or "BDL") for one or more of the compounds used to estimate the VOC-as-propane value, adjustments to the converted THC value are made only for those compounds for which emission factors are available. That is, a value of zero is inserted in the above equation for the specified compounds where no emission factor is available, or where the emission factor is reported only as BDL. For example, if no methane emission factor is available, the THC-as-carbon emission factor is converted to THC-as-propane, formaldehyde is added, and only acetone and methylene chloride are subtracted.

Table 10.6.3-1 presents emission factors for dryer emissions of PM, including filterable PM, filterable PM-10, and condensible PM. Table 10.6.3-2 presents emission factors for dryer emissions of NO_x, CO, and CO_2. Table 10.6.3-3 presents emission factors for dryer emissions of organic pollutants. The emission factors for dryer emissions are presented in units of pounds of pollutant per oven-dried ton of wood material out of the dryer (lb/ODT). Table 10.6.3-4 presents emission factors for press and board cooler emissions of PM, including filterable PM, filterable PM-10, and condensible PM. Table 10.6.3-5 presents emission factors for press emissions of NO_x and CO. Table 10.6.3-6 presents emission factors for press and board cooler emissions of organic pollutants. The units for the press and board cooler emission factors are pounds of pollutant per thousand square feet of 3/4-inch thick panel produced (lb/MSF 3/4). Table 10.6.3-7 presents emission factors for miscellaneous source emissions of organic pollutants.

To the extent possible, separate emission factors for MDF dryers are presented in Tables 10.6.3-1 to -3 for hardwoods and softwoods. Hardwoods generally correspond to deciduous species. For MDF, plywood, and other composite wood products, commonly used hardwoods include aspen, oak, poplar, maple, cherry, alder, hickory, gum, beech, birch, larch, and basswood. The emission factors for hardwood MDF dryers presented in this section are based largely on the drying of gum, alder, and hickory furnish. Softwoods generally correspond to coniferous species. For MDF, plywood, and other composite wood products, commonly used softwoods include pines, firs, and spruce. Pines and firs are the most commonly used softwood species for MDF manufacturing.

Emission factors for specific mixes of wood species may be calculated by combining emission factors for individual wood species in the ratio specific to a given application, as emission data for those species become available. For example, an uncontrolled THC as carbon emission factor for an indirect-heated tube dryer, blowline blending UF resin and processing 60 percent softwood and 40 percent hardwood may be calculated using the THC as carbon emission factors for softwood (4.4 lb/ODT) and hardwood (3.7 lb/ODT), and the ratio of 60 percent to 40 percent. The resultant emission factor, rounded to two significant figures, would be 4.1 lb/ODT.

Table 10.6.3-1. EMISSION FACTORS FOR MDF DRYERS--PARTICULATE MATTER[a]

Source[c]	Emission Control Device[d]	Filterable[b]				Condensible[e]	EMISSION FACTOR RATING
		PM	EMISSION FACTOR RATING	PM-10	EMISSION FACTOR RATING		
Tube dryer, indirect-heated, blowline blend, UF resin, softwood (SCC 3-07-009-32)	Uncontrolled	ND		0.60[f]	D	0.53[g]	D
	BH	ND		0.011[h]	D	0.14[h]	D
	BH/WESP	ND		0.013[f]	D	0.13[f]	D
Tube dryer, direct wood-fired, blowline blend, UF resin, softwood (SCC 3-07-009-23)	Uncontrolled	10.4[j]	D	1.6[j]	D	0.59[j]	D

[a] Emission factor units are pounds of pollutant per oven-dried ton of wood material out of dryer (lb/ODT). One lb/ODT = 0.5 kg/Mg (oven-dried). Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. ND = no data available. See Table 10.6.3-8 for the hardwood and softwood species commonly used in the production of MDF and other composite wood products. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's Technology Transfer Network (TTN) website at: http://www.epa.gov/ttn/chief/.**

[b] Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train. Filterable PM-10 is that PM collected on the filter, or in the sample line between the cyclone and filter of an EPA Method 201 or 201A sampling train.

[c] UF = urea formaldehyde.

[d] Emission control device: BH = baghouse (fabric filter); WESP = wet electrostatic precipitator.

[e] Condensible PM is that PM collected in the impinger portion of a PM sampling train (EPA Method 202).

[f] Reference 8.

[g] References 8 and 9.

[h] Reference 9.

[j] Reference 10.

Table 10.6.3-2. EMISSION FACTORS FOR MDF DRYERS--NO_x, CO, AND CO_2 [a]

Source [b]	Emission Control Device	NO_x	EMISSION FACTOR RATING	CO	EMISSION FACTOR RATING	CO_2	EMISSION FACTOR RATING
Tube dryer, indirect-heated, non-blowline blend, softwood (SCC 3-07-009-33)	Uncontrolled	ND		0.11 [c]	D	ND	
Tube dryer, indirect-heated, blowline blend, UF resin, softwood (SCC 3-07-009-32)	Uncontrolled Thermal oxidizer	ND 0.38 [d]	E	0.068 [c] 1.6 [d]	D E	ND ND	
Tube dryer, direct natural gas-fired, non-blowline blend, hardwood (SCC 3-07-009-27)	Uncontrolled	ND		0.20 [c]	D	ND	
Tube dryer, direct wood-fired, blowline blend, UF resin, softwood (SCC 3-07-009-23)	Uncontrolled	ND		4.0 [e]	D	ND	
Rotary predryer, direct natural gas-fired, softwood (SCC 3-07-009-40)	Uncontrolled	ND		0.24 [c]	D	ND	

[a] Emission factor units are pounds of pollutant per oven-dried ton of wood material out of dryer (lb/ODT). One lb/ODT = 0.5 kg/Mg (oven-dried). Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. ND = no data available. See Table 10.6.3-8 for the hardwood and softwood species commonly used in the production of MDF and other composite wood products. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's Technology Transfer Network (TTN) website at: http://www.epa.gov/ttn/chief/.**

[b] UF = urea formaldehyde

[c] Reference 11.

[d] Reference 12.

[e] Reference 10.

Table 10.6.3-3. EMISSION FACTORS FOR MDF DRYERS--ORGANICS[a]

Source[b]	Emission Control Device	CASRN[c]	Pollutant	Emission factor	EMISSION FACTOR RATING
Tube dryer, indirect-heated, non-blowline blend, softwood (SCC 3-07-009-33)	Uncontrolled		THC as carbon[d]	1.7	D
			VOC as propane[e]	2.1	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
			Acetaldehyde *	BDL	
		67-64-1	Acetone	0.055	D
			Acrolein *	BDL	
			Alpha-pinene	BDL	
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.085	D
			Limonene	BDL	
		67-56-1	Methanol *	0.74	D
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
			Phenol *	BDL	
			Propionaldehyde *	BDL	
			Styrene *	BDL	
			Toluene *	BDL	

Table 10.6.3-3 (cont.).

Source[b]	Emission Control Device	CASRN[c]	Pollutant	Emission factor	EMISSION FACTOR RATING
Tube dryer, indirect-heated, blowline blend, UF resin, softwood (SCC 3-07-009-32)	Uncontrolled		THC as carbon[d]	4.4	D
			VOC as propane[e]	5.6	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
		75-07-0	Acetaldehyde *	0.020[f]	D
		67-64-1	Acetone	0.025	D
			Acrolein *	BDL	
		80-56-8	Alpha-pinene	2.1	D
			Benzene *	BDL	
		127-91-3	Beta-pinene	0.43	D
			Bromomethane *	BDL	
		79-92-5	Camphene	0.12	D
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.22[g]	C
			Limonene	0.11	D
		67-56-1	Methanol *	0.87	D
			Methyl ethyl ketone *	BDL	
		108-10-1	Methyl isobutyl ketone *	0.0049	D
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
		108-95-2	Phenol *	0.023	D
			Propionaldehyde *	BDL	
			Styrene *	BDL	
			Toluene *	BDL	
Tube dryer, indirect-heated, blowline blend, UF resin, softwood (SCC 3-07-009-32)	Thermal oxidizer	75-07-0	Acetaldehyde *	0.0051[h]	E
		50-00-0	Formaldehyde *	0.15[h]	E
Tube dryer, indirect-heated, blowline blend, UF resin, hardwood (SCC 3-07-009-36)	Uncontrolled		THC as carbon[d]	3.7[j]	D
			VOC as propane[e]	4.8	E
		75-07-0	Acetaldehyde *	0.013[j]	D
		50-00-0	Formaldehyde *	0.26[j]	D

Table 10.6.3-3 (cont.).

Source[b]	Emission Control Device	CASRN[c]	Pollutant	Emission factor	EMISSION FACTOR RATING
Tube dryer, direct natural gas-fired, non-blowline blend, hardwood (SCC 3-07-009-27)	Uncontrolled		THC as carbon[d]	1.0	D
			VOC as propane[e]	1.2	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
			Acetaldehyde *	BDL	
		67-64-1	Acetone	0.016	D
			Acrolein *	BDL	
			Alpha-pinene	BDL	
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.0085	D
			Limonene	BDL	
		67-56-1	Methanol *	0.96	D
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
			Phenol *	BDL	
			Propionaldehyde *	BDL	
			Styrene *	BDL	
			Toluene *	BDL	
Tube dryer, direct wood-fired, blowline blend, UF resin, softwood (SCC 3-07-009-23)	Uncontrolled		THC as carbon[d]	4.8[j]	D
			VOC as propane[e]	6.7	E
		50-00-0	Formaldehyde *	0.86[j]	D

Table 10.6.3-3 (cont.).

Source[b]	Emission Control Device	CASRN[c]	Pollutant	Emission factor	EMISSION FACTOR RATING
Tube dryer, second stage, blowline blend, indirect-heated, softwood (SCC 3-07-009-37)	Uncontrolled		THC as carbon[d]	0.13	D
			VOC as propane[e]	0.18	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
		75-07-0	Acetaldehyde *	0.0035	D
		67-64-1	Acetone	0.0034	D
			Acrolein *	BDL	
		80-56-8	Alpha-pinene	0.055	D
		71-43-2	Benzene *	0.00073	D
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.021	D
			Limonene	BDL	
		67-56-1	Methanol *	0.015	D
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
			Phenol *	BDL	
			Propionaldehyde *	BDL	
			Styrene *	BDL	
		108-88-3	Toluene *	0.00083	D

Table 10.6.3-3 (cont.).

Source[b]	Emission Control Device	CASRN[c]	Pollutant	Emission factor	EMISSION FACTOR RATING
Rotary predryer, direct natural gas-fired, softwood (SCC 3-07-009-40)	Uncontrolled		THC as carbon[d]	0.79	D
			VOC as propane[e]	0.95	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
			Acetaldehyde *	BDL	
		67-64-1	Acetone	0.019	D
			Acrolein *	BDL	
		80-56-8	Alpha-pinene	0.28	D
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.0076	D
			Limonene	BDL	
		67-56-1	Methanol *	0.025	D
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
			Phenol *	BDL	
			Propionaldehyde *	BDL	
			Styrene *	BDL	
			Toluene *	BDL	

[a] Emission factor units are pounds of pollutant per oven-dried ton of wood material out of dryer (lb/ODT). One lb/ODT = 0.5 kg/Mg (oven-dried). Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. * = hazardous air pollutant. BDL = below test method detection limit; indicates that this pollutant has not been detected in any test runs on this source. Reference 11 unless otherwise noted. See Table 10.6.3-8 for the hardwood and softwood species commonly used in the production of MDF and other composite wood products. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's Technology Transfer Network (TTN) website at: http://www.epa.gov/ttn/chief/.**

[b] UF = urea formaldehyde.

[c] CASRN = Chemical Abstracts Service Registry Number.

[d] THC as carbon = total hydrocarbon measurements using EPA Method 25A.

[e] VOC as propane = (1.22 × THC) + formaldehyde - (acetone + methane + methylene chloride); a value of zero is inserted in the equation for the specified compounds where no emission factor is available, or where the emission factor is reported only as "BDL".

Table 10.6.3-3 (cont.).

[f] References 11 and 12.
[g] References 11, 12, and 13.
[h] Reference 12.
[j] Reference 10.

Table 10.6.3-4. EMISSION FACTORS FOR MDF HOT PRESSES AND BOARD COOLERS--PARTICULATE MATTER[a]

Source[c]	Emission Control Device[d]	Filterable[b]				Condensible[e]	EMISSION FACTOR RATING
		PM	EMISSION FACTOR RATING	PM-10	EMISSION FACTOR RATING		
Hot press, UF resin (SCC 3-07-009-60)	Uncontrolled	0.18[f]	D	0.15[g]	D	0.20[f]	D
	RTO	0.040[h]	E	ND		0.016[h]	E
Board cooler, UF resin (SCC 3-07-009-71)	Uncontrolled	0.054[g]	D	0.0038[g]	E	ND	

[a] Emission factor units are pounds of pollutant per thousand square feet of 3/4-inch thick panel (lb/MSF 3/4). One lb/MSF 3/4 = 0.26 kg/m^3. Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. ND = no data available. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's Technology Transfer Network (TTN) website at: http://www.epa.gov/ttn/chief/.**

[b] Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train. Filterable PM-10 is that PM collected on the filter, or in the sample line between the cyclone and filter of an EPA Method 201 or 201A sampling train.

[c] UF = urea formaldehyde.

[d] Emission control device: RTO = regenerative thermal oxidizer.

[e] Condensible PM is that PM collected in the impinger portion of a PM sampling train (EPA Method 202).

[f] References 10 and 14.

[g] Reference 10.

[h] Reference 14.

Table 10.6.3-5. EMISSION FACTORS FOR MDF HOT PRESSES--NO_x, CO, AND CO_2 [a]

Source[b]	Emission Control Device[c]	NO_x	EMISSION FACTOR RATING	CO	EMISSION FACTOR RATING	CO_2	EMISSION FACTOR RATING
Hot press, UF resin (SCC 3-07-009-60)	Uncontrolled	0.030[d]	E	0.034[d]	E	ND	
	RTO	0.51[e]	E	0.085[e]	E	ND	

[a] Emission factor units are pounds of pollutant per thousand square feet of 3/4-inch thick panel (lb/MSF 3/4). One lb/MSF 3/4 = 0.26 kg/m^3. Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. ND = no data available. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's Technology Transfer Network (TTN) website at: http://www.epa.gov/ttn/chief/.**

[b] UF = urea formaldehyde.

[c] Emission control device: RTO = regenerative thermal oxidizer.

[d] Reference 10.

[e] Reference 14.

Table 10.6.3-6. EMISSION FACTORS FOR MDF HOT PRESSES AND BOARD COOLERS--ORGANICS[a]

Source[b]	Emission Control Device[c]	CASRN[d]	Pollutant	Emission Factor	EMISSION FACTOR RATING
Hot press, UF resin (SCC 3-07-009-60)	Uncontrolled		THC as carbon[e]	0.29[g]	D
			VOC as propane[f]	0.80	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
		5779-94-2	2,5-Dimethyl benzaldehyde	0.0025[h]	E
			3-Carene	BDL	
		75-07-0	Acetaldehyde *	0.014[j]	D
		67-64-1	Acetone	0.029[k]	D
		107-02-8	Acrolein *	0.0012[h]	E
			Alpha-pinene	BDL	
		100-52-7	Benzaldehyde	0.00055[h]	E
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
		123-72-8	Butylaldehyde	0.0024[h]	E
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
		4170-30-3	Crotonaldehyde	0.0011[h]	E
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.48[m]	C
		66-25-1	Hexaldehyde	0.0029[h]	E
		590-86-3	Isovaleraldehyde	0.0014[h]	E
			Limonene	BDL	
		67-56-1	Methanol *	0.56[n]	D
		78-93-3	Methyl ethyl ketone *	0.00059[h]	E
		108-10-1	Methyl isobutyl ketone *	0.016[k]	D
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
		529-20-4	o-Tolualdehyde	0.00070[h]	E
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
		104-87-0	p-Tolualdehyde	0.0010[h]	E
		108-95-2	Phenol *	0.027[k]	D
		123-38-6	Propionaldehyde *	0.00054[h]	E
			Styrene *	BDL	
			Toluene *	BDL	
		110-62-3	Valeraldehyde	0.0024[h]	E
Hot press, UF resin (SCC 3-07-009-60)	RTO		THC as carbon[e]	0.019[p]	E
			VOC as propane[f]	0.032	E
		50-00-0	Formaldehyde *	0.0091[p]	E

Table 10.6.3-6 (cont.).

Source[b]	Emission Control Device[c]	CASRN[d]	Pollutant	Emission Factor	EMISSION FACTOR RATING
Board cooler, UF resin (SCC 3-07-009-71)	Uncontrolled		THC as carbon[e]	0.077[j]	D
			VOC as propane[f]	0.13	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
		5779-94-2	2,5-Dimethyl benzaldehyde	0.00019[h]	E
			3-Carene	BDL	
		75-07-0	Acetaldehyde *	0.0010[h]	E
		67-64-1	Acetone	0.0092[k]	E
		107-02-8	Acrolein *	0.00022[h]	E
			Alpha-pinene	BDL	
		100-52-7	Benzaldehyde	0.000099[h]	E
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
		123-72-8	Butylaldehyde	0.0014[h]	E
			Camphene	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Crotonaldehyde	0.00026[h]	
		4170-30-3	Cumene *	BDL	E
			Formaldehyde *	0.042[q]	
		50-00-0	Hexaldehyde	0.00065[h]	D
		66-25-1	Isovaleraldehyde	0.00025[h]	E
		590-86-3	Limonene	BDL	E
			Methanol *	0.025[k]	
		67-56-1	Methyl ethyl ketone *	0.00011[h]	E
		78-93-3	Methyl isobutyl ketone *	BDL	E
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Tolualdehyde	0.000065[h]	
		529-20-4	o-Xylene *	BDL	E
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
			p-Tolualdehyde	0.00017[h]	
		104-87-0	Phenol *	BDL	E
			Propionaldehyde *	BDL	
			Stryene *	BDL	
			Toluene *	BDL	
			Valeraldehyde	0.00048[h]	
		110-62-3			E

[a] Emission factor units are pounds of pollutant per thousand square feet of 3/4-inch thick panel (lb/MSF 3/4). One lb/MSF 3/4 = 0.26 kg/m^3. Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. * = hazardous air pollutant. BDL = below test method detection limit; indicates that this pollutant has not been detected in any test runs on this source. Reference 10 unless otherwise noted. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are**

Table 10.6.3-6 (cont.).

available on EPA's Technology Transfer Network (TTN) website at: http://www.epa.gov/ttn/chief/.

[b] UF = urea formaldehyde.

[c] Emission control device: RTO = regenerative thermal oxidizer.

[d] CASRN = Chemical Abstracts Service Registry Number.

[e] THC as carbon = total hydrocarbon measurements using EPA Method 25A.

[f] VOC as propane = (1.22 × THC) + formaldehyde - (acetone + methane + methylene chloride); a value of zero is inserted in the equation for the specified compounds where no emission factor is available, or where the emission factor is reported only as "BDL".

[g] References 10, 11, 14, 15, 16, and 17.

[h] Based on M0011 data only; suspected to be biased low due to poor collection efficiency or analytical problems.

[j] References 10 and 11.

[k] Reference 11.

[m] References 10, 11, 14, 15, 16, 17, and 18.

[n] References 11 and 17.

[p] Reference 14.

[q] References 10, 11, and 18.

Table 10.6.3-7. EMISSION FACTORS FOR MDF MISCELLANEOUS SOURCES[a]

Source[b]	Emission Control Device[c]	CASRN[d]	Pollutant	Emission Factor	Emission Factor Units	EMISSION FACTOR RATING
Log storage (SCC 3-07-008-95)	Uncontrolled		PM, THC, VOC	ND		
Log debarking (SCC 3-07-008-01)	Uncontrolled		PM, THC, VOC	ND		
Log chipper, hardwood[e] (SCC 3-07-014-82)	Uncontrolled		PM	ND		
			THC as carbon[f]	0.0041	lb/ODT	E
			VOC as propane[g]	0.0050	lb/ODT	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene	BDL		
			3-Carene	BDL		
			Acetaldehyde *	BDL		
			Acetone	BDL		
			Acrolein *	BDL		
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
			Formaldehyde *	BDL		
			Limonene	BDL		
		67-56-1	Methanol *	0.0010	lb/ODT	E
			Methyl ethyl ketone *	BDL		
			Methyl isobutyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
			Phenol *	BDL		
			Propionaldehyde *	BDL		
			Styrene *	BDL		
			Toluene *	BDL		
Chip storage (SCC 3-07-008-21)	Uncontrolled		PM, THC, VOC	ND		

Table 10.6.3-7 (cont.).

Source[b]	Emission Control Device[c]	CASRN[d]	Pollutant	Emission Factor	Emission Factor Units	EMISSION FACTOR RATING
Blender, UF resin (SCC 3-07-009-80)	Uncontrolled		1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene	BDL		
			3-Carene	BDL		
			Acetaldehyde *	BDL		
			Acetone	BDL		
			Acrolein *	BDL		
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.010	lb/ODT	E
			Limonene	BDL		
		67-56-1	Methanol *	0.48	lb/ODT	E
			Methyl ethyl ketone *	BDL		
			Methyl isobutyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
			Phenol *	BDL		
			Propionaldehyde *	BDL		
			Styrene *	BDL		
			Toluene *	BDL		

Table 10.6.3-7 (cont.).

Source[b]	Emission Control Device[c]	CASRN[d]	Pollutant	Emission Factor	Emission Factor Units	EMISSION FACTOR RATING
Former without blowline blending, UF resin (includes blender emissions) (SCC 3-07-009-81)	Uncontrolled		1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene	BDL		
			3-Carene	BDL		
			Acetaldehyde *	BDL		
		67-64-1	Acetone	0.053	lb/ODT	E
			Acrolein *	BDL		
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.060	lb/ODT	E
			Limonene	BDL		
		67-56-1	Methanol *	0.41	lb/ODT	E
			Methyl ethyl ketone *	BDL		
			Methyl isobutyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
			Phenol *	BDL		
			Propionaldehyde *	BDL		
			Styrene *	BDL		
			Toluene *	BDL		

Table 10.6.3-7 (cont.).

Source[b]	Emission Control Device[c]	CASRN[d]	Pollutant	Emission Factor	Emission Factor Units	EMISSION FACTOR RATING
Former with blowline blend, UF resin (SCC 3-07-009-82)	Uncontrolled		THC as carbon[f]	0.056	lb/ODT	E
			VOC as propane[g]	0.067	lb/ODT	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene	BDL		
			3-Carene	BDL		
			Acetaldehyde *	BDL		
		67-64-1	Acetone	0.0064	lb/ODT	D
			Acrolein *	BDL		
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.0051	lb/ODT	D
			Limonene	BDL		
		67-56-1	Methanol *	0.017	lb/ODT	D
			Methyl ethyl ketone *	BDL		
			Methyl isobutyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
			Phenol *	BDL		
			Propionaldehyde *	BDL		
			Styrene *	BDL		
			Toluene *	BDL		

Table 10.6.3-7 (cont.).

Source[b]	Emission Control Device[c]	CASRN[d]	Pollutant	Emission Factor	Emission Factor Units	EMISSION FACTOR RATING
Sander[h] (SCC 3-07-009-83)	Uncontrolled		THC as carbon[f]	0.0074	lb/MSF	E
			VOC as propane[g]	0.0066	lb/MSF	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene*	BDL		
			3-Carene	BDL		
			Acetaldehyde *	BDL		
		67-64-1	Acetone	0.0051	lb/MSF	D
			Acrolein *	BDL		
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.0027	lb/MSF	D
			Limonene	BDL		
		67-56-1	Methanol *	0.0043	lb/MSF	D
			Methyl ethyl ketone *	BDL		
			Methyl isobutyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
		108-95-2	Phenol *	0.0069	lb/MSF	D
			Propionaldehyde *	BDL		
		100-42-5	Styrene *	0.0014	lb/MSF	D
			Toluene *	BDL		

Table 10.6.3-7 (cont.).

Source[b]	Emission Control Device[c]	CASRN[d]	Pollutant	Emission Factor	Emission Factor Units	EMISSION FACTOR RATING
Saw and hogger[j] (SCC 3-07-009-84)	Uncontrolled		THC as carbon[f]	0.11	lb/MSF[k]	E
			VOC as propane[g]	0.13	lb/MSF[k]	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene	BDL		
			3-Carene	BDL		
			Acetaldehyde *	BDL		
			Acetone	BDL		
			Acrolein *	BDL		
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
			Formaldehyde *	BDL		
			Limonene	BDL		
		67-56-1	Methanol *	0.38	lb/MSF[k]	E
			Methyl ethyl ketone *	BDL		
			Methyl isobutyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
			Propionaldehyde *	BDL		
			Styrene *	BDL		
			Toluene *	BDL		

[a] Emission factor units: Pounds of pollutant per oven-dried ton of wood material (lb/ODT). One lb/ODT = 0.5 kg/Mg (oven-dried). Pounds of pollutant per thousand square feet of panel (lb/MSF). One lb/MSF = 0.0049 kg/m^2. Factors represent uncontrolled emissions unless otherwise noted. ND = No data available. SCC = Source Classification Code. * = hazardous air pollutant. BDL = below test method detection limit; indicates that this pollutant has not been detected in any test runs on this source. Reference 11. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's TTN website at: http://www.epa.gov/ttn/chief/.**

[b] UF = urea formaldehyde.

[c] Emission control devices (baghouses) are considered no control for organic pollutants.

[d] CASRN = Chemical Abstracts Service Registry Number.

[e] Reference 20; based on data for hardboard log chipping operation (See Section 10.6.4).

[f] THC as carbon = total hydrocarbon measurements using EPA Method 25A.

Table 10.6.3-7 (cont.).

[g] VOC as propane = (1.22 × THC) + formaldehyde - (acetone + methane + methylene chloride); a value of zero is inserted in the equation for the specified compounds where no emission factor is available, or where the emission factor is reported only as "BDL".

[h] Emission factors for MDF sanders in units of pounds per thousand square feet of panel produced (surface area of one side, even though both sides sanded).

[j] Board trim saw and hogger for processing wood residue for recycle. Hoggers reduce the size of wood residue by slicing or chopping.

[k] References 11 and 19; emission factors for MDF saw in units of pounds per thousand square feet of reclaimed (trimmed) material; approximate MSF reclaimed (trimmed) = MSF from press × 3%.

Table 10.6.3-8. WOOD SPECIES COMMONLY USED IN COMPOSITE WOOD PRODUCTS MANUFACTURING [a]

Wood product	AP-42 section	Hardwood species	Softwood species
Plywood	10.5	Oak, cherry, poplar, maple, larch	Firs, pines
Oriented strandboard	10.6-1	Aspen	Pines, firs, spruce
Particleboard	10.6-2	Aspen, oak	Pines, firs
Medium density fiberboard	10.6-3	Gum, alder, hickory	Pines, firs
Hardboard/fiberboard	10.6-4	Aspen, birch, beech, oak, maple	Pines
Engineered wood products	10.9	Aspen, birch, poplar	Pines, firs, hemlock

[a] Reference 7.

References For Section 10.6.3

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13. *Report For 1995 VOC Emission Compliance Tests At The Wood Fiber Dryers And Press Vents, SierraPine, Ltd., Rocklin, California, Test Dates April 10-13, 1995 And May 17-19, 1995*, prepared for SierraPine, Ltd., by Carnot, May 1995.

14. *Report Of Air Emissions And Inlet Loading Tests For Louisiana-Pacific Corporation Urania MDF Plant*, Urania, Louisiana, January 18 through 21, 1994, prepared by Environmental Monitoring Laboratories, Ridgeland, Mississippi, February 1994.

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10.6.4 Hardboard and Fiberboard Manufacturing

10.6.4.1 General[1] -

Fiberboard is a low-density insulation board used for housing, roofing, and office furnishings. Hardboard is similar to fiberboard, except that hardboard is more dense than fiberboard. Hardboard is used for applications in housing (e.g., exterior siding, garage doors, and interior door facings), furniture, store fixtures, automotive interiors, and toys. The most frequently used raw material for production of fiberboard products is wood chips which are first softened in a pressurized steam vessel (digester) and then refined or pulped into wood fibers. The fibers may then be mixed with resin, formed into mats, and pressed and/or dried to form panel products. Other materials may be added during manufacture to improve certain properties such as stiffness, hardness, finishing properties, resistance to abrasion and moisture, as well as to increase strength, durability and utility.

Hardboard/fiberboard manufacturing falls under the Standard Industrial Classification (SIC) Code 2493, for "Reconstituted Wood Products", which also includes oriented strandboard, medium density fiberboard, and particleboard. The North American Industrial Classification System (NAICS) Code for hardboard/fiberboard is 321219, for "Reconstituted Wood Product Manufacturing".

10.6.4.2 Process Description[1] -

Hardboard products are manufactured through dry processing, wet processing, or wet/dry processing. Fiberboard products are manufactured by wet processing. Dry processing involves dry mat forming and pressing, while wet processing involves wet forming and wet pressing. Wet/dry processing involves wet forming followed by dry pressing. Resin is used in wet hardboard and dry hardboard processing. Resin is not used in wet/dry hardboard or wet fiberboard processing.

The following sections summarize dry process hardboard manufacturing, fiberboard and wet process hardboard manufacturing, and the wet/dry hardboard manufacturing process.

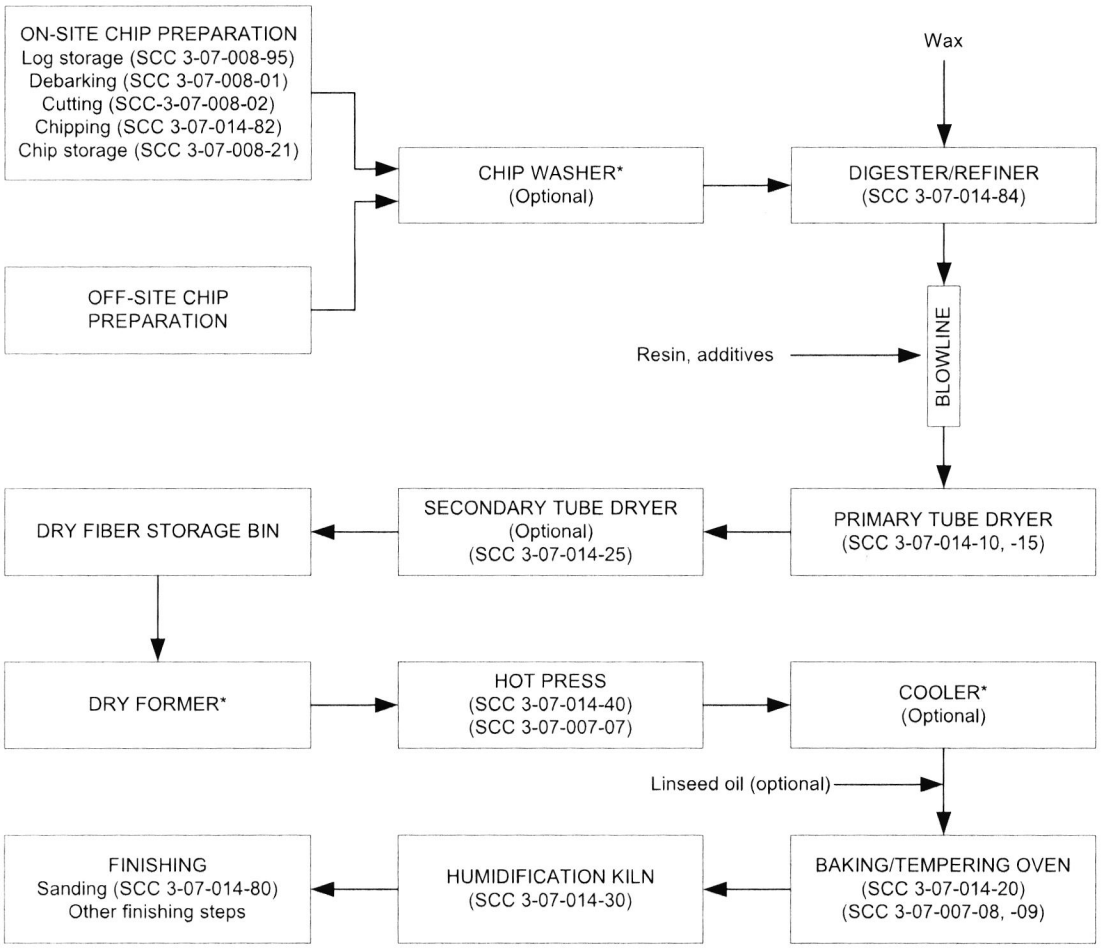
Dry Process Hardboard -

The general steps used to manufacture dry process hardboard include mechanical pulping of wood chips to fibers (digesting and refining), blending of fibers with resin and wax, drying, forming the resinated material into a mat, hot pressing, heat treatment of the pressed boards, and humidification. Figure 10.6.4-1 presents a flow diagram for dry process hardboard manufacturing.

The primary raw material used in hardboard is hardwood or softwood chips. In addition to wood chips, shavings or sawdust may be used as a raw material. If wood chips are prepared onsite, logs are debarked, cut to manageable lengths, and then sent to chippers. If necessary, the chips are washed to remove dirt and other debris.

Clean chips are either processed in pressurized refiners or are softened by steam in a digester and sent to atmospheric refiners. Pressurized refiners consist of a steaming vessel (digester) and of single or double revolving disks to mechanically pulp (refine) the chips into fibers suitable for making the board. The wood chips are discharged under pressure from the digester section of the pressurized refiner into the refiner section. The steam pressure is maintained throughout the entire refining process. Atmospheric refiners also use revolving disks to pulp the chips into fibers, but steam pressure is not maintained in atmospheric refiners.

Wax may be added to the wood chips in the digester. Phenol-formaldehyde (PF) resin and other additives (if used) are added to the wood fiber during or immediately following refining. Most dry process hardboard plants inject PF resin into a blowline that discharges the resinated fibers to a tube



** This process is a potential emission source; however, no emissions data specific to this process are available.*

Figure 10.6.4-1. Dry hardboard manufacturing processes.

dryer. The turbulent conditions in the tube dryer facilitate mixing between the wood fibers and resin droplets. After drying, the resinated fibers are conveyed to a dry fiber storage bin where they await forming.

Single-stage or multiple-stage tube drying systems are most commonly used in dry process hardboard manufacture. Most of the multiple-staged tube drying systems incorporate two stages. In multiple-stage tube dryers, there is a primary tube dryer and a secondary tube dryer in series separated by an emission point such as a cyclonic collector. Single-stage and double-stage tube dryers are shown in Figures 10.6.4-2a and 10.6.4-2b. Hardboard primary tube dryers dry wood fibers from about 51 percent moisture (dry basis) to around 20 percent moisture (dry basis) with dryer inlet temperatures ranging up to 246°C (475°F). Secondary tube dryers further dry the wood furnish to around 6 percent moisture (dry basis). Heat is provided to the hardboard tube dryers by either direct-firing with wood residuals, gas, or oil or by indirect-heating. Although less common than tube dryers, rotary dryers may also be used to dry wood material for hardboard manufacture.

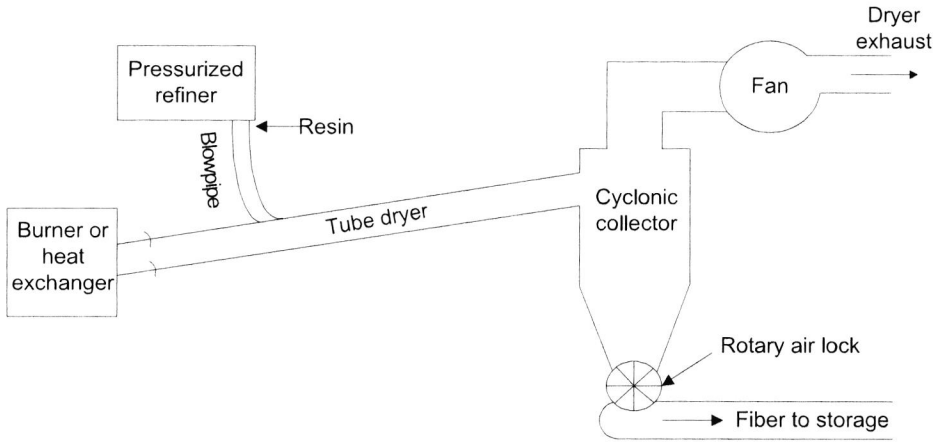


Figure 10.6.4-2a. Single-stage tube dryer.

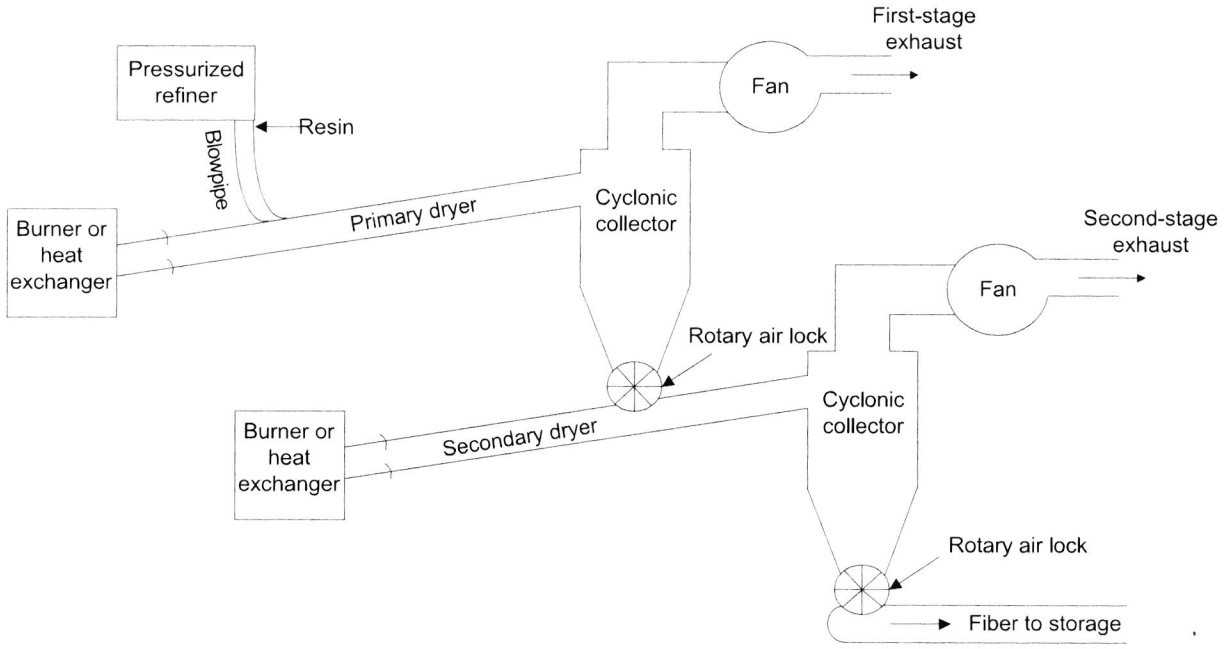


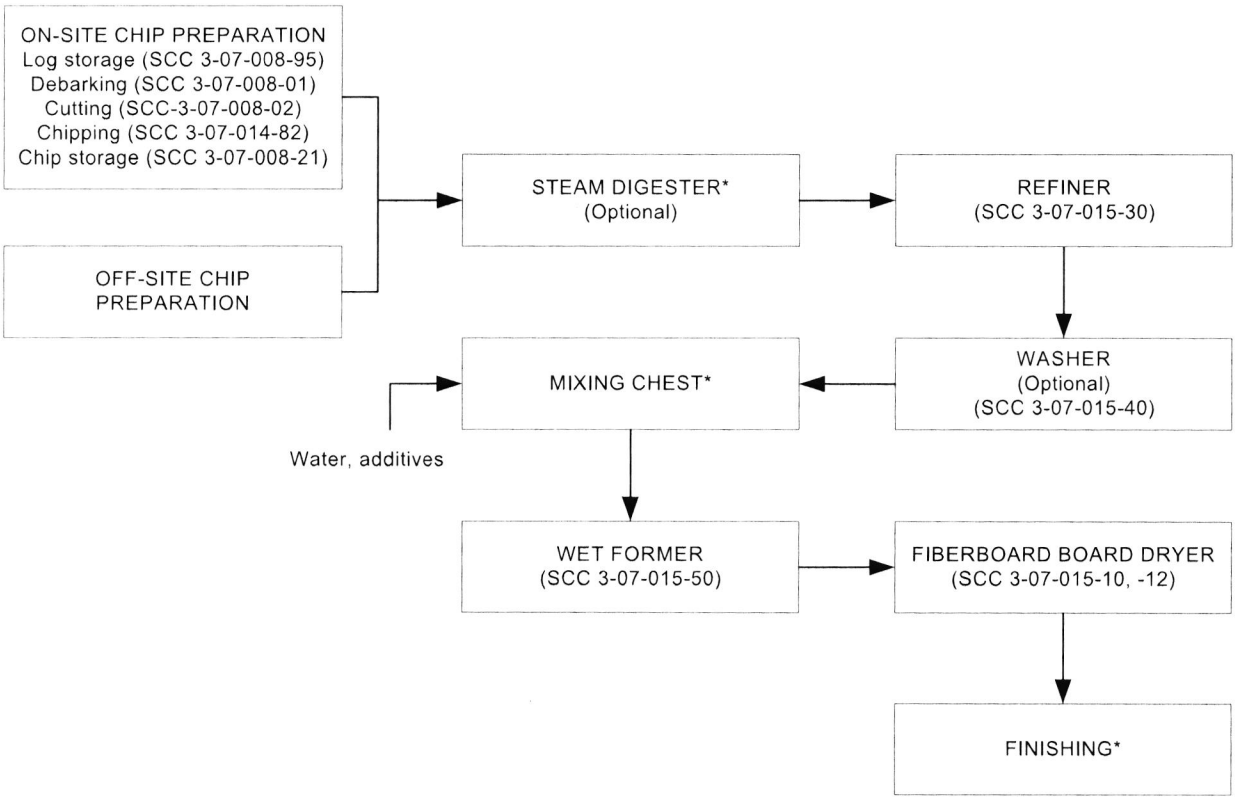
Figure 10.6.4-2b. Double-stage tube dryer.

Resinated fibers exiting the drying system enter a forming machine where they are deposited on a continuously moving conveyor. The mat is prepressed and trimmed before being loaded into the hot press. The press applies heat and pressure to activate the PF resin and bond the fibers into a solid board. Dry process hardboard plants use a multi-opening batch press. The typical press cycle is about 4 minutes. The hardboard presses are heated by steam to a temperature of around 210°C (410°F). Following pressing, boards are routed through a board cooler at some plants. However, most plants do not operate board coolers.

Hardboard plants typically heat treat the pressed hardboard in a bake or tempering oven. The purpose of heat treatment is to lower the moisture content of pressed hardboard to bone dry levels to improve dimensional stability and enhance board mechanical properties. Linseed oil is sometimes applied to the hardboard prior to heat treatment. Hardboard ovens are either indirect-heated or direct-fired and operate at temperatures up to 170°C (340°F). Humidification of boards is done immediately following heat treatment to bring the board moisture content back into equilibrium with ambient air conditions. Humidification kilns are often integrated with hardboard ovens (i.e., the boards coming out of the hardboard oven go straight into the humidification kiln). Following humidification, the hardboard is finished and packaged for shipment. Dry process hardboard densities range from 625 to 1,100 kilograms per cubic meter (kg/m^3) (39 to 69 pounds per cubic foot [lb/ft^3]).

Wet Process Fiberboard -

The general steps in production of fiberboard manufacture include pulping of hardwood or softwood wood chips, wet forming, drying, and finishing. Fiberboard may be manufactured with bagasse or other agricultural fiber instead of wood fiber. The bagasse fiberboard manufacturing process is generally the same as the wood fiberboard manufacturing process. Figure 10.6.4-3 presents a flow diagram for wet process fiberboard manufacturing. The discussion below focuses on the wood fiberboard manufacturing process.



** This process is a potential emission source; however, no emissions data specific to this process are available.*

Figure 10.6.4-3. Process flow diagram for wet process fiberboard manufacturing.

Wood chips for fiberboard may either be steamed in digesters or soaked in hot process water before being ground into fiber in atmospheric refiners. From the refiners, fibers are sometimes washed to remove wood sugars that might reduce the quality of the finished product. The refined and/or washed fibers are sent to stock chests to await further processing. The fibers from the stock chests are mixed with water and additives such as alum, starch, asphalt, and wax. Resins are not used in fiberboard production. The wood fibers are bonded together by additives and substances naturally contained in the wood. Alum aids in the precipitation of wax, asphalt, and rosin onto wood fibers. Bonds between these substances and the wood fibers assist in holding the fiber mat together.

Once mixed with additives, the fiber slurry is sent to the forming machine. In the wet forming process, the water-fiber mixture is metered onto a wire screen. Water is drained away by gravity and with the aid of suction applied to the underside of the wire. The fiber mat along with the supporting wire is moved to a room-temperature pre-press where excess water is squeezed out. Once pre-pressed, the fiber mat may be cut to length and trimmed on the edges with high-pressure water jets.

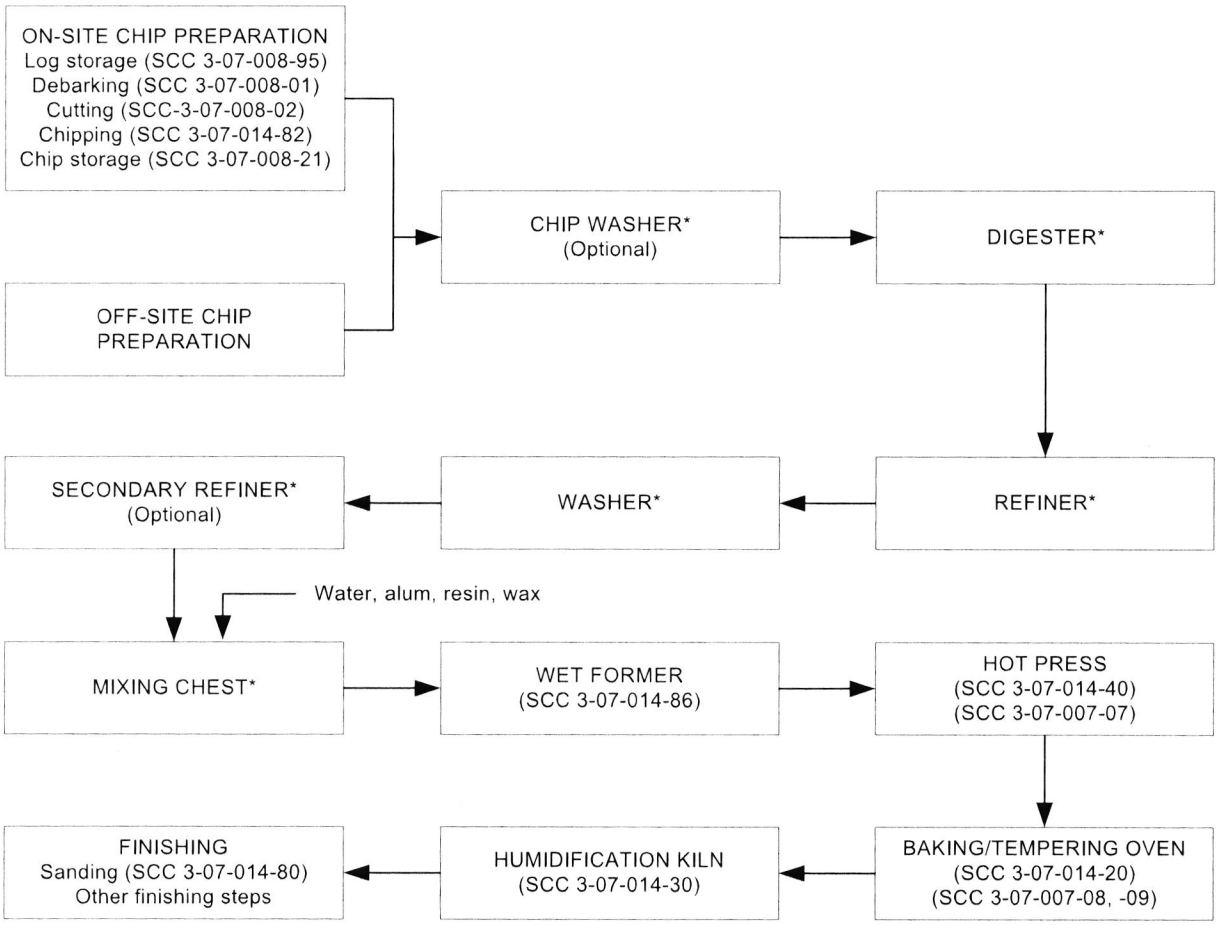
The fiber mats, which are around 60 percent moisture (dry basis), are passed through a conveyor-type board dryer where their moisture content is reduced to about 4 percent. Fiberboard board dryers operate with inlet temperatures of around 230°C (450°F) and outlet temperatures of around 160°C (320°F). Finished fiberboard density ranges from 190 to 380 kg/m^3 (12 to 24 lb/ft^3). Once dried, the fiberboard is finished, trimmed, and may be painted or roll-coated with asphalt. Finally, the fiberboard is packaged for shipment.

Wet Process Hardboard -

Production of wet process hardboard includes pulping of wood chips, wet forming, pressing, heat treatment, humidification, and finishing. Phenol-formaldehyde resin, wax, and alum are used in wet process hardboard manufacturing. Figure 10.6.4-4 presents a flow diagram for wet process hardboard manufacturing.

Hardwood or softwood chips may either be purchased from outside or generated onsite from logs. The chips are washed to remove dirt and debris. The chips are then steam cooked under pressure in digesters to soften the chips and liberate the wood sugars. After cooking, the softened chips are refined in a single or double disc atmospheric refiner (referred to as the primary refiner), which grinds the chips into fiber form. The fibers from the primary refiner are subsequently fed into stock washers, which use water and pressure to wash out the wood sugars. After washing, the wood material is further refined in a secondary refiner. Some plants may omit secondary refining.

Once refined, the wood fiber is mixed with water, alum, PF resin, and wax in stock or mix chests. The alum is added to the fiber slurry to control pH and help precipitate the resin and wax onto the fibers. The dilute slurry of fiber, additives, and water is routed to a wet forming machine. At some plants, the forming machine may have separate header boxes where separate slurries may be used to make layers in the hardboard mat. The top layer of the fiber mat is called an "overlay" and the bottom layer is called a "substrate". The wood fiber used to make the overlay undergoes additional refining prior to chemical addition and dilution so that the top layer of the hardboard will have a smoother finish. The fiber slurry from the substrate head box and the overlay head box are fed onto a moving wire screen (forming machine) where they immediately begin to form a continuous fiber mat. Water drains through the wire screen first by gravity and then by suction. The fiber mat is compressed with press rolls and further dewatered. The edges of the fiber mat may be trimmed with water jets prior to hot pressing.



** This process is a potential emission source; however, no emissions data specific to this process are available.*

Figure 10.6.4-4. Process flow diagram for wet process hardboard manufacturing.

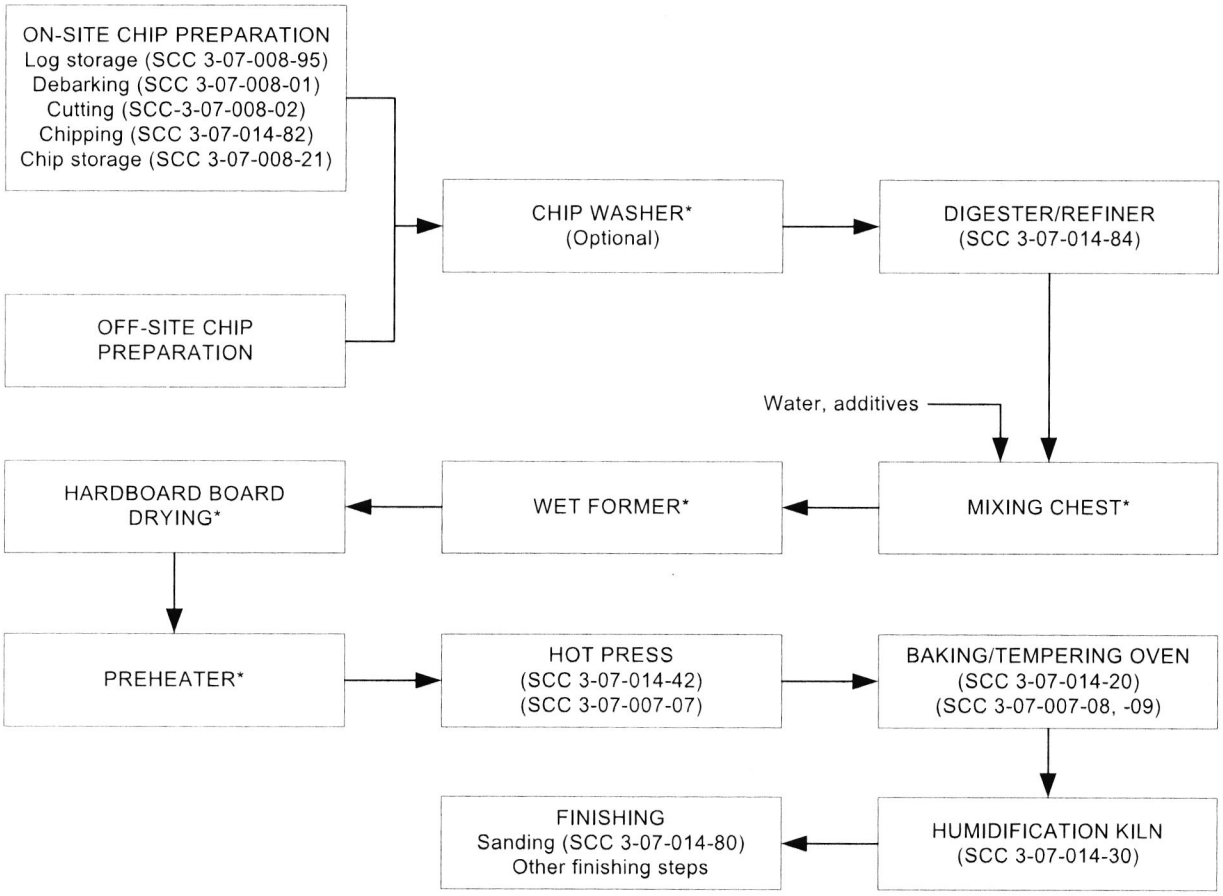
The carrying wire takes the fiber mats to a preloader to await pressing. The fiber mats are loaded into the press. Water released from the mats during pressing cascades down the sides of the press and is recycled. The fiber mats enter the press at a moisture content of about 120 percent (dry basis). Wet process hardboard presses are typically multi-opening, steam-heated, batch presses. The hardboard mats are pressed for roughly 8 minutes at around 200°C (390°F).

As with dry process hardboard, the wet process hardboard mats may be transported to baking or tempering ovens where the mats are dried to "bone-dry" levels following pressing. Further drying of the mats increases bonding and makes the hardboard more resistant to water. Once dried, the boards may be cooled and are then rehumidified to prevent buckling and to improve the overall dimensional stability of the boards. Final wet process hardboard densities range from 800 to 1,120 kg/m^3 (50 to 70 lb/ft^3).

Wet/Dry Process Hardboard -

Production of wet/dry process hardboard includes pulping of softwood or hardwood chips, wet forming, drying, pressing, heat treatment, humidification, and finishing. Wet/dry process hardboard production is similar to fiberboard production until the pressing step of the process is reached. The pressing, heat treatment, and humidification steps in wet/dry hardboard production are similar to the

same steps in wet hardboard production. Raw materials used in the production of wet/dry hardboard include wood chips and additives such as linseed oil, asphalt, and wax. No resin is used in the production of wet/dry hardboard. Figure 10.6.4-5 presents a flow diagram for wet/dry process hardboard manufacturing.



** This process is a potential emission source; however, no emissions data specific to this process are available.*

Figure 10.6.4-5. Process flow diagram for wet/dry process hardboard manufacturing.

Wood chips may either be purchased from offsite or generated onsite from logs. The chips are washed to remove dirt and debris. The chips are then steam cooked under pressure in digesters. After cooking, the chips are refined in primary and/or secondary refiners. Some plants may omit secondary refining. Some plants may use pressurized refiners in lieu of stand-alone digesters and atmospheric refiners.

Once refined the wood fiber is mixed with water and wax in stock or mix chests. The dilute slurry of fiber, additives, and water is routed to a wet forming machine. As with the manufacture of wet process hardboard, some plants may use separate substrate (bottom layer) and overlay (top layer) forming header boxes to make a layered hardboard mat. The fiber slurry from the substrate head box and the overlay head box are fed onto a moving wire screen (forming machine) where they immediately begin to form a continuous fiber mat. Water drains through the wire screen first by gravity and then by suction.

The fiber mat is compressed with press rolls which assist in further dewatering the mat. The edges of the fiber mat may be trimmed with water jets prior to drying.

The fiber mats, which are around 60 percent moisture (dry basis), are passed through a conveyor-type board dryer where their moisture content is reduced to around 4 percent. The board dryers operate with inlet temperatures of around 230°C (450°F) and outlet temperatures of around 160°C (320°F). From the dryer, the fiber mats pass through a press predryer or preheat oven. The purpose of the predryer is to reduce the mat moisture content in order to minimize the hot press cycle. Steam-heated batch presses are used in wet/dry hardboard manufacturing. Press temperatures average around 140°C (470°F) for press cycle times of nearly 4 minutes. As for dry and wet process hardboard, the wet/dry process hardboard mats are heat treated in hardboard ovens and humidification kilns following pressing. Wet/dry process hardboard densities range from 720 to 1,150 kg/m^3 (45 to 72 lb/ft^3).

10.6.4.3 Emissions and Controls -

The primary emission sources at hardboard/fiberboard mills are tube dryers, rotary dryers, hardboard ovens, board conveyor dryers, press preheat ovens, and hot presses. Other emission sources may include boilers, chip and fiber production operations, mat formers, board coolers, humidification kilns, and finishing operations such as sanding and trimming. Other potential emissions sources ancillary to the manufacturing process may include wood chip storage piles and bins (including wood fuel), chip handling systems, and resin storage and handling systems.

Emissions from tube dryers or rotary dryers that are exhausted from the product recovery cyclone include wood dust and other solid PM, volatile organic compounds (VOCs), condensible PM, and products of combustion such as carbon monoxide (CO), carbon dioxide (CO_2), and nitrogen oxides (NO_x), if direct-fired units are used. The condensible PM and a portion of the VOCs leave the dryer stack as vapor but condense at normal atmospheric temperatures to form liquid particles or mist that creates a visible blue haze. Both the VOCs and condensible PM are primarily compounds evaporated from the wood or from the resin if resinated fibers are dried, with a minor constituent being combustion products. Quantities emitted are dependent on wood species, dryer temperature, fuel used, and other factors including season of the year, time between logging and processing, and chip storage time.

Unlike tube dryers and rotary dryers, hardboard ovens, board conveyor dryers, and press preheaters process fiber mats or pressed boards and do not rely on pneumatic conveyance of fibers through the dryers. Thus, there is less potential for emissions of PM from hardboard ovens, conveyor dryers, and press preheaters. However, these dryers are sources of VOCs, CO, CO_2, NO_x, and other organic compounds. The emissions from hardboard ovens, conveyor dryers, and press preheaters depend on whether the dryer is indirect-heated or direct-fired, the fuel used if the dryer if direct-fired, wood species, and type of resin, binder, or drying oil employed.

Emissions from board hot presses are dependent on the type and amount of resin (if any) used to bind the wood fibers together, as well as wood species, wood moisture content, additives used, and press conditions. When the press opens, vapors that may include resin ingredients (if resins are used) such as formaldehyde, phenol, and other organic compounds are released. The rate at which organic compounds are emitted during pressing operations is a function of the resin formulation, board thickness, press temperature, and press cycle time.

A VOC control technology commonly used in the wood products industry for controlling both dryer and press exhaust gases is regenerative thermal oxidation. Thermal oxidizers destroy VOCs and condensible organics by burning them at high temperatures. Thermal oxidizers also reduce CO emissions in direct-fired dryer exhausts by oxidizing the CO in the exhaust to CO_2 (a product of complete

combustion). Regenerative thermal oxidizers (RTOs) are designed to preheat the inlet emission stream with heat recovered from the incineration exhaust gases. Up to 98 percent heat recovery is possible, although 95 percent is typically specified. Gases entering an RTO are heated by passing through pre-heated beds packed with a ceramic media. A gas burner brings the preheated emissions up to an incineration temperature between 788° and 871°C (1450° and 1600°F) in a combustion chamber with sufficient gas residence time to complete the combustion. Combustion gases then pass through a cooled ceramic bed where heat is extracted. By reversing the flow through the beds, the heat transferred from the combustion exhaust air preheats the gases to be treated, thereby reducing auxiliary fuel requirements.

Regenerative catalytic oxidizers (RCOs) are also used to control VOCs from hardboard dryers and presses. Regenerative catalytic oxidizers function similar to RTOs, except that the heat recovery beds in RCOs contain catalytic media. The catalyst accelerates the rate of VOC oxidation and allows for VOC destruction at lower temperatures than in an RTO, typically 316° to 538°C (600° to 1,000°F), which reduces auxiliary fuel usage.

Biofiltration systems are also used effectively for control of a variety of pollutants including organic compounds, NO_x, CO, and PM from press exhaust streams. Biofiltration uses microrganisms immobilized in a biofilm layer on a porous packing such as bark, wood chips, or synthetic media. Typical biofilter design consists of a three- to six-foot deep bed of media suspended over an air distribution plenum. Exhaust gases entering the plenum are evenly distributed through the moist biofilter media. As the contaminated vapor stream passes through the biofilter media, pollutants are transferred from the vapor to the biofilm and, through microbiological degradation, are converted to CO_2, water, and salts. The microorganisms cannot easily attack pollutants in the gas phase; therefore, less water soluble compounds (such as pinenes) are generally more difficult to control using a biofilter than are the more water-soluble compounds (such as formaldehyde).

In addition to the control devices mentioned above, absorption systems such as scrubbers are often used to control PM from hardboard/fiberboard dryers and presses.

Operations such as log chipping, in addition to chip piles and bins, and chip handling systems generate particulate matter (PM) and PM less than 10 micrometers in aerodynamic diameter (PM-10) emissions in the form of sawdust and wood particles. In hardboard/fiberboard mills where log chipping is performed onsite, PM and PM-10 emissions from log debarking, sawing, and grinding operations can be controlled through capture in an exhaust system connected to a fabric filter collection system. Emissions of PM and PM-10 from final sanding and sawing operations can be controlled using similar methods. These wood dust capture and collection systems are used not only to control atmospheric emissions, but also to recover the dust as a by-product fuel for a boiler or direct-fired dryer burners.

Fiber production operations such as digesters, pressurized refiners, atmospheric refiners, and fiber washers may be sources of organic emissions. Emissions from these sources are typically uncontrolled, except for pressurized refiners that vent directly into tube dryers at dry process hardboard plants. When exhausted through a tube dryer, the pressurized refiner exhaust exits through the tube dryer control device.

Hardboard/fiberboard mat forming systems may also emit small amounts of organic emissions, and PM emissions in the case of dry forming systems. Emission factors for wet forming vacuum systems are provided in this section. No emission factors are available for dry hardboard formers; however, the magnitude of the emissions from dry formers may be comparable to the emissions from dry formers used to form other reconstituted wood products (e.g., medium density fiberboard).

Hardboard board coolers and humidification kilns may also be sources of organic emissions. Exhaust from board coolers is typically uncontrolled or is routed to the press control device. No emission factors are available specifically for hardboard board coolers, but emission factors are available for particleboard and MDF board coolers. Humidification kilns are usually uncontrolled. Emission factors for humidification kilns are provided in this section.

Emissions from hardboard/fiberboard finishing operations are dependent on the type of products being finished. For most hardboard/fiberboard products, finishing involves cutting to size and, in some cases, application of edge seals, anti-skid coatings, primers, company logos, or trademark or grade stamps. Some products may require sanding. Sawing and sanding operations are sources of PM and PM-10 emissions. No data specific to hardboard/fiberboard sawing are available. However, emission factors for MDF sawing operations may provide an order of magnitude estimate for similar hardboard/fiberboard sawing operations. Available emission factors for sanding of hardboard are presented in this section.

Fugitive PM emissions from road dust and uncovered bark and dust storage piles may be controlled in a number of different ways. Some of these methods include enclosure, wet suppression systems, and chemical stabilization.

Calculating PM-10 emissions from wood products industry emission sources is problematic due to the relationship between PM-10 (or PM) emissions and VOC emissions from these processes. Because the Method 201A train (PM-10) operates with an in-stack cyclone and filter, organic materials that are volatile at stack gas temperatures but that are condensed at back half impinger temperatures (~20°C [~68°F]) are collected as condensible PM-10. However, these materials will also be measured as VOC via Methods 25 and 25A, which operate with a heated or an in-stack filter. Hence, if PM-10 is calculated as the sum of filterable and condensible material, some pollutants will be measured as both PM-10 and VOC emissions. However, if only filterable material is considered to be PM-10, the PM-10 emission factors will be highly dependent on stack gas temperature. In this AP-42 section, PM-10 is reported as front half catch only (Method 201A results only; not including Method 202 results). However, condensible PM results are also reported, and these results can be combined with the PM-10 results as appropriate for a specific application. Measured VOC emissions may be affected by the sampling method and by the quantity of formaldehyde and other aldehydes and ketones in the exhaust; formaldehyde is not quantified using Method 25A. Other low molecular weight oxygenated compounds have reduced responses to Method 25A. Therefore, when VOC emissions are measured using Method 25A, the emission rates will be biased low if low molecular weight oxygenated compounds are present in significant concentrations in the exhaust stream. A more extensive discussion of these sampling and analysis issues is provided in the Background Report for this section.

Guidance from EPA's Emission Factor and Inventory Group (EFIG) indicates that when it is possible, VOC emission factors should be reported in terms of the actual weight of the emitted compound. However, when an actual molecular weight (MW) of the emitted stream is not feasible (as is the case with the mixed streams emitted from wood products industry sources), the VOC should be reported using an assumed MW of 44, and reported "as propane." Each VOC-as-propane emission factor is estimated by first converting the THC from a carbon basis to a propane basis. Propane (MW = 44) includes 3 carbon atoms (total MW of 36) and 8 hydrogen atoms (total MW of 8). Every 36 pounds of carbon measured corresponds to 44 pounds of propane. The ratio of the MW of propane to the MW of carbon in propane is 44/36, or 1.22. The conversion is expressed by the following equation:

$$\text{THC as pounds carbon} \times \frac{\text{44 pounds propane}}{\text{36 pounds carbon}} = \text{THC as pounds propane}$$

or

$$\text{THC as pounds carbon} \times 1.22 = \text{THC as pounds propane}$$

After the THC emission factor has been converted from a carbon to a propane basis, the formaldehyde emission factor is added (where available), then the available emission factors for non-VOC compounds, including acetone, methane, and methylene chloride, are subtracted. This procedure is expressed simply by the following equation:

$$\text{VOC as propane} = (1.22 \times \text{THC as carbon}) + \text{formaldehyde} - (\text{acetone} + \text{methane} + \text{methylene chloride})$$

In cases where no emission factor is available (or the emission factor is reported only as below the test method detection limit, or "BDL") for one or more of the compounds used to estimate the VOC-as-propane value, adjustments to the converted THC value are made only for those compounds for which emission factors are available. That is, a value of zero is inserted in the above equation for the specified compounds where no emission factor is available, or where the emission factor is reported only as BDL. For example, if no methane emission factor is available, the THC-as-carbon emission factor is converted to THC-as-propane, formaldehyde is added, and only acetone and methylene chloride are subtracted.

Table 10.6.4-1 presents emission factors for dryer emissions of PM, including filterable PM and condensible PM. Table 10.6.4-2 presents emission factors for dryer and oven emissions of NO_x, CO, and CO_2. Table 10.6.4-3 presents emission factors for dryer and oven emissions of VOC and speciated organic compounds. Table 10.6.4-4 presents emission factors for hardboard press emissions of PM, including filterable PM, filterable PM-10, and condensible PM. Table 10.6.4-5 presents emission factors for hardboard press emissions of NO_x, CO, and CO_2. Table 10.6.4-6 presents emission factors for hardboard press emissions of VOC and speciated organic compounds. Table 10.6.4-7 presents emission factors for miscellaneous sources of PM, including filterable PM, filterable PM-10, and condensible PM. Table 10.6.4-8 presents emission factors for miscellaneous source emissions of NO_x, CO, and CO_2. Table 10.6.4-9 presents emission factors for miscellaneous source emissions of VOC and speciated organic compounds.

To the extent possible, separate emission factors for hardboard and fiberboard dryers are presented in Tables 10.6.4-1 to -3 for hardwoods and softwoods. Hardwoods generally correspond to deciduous species. For hardboard, fiberboard, plywood, and other composite wood products, commonly used hardwoods include aspen, oak, poplar, maple, cherry, alder, hickory, gum, beech, birch, and basswood. The emission factors for hardwood hardboard and fiberboard dryers presented in this section are based largely on the drying of aspen, birch, beech, oak, and maple furnish. Softwoods generally correspond to coniferous species. For hardboard, fiberboard, plywood, and other composite wood products, commonly used softwoods include pines, firs, and spruce. Pines are the most commonly used softwood species for hardboard and fiberboard manufacturing.

Table 10.6.4-1. EMISSION FACTORS FOR HARDBOARD AND FIBERBOARD DRYERS AND OVENS—PARTICULATE MATTER[a]

Source	Emission Control Device	Filterable[b]				Condensible[c]	EMISSION FACTOR RATING
		PM	EMISSION FACTOR RATING	PM-10	EMISSION FACTOR RATING		
Tube dryer, direct natural gas-fired, blowline blend, PF resin, hardwood (SCC 3-07-014-15)	None	1.9	E	ND		0.57	E

[a] Emission factor units: pounds of pollutant per oven-dried ton of wood material (lb/ODT); one lb/ODT = 0.5 kg/Mg (oven-dried). Factors represent uncontrolled emissions. SCC = Source Classification Code. ND = no data available. Reference 2. See Table 10.6.4-10 for the hardwood and softwood species commonly used in the production of hardboard, fiberboard, and other composite wood products. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's TTN website at: http://www.epa.gov/ttn/chief/.**

[b] Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train. Filterable PM-10 is that PM collected on the filter, or in the sample line between the cyclone and filter of an EPA Method 201 or 201A sampling train.

[c] Condensible PM is that PM collected in the impinger portion of a PM sampling train (EPA Method 202).

Table 10.6.4-2. EMISSION FACTORS FOR HARDBOARD AND FIBERBOARD DRYERS, OVENS—NO_x, CO, AND CO_2[a]

Source	Emission Control Device[b]	Emission Factor Units[c]	NO_x	EMISSION FACTOR RATING	CO	EMISSION FACTOR RATING	CO_2	EMISSION FACTOR RATING
Hardboard tube dryer, direct natural gas-fired, blowline blend, PF resin, hardwood (SCC 3-07-014-15)	Uncontrolled	lb/ODT	0.44[d]	E	0.067[d]	E	384[d]	E
Hardboard tube dryer, direct wood-fired, blowline blend, PF resin, hardwood (SCC 3-07-014-10)	Uncontrolled	lb/ODT	ND		0.085	E	ND	
Hardboard tube dryer, second stage, indirect-heated, hardwood (SCC 3-07-014-25)	Uncontrolled	lb/ODT	ND		0.076	E	ND	
Hardboard board dryer, direct natural-gas fired, linseed oil binder, heated zones, softwood (SCC 3-07-014-16)	Uncontrolled	lb/MSF 1/2	ND		0.49[e]	E	ND	
Hardboard tempering oven, direct natural gas-fired, hardwood (SCC 3-07-014-20)	Uncontrolled	lb/MSF 1/8	ND		0.11	E	ND	
	RTO	lb/MSF 1/8	ND		0.0021	E	ND	
Fiberboard board dryer, indirect heated, starch binder, heated zones, softwood (SCC 3-07-015-10)	Uncontrolled	lb/MSF 1/2	ND		0.092	E	ND	
Fiberboard board dryer, indirect heated, 6-12% asphalt binder, heated zones, softwood (SCC 3-07-015-12)	Uncontrolled	lb/MSF 1/2	ND		0.029[e]	E	ND	

[a] Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. ND = no data available. Reference 3 unless otherwise noted. See Table 10.6.4-10 for the hardwood and softwood species commonly used in the production of hardboard, fiberboard, and other composite wood products. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's TTN website at: http://www.epa.gov/ttn/chief/.**

[b] Emission control device: RTO = regenerative thermal oxidizer.

[c] Emission factor units: pounds of pollutant per oven-dried ton of wood material (lb/ODT); one lb/ODT = 0.5 kg/Mg (oven-dried); pounds of pollutant per thousand square feet of 1/2-inch thick panel

(lb/MSF 1/2); one lb/MSF 1/2 = 0.38 kg/m^3; pounds of pollutant per thousand square feet of 1/8-inch thick panel (lb/MSF 1/8); one lb/MSF 1/8 = 1.54 kg/m^3.

[d] Reference 2.

[e] Emission factors apply only to the heated zones of the dryer; the cooling sections also have emissions but data were not available for cooling section emissions.

Table 10.6.4-3. EMISSION FACTORS FOR HARDBOARD AND FIBERBOARD DRYERS, OVENS—ORGANICS[a]

Source	Emission Control Device	CASRN[b]	Pollutant	Emission Factor	Emission Factor Units[c]	EMISSION FACTOR RATING
Hardboard tube dryer, direct natural gas-fired, blowline blend, PF resin, hardwood (SCC 3-07-014-15)	None		THC as carbon[d]	3.2[f]	lb/ODT	E
			VOC as propane[e]	5.0	lb/ODT	E
		75-07-0	Acetaldehyde *	0.0096[f]	lb/ODT	E
		67-64-1	Acetone	0.0095[f]	lb/ODT	E
		107-02-8	Acrolein *	0.0041[f,g]	lb/ODT	E
		71-43-2	Benzene *	0.000088[f]	lb/ODT	E
			Benzo(a)pyrene	BDL		
			Bromomethane *	BDL		
		74-87-3	Chloromethane *	0.000019[f]	lb/ODT	E
			Ethanol	BDL		
		100-41-4	Ethylbenzene *	0.00013[f]	lb/ODT	E
		50-00-0	Formaldehyde *	1.1[f,g]	lb/ODT	E
		66-25-1	Hexaldehyde	0.052[f,g]	lb/ODT	E
			Isobutanol	BDL		
			m,p-Cresol *	BDL		
		67-56-1	Methanol *	1.4[f]	lb/ODT	E
		78-93-3	Methyl ethyl ketone *	0.00083[f]	lb/ODT	E
			Methyl propyl ketone	BDL		
			Methylene chloride *	BDL		
			Naphthalene *	BDL		
			o-Cresol *	BDL		
		108-95-2	Phenol *	0.056[f]	lb/ODT	E
			Propanol	BDL		
		123-38-6	Propionaldehyde *	0.041[f]	lb/ODT	E
			Pyridine	BDL		
		100-42-5	Styrene *	0.0027[f]	lb/ODT	E
		108-88-3	Toluene *	0.00023[f]	lb/ODT	E
		75-69-4	Trichlorofluoromethane	0.000020[f]	lb/ODT	E
		1330-20-7	Xylenes *	0.000056[f]	lb/ODT	E

Table 10.6.4-3 (cont.).

Source	Emission Control Device	CASRN[b]	Pollutant	Emission Factor	Emission Factor Units[c]	EMISSION FACTOR RATING
Hardboard tube dryer, direct wood-fired, blowline blend, PF resin, hardwood (SCC 3-07-014-10)	None		THC as carbon[d]	0.74	lb/ODT	D
			VOC as propane[e]	1.1	lb/ODT	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene *	BDL		
			3-Carene	BDL		
		75-07-0	Acetaldehyde *	0.11	lb/ODT	D
		67-64-1	Acetone	0.018	lb/ODT	D
			Acrolein *	BDL		
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.26	lb/ODT	D
			Limonene	BDL		
		67-56-1	Methanol *	1.0	lb/ODT	D
			Methyl ethyl ketone *	BDL		
			Methyl isobutyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
		108-95-2	Phenol *	0.083	lb/ODT	D
			Propionaldehyde *	BDL		
			Styrene *	BDL		
			Toluene *	BDL		

Table 10.6.4-3 (cont.).

Source	Emission Control Device	CASRN[b]	Pollutant	Emission Factor	Emission Factor Units[c]	EMISSION FACTOR RATING
Hardboard tube dryer, second stage, indirect-heated, hardwood (SCC 3-07-014-25)	None		THC as carbon[d]	0.23	lb/ODT	D
			VOC as propane[e]	0.27	lb/ODT	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene *	BDL		
			3-Carene	BDL		
			Acetaldehyde *	BDL		
		67-64-1	Acetone	0.031	lb/ODT	D
			Acrolein *	BDL		
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.017	lb/ODT	D
			Limonene	BDL		
		67-56-1	Methanol *	0.042	lb/ODT	D
			Methyl isobutyl ketone *	BDL		
			Methyl ethyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p,-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
		108-95-2	Phenol *	0.039	lb/ODT	D
			Propionaldehyde *	BDL		
			Styrene *	BDL		
			Toluene *	BDL		

Table 10.6.4-3 (cont.).

Source	Emission Control Device	CASRN[b]	Pollutant	Emission Factor	Emission Factor Units[c]	EMISSION FACTOR RATING
Hardboard board dryer, direct natural-gas fired, linseed oil binder (heated zones), softwood (SCC 3-07-014-16)	None		1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene *	BDL		
			3-Carene	BDL		
		75-07-0	Acetaldehyde *	0.053[h]	lb/MSF 1/2	E
		67-64-1	Acetone	0.021[h]	lb/MSF 1/2	E
		107-02-8	Acrolein *	0.037[h]	lb/MSF 1/2	E
			Alpha-pinene	BDL		
		71-43-2	Benzene *	0.0021[h]	lb/MSF 1/2	E
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.059[h]	lb/MSF 1/2	E
			Limonene	BDL		
		67-56-1	Methanol *	0.047[h]	lb/MSF 1/2	E
		78-93-3	Methyl ethyl ketone *	0.0013[h]	lb/MSF 1/2	E
		108-10-1	Methyl isobutyl ketone *	0.0034[h]	lb/MSF 1/2	E
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
		108-95-2	Phenol *	0.0019[h]	lb/MSF 1/2	E
		123-38-6	Propionaldehyde *	0.025[h]	lb/MSF 1/2	E
		100-42-5	Styrene *	0.00016[h]	lb/MSF 1/2	E
		108-88-3	Toluene *	0.0010[h]	lb/MSF 1/2	E

Table 10.6.4-3 (cont.).

Source	Emission Control Device	CASRN[b]	Pollutant	Emission Factor	Emission Factor Units[c]	EMISSION FACTOR RATING
Hardboard tempering oven, direct natural gas-fired (SCC 3-07-014-20)	None		THC as carbon[d]	0.50	lb/MSF 1/8	E
			VOC as propane[e]	0.61	lb/MSF 1/8	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene *	BDL		
			3-Carene	BDL		
		75-07-0	Acetaldehyde *	0.076	lb/MSF 1/8	E
		67-64-1	Acetone	0.0034	lb/MSF 1/8	E
		107-02-8	Acrolein *	0.024	lb/MSF 1/8	E
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.0043	lb/MSF 1/8	E
			Limonene	BDL		
		67-56-1	Methanol *	0.015	lb/MSF 1/8	E
		78-93-3	Methyl ethyl ketone *	0.00075	lb/MSF 1/8	E
		108-10-1	Methyl isobutyl ketone *	0.0046	lb/MSF 1/8	E
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
		108-95-2	Phenol *	0.0019	lb/MSF 1/8	E
		123-38-6	Propionaldehyde *	0.10	lb/MSF 1/8	E
			Styrene *	BDL		
			Toluene *	BDL		

Table 10.6.4-3 (cont.).

Source	Emission Control Device	CASRN[b]	Pollutant	Emission Factor	Emission Factor Units[c]	EMISSION FACTOR RATING
Hardboard tempering oven, direct natural gas-fired (SCC 3-07-014-20)	RTO		THC as carbon[d]	BDL		
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene *	BDL		
			3-Carene	BDL		
			Acetaldehyde *	BDL		
		67-64-1	Acetone	0.00091	lb/MSF 1/8	E
			Acrolein *	BDL		
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
			Formaldehyde *	BDL		
			Limonene	BDL		
		67-56-1	Methanol *	0.00087	lb/MSF 1/8	E
			Methyl ethyl ketone *	BDL		
			Methyl isobutyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
		108-95-2	Phenol *	0.0020	lb/MSF 1/8	E
			Propionaldehyde *	BDL		
			Styrene *	BDL		
			Toluene *	BDL		

Table 10.6.4-3 (cont.).

Source	Emission Control Device	CASRN[b]	Pollutant	Emission Factor	Emission Factor Units[c]	EMISSION FACTOR RATING
Fiberboard board dryer, indirect heated, starch binder (heated zones), softwood (SCC 3-07-015-10)	None		THC as carbon[d]	0.063[h]	lb/MSF 1/2	E
			VOC as propane[e]	0.082[h]	lb/MSF 1/2	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene *	BDL		
			3-Carene	BDL		
		75-07-0	Acetaldehyde *	0.00097[h]	lb/MSF 1/2	E
		67-64-1	Acetone	0.0038[h]	lb/MSF 1/2	E
		107-02-8	Acrolein *	0.00057[h]	lb/MSF 1/2	E
		80-56-8	Alpha-pinene	0.013[h]	lb/MSF 1/2	E
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.0093[h]	lb/MSF 1/2	E
			Limonene	BDL		
		67-56-1	Methanol *	0.017[h]	lb/MSF 1/2	E
			Methyl ethyl ketone *	BDL		
			Methyl isobutyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
		108-95-2	Phenol *	0.0012[h]	lb/MSF 1/2	E
		123-38-6	Propionaldehyde *	0.00069[h]	lb/MSF 1/2	E
			Styrene *	BDL		
			Toluene *	BDL		

Table 10.6.4-3 (cont.).

Source	Emission Control Device	CASRN[b]	Pollutant	Emission Factor	Emission Factor Units[c]	EMISSION FACTOR RATING
Fiberboard board dryer, indirect heated, 6-12% asphalt binder (heated zones), softwood (SCC 3-07-015-12)	None		THC as carbon[d]	0.11[h]	lb/MSF 1/2	D
			VOC as propane[e]	0.14[h]	lb/MSF 1/2	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene *	BDL		
			3-Carene	BDL		
		75-07-0	Acetaldehyde *	0.0029[h]	lb/MSF 1/2	E
		67-64-1	Acetone	0.0048[h]	lb/MSF 1/2	E
		107-02-8	Acrolein *	0.0012[h]	lb/MSF 1/2	E
		80-56-8	Alpha-pinene	0.014[h]	lb/MSF 1/2	E
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.013[h]	lb/MSF 1/2	E
			Limonene	BDL		
		67-56-1	Methanol *	0.026[h]	lb/MSF 1/2	E
			Methyl isobutyl ketone *	BDL		
			Methyl ethyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
		108-95-2	Phenol *	0.0014[h]	lb/MSF 1/2	E
			Propionaldehyde *	BDL		
			Styrene *	BDL		
			Toluene *	BDL		

[a] Factors represent uncontrolled emissions. SCC = Source Classification Code. * = hazardous air pollutant. BDL = below test method detection limit; indicates that this pollutant has not been detected in any test runs on this source. Reference 3 unless otherwise noted. See Table 10.6.4-10 for the hardwood and softwood species commonly used in the production of hardboard, fiberboard, and other composite wood products. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's TTN website at: http://www.epa.gov/ttn/chief/.**

[b] CASRN = Chemical Abstracts Service Registry Number.

[c] Emission factor units: pounds of pollutant per oven-dried ton of wood material (lb/ODT); one lb/ODT = 0.5 kg/Mg (oven-dried); pounds of pollutant per thousand square feet of 1/2-inch thick panel (lb/MSF 1/2); one lb/MSF 1/2 = 0.38 kg/m^3; pounds of pollutant per thousand square feet of 1/8-inch thick panel (lb/MSF 1/8); one lb/MSF 1/8 = 1.54 kg/m^3.

[d] THC as carbon = total hydrocarbon measurements using EPA Method 25A.

Table 10.6.4-3 (cont.).

[e] VOC as propane = (1.22 × THC) + formaldehyde - (acetone + methane + methylene chloride); a value of zero is inserted in the equation for the specified compounds where no emission factor is available, or where the emission factor is reported only as "BDL".

[f] Reference 2.

[g] Based on M0011 data only; suspected to be biased low due to poor collection efficiency or analytical problems.

[h] Emission factors apply only to the heated zones of the dryer; the cooling sections also have emissions but data were not available for cooling section emissions.

Table 10.6.4-4. EMISSION FACTORS FOR HARDBOARD PRESSES--PARTICULATE MATTER[a]

Source[c]	Emission Control Device	Filterable[b]				Condensible[d]	EMISSION FACTOR RATING
		PM	EMISSION FACTOR RATING	PM-10	EMISSION FACTOR RATING		
Hardboard hot press, PF resin (SCC 3-07-014-40)	Uncontrolled	0.14	E	0.086	E	0.12	E

[a] Emission factor units are pounds of pollutant per thousand square feet of 1/8-inch thick panel (lb/MSF 1/8). One lb/MSF 1/8 = 1.54 kg/m^3. Factors represent uncontrolled emissions. SCC = Source Classification Code. Reference 4. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's TTN website at: http://www.epa.gov/ttn/chief/.**

[b] Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train. Filterable PM-10 is that PM collected on the filter, or in the sample line between the cyclone and filter of an EPA Method 201 or 201A sampling train.

[c] PF = phenol formaldehyde.

[d] Condensible PM is that PM collected in the impinger portion of a PM sampling train (EPA Method 202).

Table 10.6.4-5. EMISSION FACTORS FOR HARDBOARD PRESSES--NO_x, CO, AND CO_2 [a]

Source[b]	Emission Control Device	NO_x	EMISSION FACTOR RATING	CO	EMISSION FACTOR RATING	CO_2	EMISSION FACTOR RATING
Hardboard hot press, PF resin (SCC 3-07-014-40)	Uncontrolled	ND		ND		ND	

[a] Emission factor units are pounds of pollutant per thousand square feet of 1/8-inch thick panel (lb/MSF 1/8). One lb/MSF 1/8 = 1.54 kg/m^3. Factors represent uncontrolled emissions. SCC = Source Classification Code. ND = no data available. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's TTN website at: http://www.epa.gov/ttn/chief/.**

[b] PF = phenol formaldehyde.

Table 10.6.4-6. EMISSION FACTORS FOR HARDBOARD PRESSES--ORGANICS[a]

Source[b]	Emission Control Device[c]	CASRN[d]	Pollutant	Emission Factor	EMISSION FACTOR RATING
Hardboard hot press, PF resin (SCC 3-07-014-40)	Uncontrolled		THC as carbon[e]	0.42	D
			VOC as propane[f]	0.52	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			2,4-Dimethylbenzaldehyde	BDL	
			3-Carene	BDL	
		75-07-0	Acetaldehyde *	0.016	D
		67-64-1	Acetone	0.0055[g]	D
			Acrolein *	BDL	
			Alpha-pinene	BDL	
			Benzaldehyde	BDL	
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Butyraldehyde	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Crotonaldehyde	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.014	D
			Hexaldehyde	BDL	
			Isovaleraldehyde	BDL	
			Limonene	BDL	
		67-56-1	Methanol *	0.24[g]	D
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
		1330-20-7	m,p-Xylene *	0.0053	D
			o-,m-,p-Tolualdehyde	BDL	
		95-47-6	o-Xylene *	0.0036	D
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
		108-95-2	Phenol *	0.010	D
			Propionaldehyde *	BDL	
			Styrene *	BDL	
		108-88-3	Toluene *	0.0011	D
			Valeraldehyde	BDL	

Table 10.6.4-6 (cont.).

Source[b]	Emission Control Device[c]	CASRN[d]	Pollutant	Emission Factor	EMISSION FACTOR RATING
Hardboard hot press, PF resin (SCC 3-07-014-40)	Scrubber		THC as carbon[e]	0.043	E
			VOC as propane[f]	0.052	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
		75-07-0	Acetaldehyde *	0.0033	E
		67-64-1	Acetone	0.0039	E
			Acrolein *	BDL	
			Alpha-pinene	BDL	
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-00	Formaldehyde *	0.0034	E
			Limonene	BDL	
		67-56-1	Methanol *	0.15	E
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
			Phenol *	BDL	
			Propionaldehyde *	BDL	
			Styrene *	BDL	
			Toluene *	BDL	

Table 10.6.4-6 (cont.).

Source[b]	Emission Control Device[c]	CASRN[d]	Pollutant	Emission Factor	EMISSION FACTOR RATING
Hardboard hot press, linseed oil binder (SCC 3-07-014-42)	Uncontrolled		THC as carbon[e]	0.58	E
			VOC as propane[f]	0.71	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
		75-070	Acetaldehyde *	0.036	E
		67-64-1	Acetone	0.015	E
		107-02-8	Acrolein *	0.0057	E
			Alpha-pinene	BDL	
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.018	E
			Limonene	BDL	
		67-56-1	Methanol *	0.093	E
		78-93-3	Methyl ethyl ketone *	0.0045	E
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
		108-95-2	Phenol *	0.0039	E
		123-38-6	Propionaldehyde *	0.031	E
			Styrene *	BDL	
			Toluene *	BDL	

[a] Emission factor units are pounds of pollutant per thousand square feet of 1/8-inch thick panel (lb/MSF 1/8). One lb/MSF 1/8 = 1.54 kg/m^3. Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. * = hazardous air pollutant. BDL = below test method detection limit; indicates that this pollutant has not been detected in any test runs on this source. Reference 3 unless otherwise noted. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's TTN website at: http://www.epa.gov/ttn/chief/.**

[b] PF = phenol formaldehyde.

[c] Emission control device: scrubber consists of a water quench, followed by a water tray tower, followed by a high-energy venturi scrubber with a 49-inch pressure drop, followed by a chevron demister.

Table 10.6.4-6 (cont.).

[d] CASRN = Chemical Abstracts Service Registry Number.
[e] THC as carbon = total hydrocarbon measurements using EPA Method 25A.
[f] VOC as propane = (1.22 × THC) + formaldehyde - (acetone + methane + methylene chloride); a value of zero is inserted in the equation for the specified compounds where no emission factor is available, or where the emission factor is reported only as "BDL".
[g] References 3 and 4.

Table 10.6.4-7. EMISSION FACTORS FOR HARDBOARD AND FIBERBOARD MISCELLANEOUS SOURCES–PARTICULATE MATTER[a]

Source	Emission Control Device	Filterable[b]				Condensible[c]	EMISSION FACTOR RATING
		PM	EMISSION FACTOR RATING	PM-10	EMISSION FACTOR RATING		
Hardboard sander (SCC 3-07-014-80)	Fabric filter	0.030	E	ND		ND	
Log storage (SCC 3-07-008-95)	Uncontrolled	ND		ND		ND	
Debarking (SCC 3-07-008-01)	Uncontrolled	ND		ND		ND	
Log cutting (SCC 3-07-008-02)	Uncontrolled	ND		ND		ND	
Log chipping (SCC 3-07-014-82)	Uncontrolled	ND		ND		ND	
Chip storage (SCC 3-07-008-21)	Uncontrolled	ND		ND		ND	

[a] Emission factor units are pounds of pollutant per thousand square feet of 1/8-inch thick panel (lb/MSF 1/8). One lb/MSF 1/8 = 1.54 kg/m^3. SCC = Source Classification Code. ND = no data available. Reference 4.

[b] Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train. Filterable PM-10 is that PM collected on the filter, or in the sample line between the cyclone and filter of an EPA Method 201 or 201A sampling train.

[c] Condensible PM is that PM collected in the impinger portion of a PM sampling train (EPA Method 202).

Table 10.6.4-8. EMISSION FACTORS FOR HARDBOARD AND FIBERBOARD MISCELLANEOUS SOURCES--NO_x, CO, AND CO_2[a]

Source	Emission Control Device	NO_x	EMISSION FACTOR RATING	CO	EMISSION FACTOR RATING	CO_2	EMISSION FACTOR RATING
Hardboard humidification kiln, indirect heated (SCC 3-07-014-30)	Uncontrolled	0.0028	E	0.16	E	ND	

[a] Emission factor units are pounds of pollutant per thousand square feet of 1/8-inch thick panel (lb/MSF 1/8). One lb/MSF 1/8 = 1.54 kg/m^3. SCC = Source Classification Code. ND = no data available. Reference 2.

Table 10.6.4-9. EMISSION FACTORS FOR HARDBOARD AND FIBERBOARD MISCELLANEOUS SOURCES--ORGANICS[a]

Source	Emission Control Device[b]	CASRN[c]	Pollutant	Emission Factor	Emission Factor Units[d]	EMISSION FACTOR RATING
Log storage (SCC 3-07-008-95)	Uncontrolled		THC, VOC	ND		
Debarking (SCC 3-07-008-01)	Uncontrolled		THC, VOC	ND		
Log cutting (SCC 3-07-008-02)	Uncontrolled		THC, VOC	ND		
Chip storage (SCC 3-07-008-21)	Uncontrolled		THC, VOC	ND		
Hardboard log chipper, hardwood (SCC 3-07-014-82)	None		THC as carbon[e]	0.0041	lb/ODT	E
			VOC as propane[f]	0.0050	lb/ODT	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene *	BDL		
			3-Carene	BDL		
			Acetaldehyde *	BDL		
			Acetone	BDL		
			Acrolein *	BDL		
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
			Formaldehyde *	BDL		
			Limonene	BDL		
		67-56-1	Methanol *	0.0010	lb/ODT	E
			Methyl ethyl ketone *	BDL		
			Methyl isobutyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
			Phenol *	BDL		
			Propionaldehyde *	BDL		
			Styrene *	BDL		
			Toluene *	BDL		

Table 10.6.4-9 (cont.).

Source	Emission Control Device[b]	CASRN[c]	Pollutant	Emission Factor	Emission Factor Units[d]	EMISSION FACTOR RATING
Hardboard pressurized digester/ refiner, hardwood (SCC 3-07-014-84)	None		THC as carbon[e]	0.40	lb/ODT	E
			VOC as propane[f]	0.49	lb/ODT	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene *	BDL		
			3-Carene	BDL		
		75-07-0	Acetaldehyde *	0.030	lb/ODT	E
		67-64-1	Acetone	0.0042	lb/ODT	E
		107-02-8	Acrolein *	0.0024	lb/ODT	E
		80-56-8	Alpha-pinene	0.0039	lb/ODT	E
			Benzene *	BDL		
		127-91-3	Beta-pinene	0.0063	lb/ODT	E
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.0045	lb/ODT	E
		138-86-3	Limonene	0.0026	lb/ODT	E
		67-56-1	Methanol *	0.35	lb/ODT	E
		78-93-3	Methyl ethyl ketone *	0.00025	lb/ODT	E
		108-10-1	Methyl isobutyl ketone *	0.00024	lb/ODT	E
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
		108-95-2	Phenol *	0.0012	lb/ODT	E
		123-38-6	Propionaldehyde *	0.00091	lb/ODT	E
		100-42-5	Styrene *	0.00016	lb/ODT	E
			Toluene *	BDL		

Table 10.6.4-9 (cont.).

Source	Emission Control Device[b]	CASRN[c]	Pollutant	Emission Factor	Emission Factor Units[d]	EMISSION FACTOR RATING
Hardboard former vacuum system, wet, PF resin (SCC 3-07-014-86)	None		1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene *	BDL		
			3-Carene	BDL		
		75-07-0	Acetaldehyde *	0.0058	lb/ODT	D
		67-64-1	Acetone	0.0032	lb/ODT	D
			Acrolein *	BDL		
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.00026	lb/ODT	D
			Limonene	BDL		
		67-56-1	Methanol *	0.054	lb/ODT	D
		78-93-3	Methyl ethyl ketone *	0.00030	lb/ODT	D
		108-10-1	Methyl isobutyl ketone *	0.00023	lb/ODT	D
			Methylene chloride *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
		108-95-2	Phenol *	0.00071	lb/ODT	D
		123-38-6	Propionaldehyde *	0.00021	lb/ODT	D
			Styrene *	BDL		

Table 10.6.4-9 (cont.).

Source	Emission Control Device[b]	CASRN[c]	Pollutant	Emission Factor	Emission Factor Units[d]	EMISSION FACTOR RATING
Fiberboard atmospheric refiner and dump chest, softwood (SCC 3-07-015-30)	None		THC as carbon[e]	0.79	lb/ODT	E
			VOC as propane[f]	0.96	lb/ODT	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene *	BDL		
			3-Carene	BDL		
		75-07-0	Acetaldehyde *	0.0027	lb/ODT	E
		67-64-1	Acetone	0.0039	lb/ODT	E
		107-02-8	Acrolein *	0.00030	lb/ODT	E
		80-56-8	Alpha-pinene	0.72	lb/ODT	E
			Benzene *	BDL		
		127-91-3	Beta-pinene	0.099	lb/ODT	E
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
		98-82-8	Cumene *	0.0034	lb/ODT	E
		50-00-0	Formaldehyde *	0.00061	lb/ODT	E
		138-86-3	Limonene	0.017	lb/ODT	E
		67-56-1	Methanol *	0.0084	lb/ODT	E
		78-93-3	Methyl ethyl ketone *	0.00021	lb/ODT	E
			Methyl isobutyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
			Phenol *	BDL		
		123-38-6	Propionaldehyde *	0.00026	lb/ODT	E
			Styrene *	BDL		
		108-88-3	Toluene *	0.00029	lb/ODT	E

Table 10.6.4-9 (cont.).

Source	Emission Control Device[b]	CASRN[c]	Pollutant	Emission Factor	Emission Factor Units[d]	EMISSION FACTOR RATING
Fiberboard washer, softwood (SCC 3-07-015-40)	None		THC as carbon[e]	0.19	lb/ODT	E
			VOC as propane[f]	0.23	lb/ODT	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene *	BDL		
			3-Carene	BDL		
		75-07-0	Acetaldehyde *	0.015	lb/ODT	E
		67-64-1	Acetone	0.0047	lb/ODT	E
			Acrolein *	BDL		
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.0026	lb/ODT	E
			Limonene	BDL		
		67-56-1	Methanol *	0.13	lb/ODT	E
			Methyl ethyl ketone *	BDL		
			Methyl isobutyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
			Phenol *	BDL		
			Propionaldehyde *	BDL		
			Styrene *	BDL		
			Toluene *	BDL		

Table 10.6.4-9 (cont.).

Source	Emission Control Device[b]	CASRN[c]	Pollutant	Emission Factor	Emission Factor Units[d]	EMISSION FACTOR RATING
Fiberboard former vacuum system, wet, 6-12% asphalt (SCC 3-07-015-50)	None		THC as carbon[e]	0.15	lb/MSF 1/2	E
			VOC as propane[f]	0.17	lb/MSF 1/2	E
			1,2-Dichloroethane *	BDL		
			1,2,4-Trichlorobenzene *	BDL		
			3-Carene	BDL		
		75-07-0	Acetaldehyde *	0.0075	lb/MSF 1/2	E
		67-64-1	Acetone	0.014	lb/MSF 1/2	E
			Acrolein *	BDL		
			Alpha-pinene	BDL		
			Benzene *	BDL		
			Beta-pinene	BDL		
			Bromomethane *	BDL		
			Camphene	BDL		
			Chloroethane *	BDL		
			Chloroethene *	BDL		
			Cis-1,2-dichloroethylene	BDL		
			Cumene *	BDL		
		50-00-0	Formaldehyde *	0.0036	lb/MSF 1/2	E
			Limonene	BDL		
		67-56-1	Methanol *	0.014	lb/MSF 1/2	E
			Methyl ethyl ketone *	BDL		
			Methyl isobutyl ketone *	BDL		
			Methylene chloride *	BDL		
			m,p-Xylene *	BDL		
			o-Xylene *	BDL		
			p-Cymene	BDL		
			p-Mentha-1,5-diene	BDL		
			Phenol *	BDL		
			Propionaldehyde *	BDL		
			Styrene *	BDL		
		108-88-3	Toluene *	0.0023	lb/MSF 1/2	E

Table 10.6.4-9 (cont.).

Source	Emission Control Device[b]	CASRN[c]	Pollutant	Emission Factor	Emission Factor Units[d]	EMISSION FACTOR RATING
Hardboard humidification kiln, indirect heated (SCC 3-07-014-30)	None		THC as carbon[e]	0.62[g]	lb/MSF 1/8	E
			VOC as propane[f]	0.76	lb/MSF 1/8	E
			2,4-Dimethylbenzaldehyde	BDL		
		75-07-0	Acetaldehyde *	0.0018[g]	lb/MSF 1/8	E
		67-64-1	Acetone	0.0038[g]	lb/MSF 1/8	D
		107-02-8	Acrolein *	0.0087[g,h]	lb/MSF 1/8	E
			Benzaldehyde	BDL		
		71-43-2	Benzene *	6.2E-06[g]	lb/MSF 1/8	E
			Benzo(a)pyrene	BDL		
			Bromomethane *	BDL		
			Butyraldehyde	BDL		
		75-00-3	Chloroethane *	0.000014[g]	lb/MSF 1/8	E
		74-87-3	Chloromethane *	0.00012[g]	lb/MSF 1/8	E
			Crotonaldehyde	BDL		
			Ethanol	BDL		
		100-41-4	Ethylbenzene *	0.000032[g]	lb/MSF 1/8	E
		50-00-0	Formaldehyde *	0.0010[g,h]	lb/MSF 1/8	E
		66-25-1	Hexaldehyde	0.011[g,h]	lb/MSF 1/8	E
			Isobutanol	BDL		
			Isovaleraldehyde	BDL		
			Methanol *	BDL		
		78-93-3	Methyl ethyl ketone *	0.0014[g]	lb/MSF 1/8	E
			Methyl propyl ketone *	BDL		
			Methylene chloride *	BDL		
		1319-77-3	m,p-Cresol *	0.00033[g]	lb/MSF 1/8	E
			Naphthalene *	BDL		
		95-48-7	o-Cresol *	0.00021[g]	lb/MSF 1/8	E
			o-,m-,p-Tolualdehyde	BDL		
		108-95-2	Phenol *	0.00057[g]	lb/MSF 1/8	E
			Propanol	BDL		
		123-38-6	Propionaldehyde *	0.0077[g]	lb/MSF 1/8	E
			Pyridine	BDL		
			Styrene *	BDL		
		108-88-3	Toluene *	0.000034[g]	lb/MSF 1/8	E
			Trichlorofluoromethane	BDL		
			Valeraldehyde	BDL		
		1330-20-7	Xylenes *	0.000042[g]	lb/MSF 1/8	E

[a] Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. * = hazardous air pollutant. BDL = below test method detection limit; indicates that this pollutant has not been detected in any test runs on this source. Reference 3 unless otherwise noted. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's TTN website at: http://www.epa.gov/ttn/chief/.**

[b] Fabric filters (baghouses) are considered no control for organic pollutants.

[c] CASRN = Chemical Abstracts Service Registry Number.

Table 10.6.4-9 (cont.).

[d] Emission factor units: pounds of pollutant per oven-dried ton of wood material (lb/ODT); one lb/ODT = 0.5 kg/Mg (oven-dried); pounds of pollutant per thousand square feet of 1/2-inch thick panel (lb/MSF 1/2); one lb/MSF 1/2 = 0.38 kg/m^3; pounds of pollutant per thousand square feet of 1/8-inch thick panel (lb/MSF 1/8); one lb/MSF 1/8 = 1.54 kg/m^3.

[e] THC as carbon = total hydrocarbon measurements using EPA Method 25A.

[f] VOC as propane = (1.22 × THC) + formaldehyde - (acetone + methane + methylene chloride); a value of zero is inserted in the equation for the specified compounds where no emission factor is available, or where the emission factor is reported only as "BDL".

[g] Reference 2.

[h] Based on M0011 data only; suspected to be biased low due to poor collection efficiency or analytical problems.

Table 10.6.4-10. WOOD SPECIES COMMONLY USED IN COMPOSITE WOOD PRODUCTS MANUFACTURING [a]

Wood product	AP-42 section	Hardwood species	Softwood species
Plywood	10.5	Oak, cherry, poplar, maple, larch	Firs, pines
Oriented strandboard	10.6-1	Aspen	Pines, firs, spruce
Particleboard	10.6-2	Aspen, oak	Pines, firs
Medium density fiberboard	10.6-3	Gum, alder, hickory	Pines, firs
Hardboard/fiberboard	10.6-4	Aspen, birch, beech, oak, maple	Pines
Engineered wood products	10.9	Aspen, birch, poplar	Pines, firs, hemlock

[a] Reference 5.

References For Section 10.6.4

1. *Background Information Document For Proposed Plywood And Composite Wood Products NESHAP*, prepared for the U. S. Environmental Protection Agency, OAQPS, by Midwest Research Institute, Cary, NC, September 2000.

2. *Results Of The January 17-19, 1995 Source Emission Tests On The Dryer Stack, Dump Stack And Humidification Kiln Stack At The Georgia Pacific Facility Located In Phillips, Wisconsin*, prepared for CH2M Hill, by PACE, Inc., Project No. 941228.401, March 2, 1995.

3. *Volatile Organic Compound Emissions From Wood Products Manufacturing Facilities, Part VI - Hardboard/Fiberboard, Technical Bulletin No. 773*, National Council of the Paper Industry for Air and Stream Improvement, Inc., Research Triangle Park, NC, 1999.

4. *Title V Emissions Test Report, PM10, Particulate Matter, Condensible Particulate Matter, Aldehydes/Ketones, Phenols, Methanol, Oxygen, Carbon Dioxide, Carbon Monoxide, Nitrogen Oxides, And Cold Total Hydrocarbons From Process Stacks, Georgia Pacific Hardboard Manufacturing Plant, North Little Rock, Arkansas, Test Dates September 26-29, 1995*, prepared for CH2M Hill and Georgia Pacific Corporation, by DEECO, Inc., Report No. 95-1200-A, October 27, 1995.

5. *Emission Factor Documentation For AP-42 Chapter 10, Wood Products Industry,* prepared for the U. S. Environmental Protection Agency, OAQPS/EFIG, by Midwest Research Institute, Cary, NC, July 2003.

SUPPLEMENTAL TABLE
FACILITY-WIDE UNCONTROLLED $PM/PM_{10}/PM_{2.5}$ SUMMARY
ENVIVA PELLETS GREENWOOD, LLC

			Uncontrolled		
Process ID	**Emission Unit ID**	**Source Description**	**PM (tpy)**	**PM_{10} (tpy)**	**$PM_{2.5}$ (tpy)**
P0	E1	Debarker	11.82	0.32	0.05
	E2	Electric Powered Chipper	7.36	3.68	3.68
	E3	Green Wood Screening	1.46	1.46	1.46
	E4	Pile Drop	0.06	0.03	4.09E-03
	E5	Storage Pile Wind Erosion	2.83	1.41	0.21
	E46	Truck Dump 1	0.03	0.01	1.84E-03
	E47	Truck Dump 2	0.03	0.01	1.84E-03
P1	E6	Green Hammermill 1	1,125	1,125	1,125
	E7	Green Hammermill 2			
	E8	Green Hammermill 3			
	E9	Green Hammermill 4			
	E58	Green Hammermill 5			
	E10	Green Chip Silo			
P2	E11	Furnace			
	E12	Dryer			
	E11	Furnace Bypass - Cold Startup from Biomass Combustion	75.82	67.93	58.74
		Furnace Bypass - Cold Startup from Diesel Fuel Combustion	3.30E-04	3.30E-04	3.30E-04
		Furnace Bypass - Idle Mode from Biomass Combustion	30.33	27.17	23.49
	E13	Dry Chip Silo	75.09	75.09	75.09
	E48	Dryer Duct Burner	0.16	0.16	0.16
P3	E59 - E94	Vertical Dry Hammermill 1 - 36	6,596	6,596	6,596
	E19	Pelletizer Feed Silo	75.09	75.09	75.09

SUPPLEMENTAL TABLE
FACILITY-WIDE UNCONTROLLED $PM/PM_{10}/PM_{2.5}$ SUMMARY
ENVIVA PELLETS GREENWOOD, LLC

			Uncontrolled		
Process ID	**Emission Unit ID**	**Source Description**	**PM (tpy)**	**PM_{10} (tpy)**	**$PM_{2.5}$ (tpy)**
P4	E20	Pelletizer 1	1,877	489.93	251.46
	E21	Pelletizer 2			
	E22	Pelletizer 3			
	E24	Pelletizer 4			
	E25	Pelletizer 5			
	E26	Pelletizer 6			
	E28	Pelletizer 7			
	E29	Pelletizer 8			
	E30	Pelletizer 9			
	E23	Pellet Cooler 1			
	E27	Pellet Cooler 2			
	E31	Pellet Cooler 3			
	E20	Pelletizer 1 - RTO/RCO Natural Gas Combustion	--	--	--
	E21	Pelletizer 2 - RTO/RCO Natural Gas Combustion			
	E22	Pelletizer 3 - RTO/RCO Natural Gas Combustion			
	E24	Pelletizer 4 - RTO/RCO Natural Gas Combustion			
	E25	Pelletizer 5 - RTO/RCO Natural Gas Combustion			
	E26	Pelletizer 6 - RTO/RCO Natural Gas Combustion			
	E28	Pelletizer 7 - RTO/RCO Natural Gas Combustion			
	E29	Pelletizer 8 - RTO/RCO Natural Gas Combustion			
	E30	Pelletizer 9 - RTO/RCO Natural Gas Combustion			
	E23	Pellet Cooler 1 - RTO/RCO Natural Gas Combustion			
	E27	Pellet Cooler 2 - RTO/RCO Natural Gas Combustion			
	E31	Pellet Cooler 3 - RTO/RCO Natural Gas Combustion			
	E32	Pelletizer 10			
	E33	Pelletizer 11			
	E34	Pelletizer 12			
	E36	Pelletizer 13			

SUPPLEMENTAL TABLE
FACILITY-WIDE UNCONTROLLED $PM/PM_{10}/PM_{2.5}$ SUMMARY
ENVIVA PELLETS GREENWOOD, LLC

			Uncontrolled		
Process ID	**Emission Unit ID**	**Source Description**	**PM (tpy)**	**PM_{10} (tpy)**	**$PM_{2.5}$ (tpy)**
	E37	Pelletizer 14	1,877.1	489.93	251.46
	E38	Pelletizer 15			
	E49	Pelletizer 16			
	E50	Pelletizer 17			
	E51	Pelletizer 18			
	E35	Pellet Cooler 4			
	E39	Pellet Cooler 5			
	E52	Pellet Cooler 6			
	E32	Pelletizer 10 - RTO/RCO Natural Gas Combustion	--	--	--
	E33	Pelletizer 11 - RTO/RCO Natural Gas Combustion			
	E34	Pelletizer 12 - RTO/RCO Natural Gas Combustion			
	E36	Pelletizer 13 - RTO/RCO Natural Gas Combustion			
	E37	Pelletizer 14 - RTO/RCO Natural Gas Combustion			
	E38	Pelletizer 15 - RTO/RCO Natural Gas Combustion			
	E49	Pelletizer 16 - RTO/RCO Natural Gas Combustion			
	E50	Pelletizer 17 - RTO/RCO Natural Gas Combustion			
	E51	Pelletizer 18 - RTO/RCO Natural Gas Combustion			
	E35	Pellet Cooler 4 - RTO/RCO Natural Gas Combustion			
	E39	Pellet Cooler 5 - RTO/RCO Natural Gas Combustion			
	E52	Pellet Cooler 6 - RTO/RCO Natural Gas Combustion			

SUPPLEMENTAL TABLE
FACILITY-WIDE UNCONTROLLED PM/PM_{10}/$PM_{2.5}$ SUMMARY
ENVIVA PELLETS GREENWOOD, LLC

			Uncontrolled		
Process ID	**Emission Unit ID**	**Source Description**	**PM (tpy)**	**PM_{10} (tpy)**	**$PM_{2.5}$ (tpy)**
P5	E40	Pellet Silo 1	75.09	75.09	75.09
	E41	Pellet Silo 2			
	E42	Loadout	431.74	431.74	431.74
	E43	Dust Silo	123.89	123.89	123.89
P6	E44	Engine 1 (Generator)	8.58E-03	8.58E-03	8.58E-03
	E45	Engine 2 (Fire Pump)	0.03	0.03	0.03
	E53	Woodyard Fuel Storage Tank	--	--	--
	E54	Fire Pump House Fuel Storage Tank	--	--	--
	E55	Diesel Generator Fuel Storage Tank	--	--	--
P7	E56	Unpaved Roads	276.09	78.70	7.87
	E57	Paved Roads	21.79	4.36	1.07
FACILITY-WIDE TOTAL			**12,684.0**	**9,667.1**	**9,101.7**

RAMBOLL

TABLE 1
FACILITY-WIDE CRITERIA & CO_2e POLLUTANT SUMMARY
ENVIVA PELLETS GREENWOOD, LLC

Process ID	Emission Unit ID	Source Description	Control Device ID	Control Device Description	CO (tpy)	NO_x (tpy)	TSP (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_2 (tpy)	VOC (tpy)	CO_2e (tpy)
P0	E1	Debarker	--	--	--	--	10.28	0.28	0.05	--	--	--
	E2	Electric Powered Chipper	--	--	--	--	7.36	3.68	3.68	--	1.92	--
	E3	Green Wood Screening	--	--	--	--	1.46	1.46	1.46	--	--	--
	E4	Pile Drop	--	--	--	--	0.06	0.027	0.0041	--	--	--
	E5	Storage Pile Wind Erosion	--	--	--	--	2.83	1.41	0.21	--	3.03	--
	E46	Truck Dump 1	--	--	--	--	0.03	0.012	0.002	--	--	--
	E47	Truck Dump 2	--	--	--	--	0.03	0.012	0.002	--	--	--
P1	E6	Green Hammermill 1	CD2, CD3	WESP, RTO-1	59.80	112.07	11.25	11.25	11.25	21.90	41.02	204,251
	E7	Green Hammermill 2										
	E8	Green Hammermill 3										
	E9	Green Hammermill 4										
	E58	Green Hammermill 5										
	E10	Green Chip Silo										
P2	E11	Furnace	CD1 - 3	Cyclone, WESP, RTO-1								
	E12	Dryer										
	E11	Furnace Bypass	--	--	2.25	0.83	2.16	1.94	1.68	0.09	0.06	786
	E13	Dry Chip Silo	CD4	Bin Vent Filter 1	--	--	0.75	0.75	0.75	--	4.69	--
	E48	Dryer Duct Burner	--	--	1.80	2.15	0.16	0.16	0.16	0.01	0.12	3,232
P3	E59 - E94	Vertical Dry Hammermill 1 - 36	CD2/CD3 or CD24 then E11/CD2/CD2	WESP/RTO or Bin Vent Filter 3 then Furnace/WESP/RTO-1	0.62	0.74	56.27	56.27	56.27	--	20.33	1,110
	E19	Pelletizer Feed Silo	CD10	Bin Vent Filter 2	--	--	0.75	0.75	0.75	--	0.07	--
P4	E20	Pelletizer 1	CD14a - c, CD15	Baghouses 1a - c, RTO-2/RCO-1	17.62	2.97	18.94	5.07	2.51	0.01	24.51	4,699
	E21	Pelletizer 2										
	E22	Pelletizer 3										
	E24	Pelletizer 4										
	E25	Pelletizer 5										
	E26	Pelletizer 6										
	E28	Pelletizer 7										
	E29	Pelletizer 8										
	E30	Pelletizer 9										
	E23	Pellet Cooler 1										
	E27	Pellet Cooler 2										
	E31	Pellet Cooler 3										
	E32	Pelletizer 10	CD18a - c, CD19	Baghouses 2a - c, RTO-3/RCO-2	17.62	2.97	19.11	5.24	2.51	0.03	24.51	9,398
	E33	Pelletizer 11										
	E34	Pelletizer 12										
	E36	Pelletizer 13										
	E37	Pelletizer 14										
	E38	Pelletizer 15										
	E49	Pelletizer 16										
	E50	Pelletizer 17										
	E51	Pelletizer 18										
	E35	Pellet Cooler 4										
	E39	Pellet Cooler 5										
	E52	Pellet Cooler 6										

RAMBOLL

TABLE 1
FACILITY-WIDE CRITERIA & CO_2e POLLUTANT SUMMARY
ENVIVA PELLETS GREENWOOD, LLC

Process ID	Emission Unit ID	Source Description	Control Device ID	Control Device Description	CO (tpy)	NO_x (tpy)	TSP (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_2 (tpy)	VOC (tpy)	CO_2e (tpy)
P5	E40	Pellet Silo 1	CD20	Cyclofilter 6	0.02	--	0.75	0.75	0.75	--	0.06	--
	E41	Pellet Silo 2										
	E42	Loadout	CD21, CD22	Cyclone 6, Baghouse 3	--	--	4.32	4.32	4.32	--	--	--
	E43	Dust Silo	CD23	Cyclofilter 7	--	--	1.24	1.24	1.24	--	--	--
P6	E44	Engine 1 (Generator)	--	--	0.19	2.74	8.58E-03	8.58E-03	8.58E-03	2.35E-03	4.77E-03	247.67
	E45	Engine 2 (Fire Pump)	--	--	0.44	0.50	0.025	0.025	0.025	8.30E-04	1.34E-03	87.33
	E53	Woodyard Fuel Storage Tank	--	--	--	--	--	--	--	--	8.65E-04	--
	E54	Fire Pump House Fuel Storage Tank	--	--	--	--	--	--	--	--	1.45E-04	--
	E55	Diesel Generator Fuel Storage Tank	--	--	--	--	--	--	--	--	2.88E-04	--
P7	E56	Unpaved Roads	--	--	--	--	27.61	7.87	0.79	--	--	--
	E57	Paved Roads	--	--	--	--	2.18	0.44	0.11	--	--	--
				Total Emissions:	**100.4**	**125.0**	**167.6**	**103.0**	**88.5**	**22.1**	**120.3**	**223,810**
				Total Excluding Fugitives[1]:	**100.4**	**125.0**	**134.8**	**93.2**	**87.4**	**22.1**	**117.3**	**223,810**
				PSD Major Source Threshold:	**250**	**250**	**250**	**250**	**250**	**250**	**250**	**--**
				Major Source?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**--**

Notes:

1. Fugitive emissions are not included in comparison against the major source threshold because the facility is not on the list of 28 source categories in 40 CFR 52.21.

TABLE 2
FACILITY-WIDE HAP EMISSIONS SUMMARY
ENVIVA PELLETS GREENWOOD, LLC

Description	CAS No.	HAP	Dryer & GHM (RTO-1) (tpy)	Furnace Bypass (tpy)	Dryer Duct Burner (tpy)	DHM (RTO-1) (tpy)	Pellet Coolers (RTO-2/RCO-1) (tpy)	Pellet Coolers (RTO-3/RCO-2) (tpy)	Dry Chip & Pelletizer Feed Silos (tpy)	Wood Pellet Silos (tpy)	Chipper (tpy)	Engine 1 (Generator) (tpy)	Engine 2 (Fire Pump) (tpy)	Total (tpy)	Major Source?
Acetaldehyde	75-07-0	Y	3.08	3.11E-03	3.26E-07	0.12	0.28	0.28	-	-	-	1.16E-03	4.09E-04	3.75	No
Acrolein	107-02-8	Y	2.00	0.02	3.86E-07	0.18	0.41	0.41	-	-	-	1.40E-04	4.94E-05	3.01	No
Formaldehyde	50-00-0	Y	1.99	0.02	1.61E-03	3.96E-03	1.05	1.05	0.28	0.02	-	1.79E-03	6.30E-04	4.41	No
Methanol	67-56-1	Y	2.44	-	-	0.10	0.05	0.05	0.64	0.04	0.38	-	-	3.70	No
Phenol	108-95-2	Y	2.47	1.91E-04	-	0.05	0.21	0.21	-	-	-	-	-	2.93	No
Propionaldehyde	123-38-6	Y	0.93	2.29E-04	-	0.20	0.12	0.12	-	-	-	-	-	1.37	No
Acetophenone	98-86-2	Y	1.40E-07	1.20E-08	-	-	-	-	-	-	-	-	-	1.52E-07	No
Ammonia	7664-41-7	N	0.44	-	0.07	-	0.07	0.14	-	-	-	-	-	0.72	No
Antimony and compounds	--	Y	5.02E-04	2.96E-05	-	-	-	-	-	-	-	-	-	5.31E-04	No
Arsenic	7440-38-2	Y	1.42E-03	8.26E-05	4.29E-06	-	4.47E-06	8.93E-06	-	-	-	-	-	1.52E-03	No
Benzene	71-43-2	Y	0.18	2.14E-08	4.51E-05	-	4.69E-05	9.38E-05	-	-	-	1.41E-03	4.98E-04	0.19	No
Benzo(a)pyrene	50-32-8	Y	1.14E-04	9.75E-06	2.58E-08	-	2.68E-08	5.36E-08	-	-	-	2.85E-07	1.00E-07	1.24E-04	No
Beryllium	7440-41-7	Y	7.15E-05	4.17E-06	2.58E-07	-	2.68E-07	5.36E-07	-	-	-	-	-	7.67E-05	No
1,3-Butadiene	106-99-0	Y	-	-	-	-	-	-	-	-	-	5.92E-05	2.09E-05	8.01E-05	No
Cadmium	7440-43-9	Y	4.12E-04	1.54E-05	2.36E-05	-	2.46E-05	4.91E-05	-	-	-	-	-	5.24E-04	No
Carbon tetrachloride	56-23-5	Y	1.97E-03	1.69E-04	-	-	-	-	-	-	-	-	-	2.14E-03	No
Chlorine	7782-50-5	Y	0.69	2.96E-03	-	-	-	-	-	-	-	-	-	0.70	No
Chlorobenzene	108-90-7	Y	1.45E-03	1.24E-04	-	-	-	-	-	-	-	-	-	1.57E-03	No
Chloroform	67-66-3	Y	1.23E-03	-	-	-	-	-	-	-	-	-	-	1.23E-03	No
Chromium VI	18540-29-9	Y	4.15E-04	-	3.01E-05	-	3.13E-05	6.25E-05	-	-	-	-	-	5.39E-04	No
Chromium-Other compounds	--	Y	1.11E-03	7.88E-05	-	-	-	-	-	-	-	-	-	1.19E-03	No
Cobalt compounds	--	Y	4.24E-04	2.44E-05	1.80E-06	-	1.88E-06	3.75E-06	-	-	-	-	-	4.56E-04	No
Copper	7440-50-8	N	-	8.40E-08	-	-	-	-	-	-	-	-	-	8.40E-08	No
Dichlorobenzene	106-46-7	Y	1.65E-04	-	2.58E-05	-	2.68E-05	5.36E-05	-	-	-	-	-	2.71E-04	No
Dichloroethane, 1,2-	107-06-2	Y	1.27E-03	1.09E-04	-	-	-	-	-	-	-	-	-	1.38E-03	No
Dichloropropane, 1,2-	78-87-5	Y	1.45E-03	1.24E-04	-	-	-	-	-	-	-	-	-	1.57E-03	No
Dinitrophenol, 2,4-	51-28-5	Y	7.88E-06	6.75E-07	-	-	-	-	-	-	-	-	-	8.56E-06	No
Di(2-ethylhexyl)phthalate	117-81-7	Y	2.06E-06	1.76E-07	-	-	-	-	-	-	-	-	-	2.23E-06	No
Ethyl benzene	100-41-4	Y	1.36E-03	1.16E-04	-	-	-	-	-	-	-	-	-	1.47E-03	No
Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	57653-85-7	N	7.84E-10	-	-	-	-	-	-	-	-	-	-	7.84E-10	No
Hexane	110-54-3	Y	0.25	-	0.04	-	0.04	0.08	-	-	-	-	-	0.41	No
Indeno(1,2,3-cd)pyrene	193-39-5	Y	2.47E-07	2.14E-10	3.86E-08	-	4.02E-08	8.04E-08	-	-	-	-	-	4.07E-07	No
Hydrochloric acid	7647-01-0	Y	1.66	0.07	-	-	-	-	-	-	-	-	-	1.74	No
Lead	7439-92-1	Y	3.12E-03	1.80E-04	1.07E-05	-	1.12E-05	2.23E-05	-	-	-	-	-	3.34E-03	No
Manganese	7439-96-5	Y	0.10	6.00E-03	8.16E-06	-	8.49E-06	1.70E-05	-	-	-	-	-	0.11	No
Mercury	7439-97-6	Y	2.58E-04	1.32E-05	5.58E-06	-	5.81E-06	1.16E-05	-	-	-	-	-	2.94E-04	No
Methyl bromide	74-83-9	Y	6.57E-04	5.63E-05	-	-	-	-	-	-	-	-	-	7.13E-04	No
Methyl chloride	74-87-3	Y	1.01E-03	8.63E-05	-	-	-	-	-	-	-	-	-	1.09E-03	No
3-Methylchloranthrene	56-49-5	Y	2.47E-07	-	3.86E-08	-	4.02E-08	8.04E-08	-	-	-	-	-	4.07E-07	No
Methylene chloride	75-09-2	Y	0.01	-	-	-	-	-	-	-	-	-	-	0.01	No
Naphthalene	91-20-3	Y	4.33E-03	3.64E-04	1.31E-05	-	1.36E-05	2.72E-05	-	-	-	-	-	4.75E-03	No
Nickel	7440-02-0	Y	2.38E-03	1.24E-04	4.51E-05	-	4.69E-05	9.38E-05	-	-	-	-	-	2.69E-03	No
Nitrophenol, 4-	100-02-7	Y	4.82E-06	4.13E-07	-	-	-	-	-	-	-	-	-	5.23E-06	No
Octachlorodibenzodioxin	3268-87-9	N	-	3.10E-13	-	-	-	-	-	-	-	-	-	3.10E-13	No
Pentachlorophenol	87-86-5	Y	2.23E-06	1.91E-07	-	-	-	-	-	-	-	-	-	2.43E-06	No
Perchloroethylene	127-18-4	Y	1.66E-03	1.43E-04	-	-	-	-	-	-	-	-	-	1.81E-03	No
Phosphorus metal, yellow or white	7723-14-0	Y	1.71E-03	1.01E-04	-	-	-	-	-	-	-	-	-	1.82E-03	No
Polychlorinated biphenyls	1336-36-3	Y	3.57E-07	3.06E-08	-	-	-	-	-	-	-	-	-	3.88E-07	No
Polycyclic Organic Matter	--	Y	5.48E-03	4.69E-04	1.50E-05	-	1.56E-05	3.12E-05	-	-	-	2.54E-04	8.97E-05	6.35E-03	No
Selenium compounds	--	Y	1.81E-04	1.07E-05	5.15E-07	-	5.36E-07	1.07E-06	-	-	-	-	-	1.94E-04	No
Styrene	100-42-5	Y	0.08	-	-	-	-	-	-	-	-	-	-	0.08	No
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	1746-01-6	Y	3.77E-10	3.23E-11	-	-	-	-	-	-	-	-	-	4.09E-10	No
Toluene	108-88-3	Y	1.78E-03	6.20E-07	7.30E-05	-	7.59E-05	1.52E-04	-	-	-	6.19E-04	2.18E-04	2.92E-03	No
Trichloroethane, 1,1,1-	71-55-6	Y	1.36E-03	1.16E-04	-	-	-	-	-	-	-	-	-	1.47E-03	No

TABLE 2
FACILITY-WIDE HAP EMISSIONS SUMMARY
ENVIVA PELLETS GREENWOOD, LLC

Description	CAS No.	HAP	Dryer & GHM (RTO-1) (tpy)	Furnace Bypass (tpy)	Dryer Duct Burner (tpy)	DHM (RTO-1) (tpy)	Pellet Coolers (RTO-2/RCO-1) (tpy)	Pellet Coolers (RTO-3/RCO-2) (tpy)	Dry Chip & Pelletizer Feed Silos (tpy)	Wood Pellet Silos (tpy)	Chipper (tpy)	Engine 1 (Generator) (tpy)	Engine 2 (Fire Pump) (tpy)	Total (tpy)	Major Source?
Trichloroethylene	79-01-6	Y	1.31E-03	1.13E-04	-	-	-	-	-	-	-	-	-	1.43E-03	No
Trichlorofluoromethane	75-69-4	N	1.80E-03	-	-	-	-	-	-	-	-	-	-	1.80E-03	No
Trichlorophenol, 2,4,6-	88-06-2	Y	9.64E-07	8.25E-08	-	-	-	-	-	-	-	-	-	1.05E-06	No
Vinyl chloride	75-01-4	Y	7.88E-04	6.75E-05	-	-	-	-	-	-	-	-	-	8.56E-04	No
Xylene	1330-20-7	Y	1.10E-03	1.09E-08	-	-	-	-	-	-	-	4.31E-04	1.52E-04	1.68E-03	No
Zinc	7440-66-6	N	-	5.60E-08	-	-	-	-	-	-	-	-	-	5.60E-08	No
		TOTAL HAP	**15.92**	**0.12**	**0.04**	**0.65**	**2.16**	**2.20**	**0.92**	**0.06**	**0.38**	**5.86E-03**	**2.07E-03**	**22.45**	No

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TABLE 3
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
ROTARY DRYER, GHM, AND GREEN CHIP SILO - CRITERIA POLLUTANT EMISSIONS
ENVIVA PELLETS GREENWOOD, LLC

Dryer Inputs

Annual Dried Wood Throughput	**660,000**	ODT/year
Max. Hourly Dried Wood Throughput of Dryer	75.3	ODT/hr
Furnace Heat Input	200.0	MMBtu/hr
Percent Hardwood	0.0%	
Percent Softwood	100.0%	
Annual Operation	8,760	hr/yr
Annual Heat Input	**1,752,000**	**MMBtu/yr**
WESP Control Efficiency	99.0%	
Number of RTO Burners	**4**	
RTO Burner Rating	**8**	**MMBtu/hr**
RTO Control Efficiency	**95.00%**	

Criteria Pollutant Calculations at the RTO Outlet:

Pollutant	Uncontrolled Emission Factor	Units	Footnote	Uncontrolled & Unlimited Emissions[1]		Controlled & Unlimited Emissions[1]		Controlled & Limited Emissions (PTE)[1]	
				Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
CO	0.18	lb/ODT	2	13.7	59.8	13.7	59.8	13.7	59.8
NO_X	0.34	lb/ODT	2	25.6	112	25.6	112	25.6	112
$PM/PM_{10}/PM_{2.5}$ (Filterable + Condensable)	3.41	lb/ODT	2	257	1,125	2.57	11.2	2.57	11.2
SO_2	0.025	lb/MMBtu	AP-42, Section 1.6[3]	5.00	21.9	5.00	21.9	5.00	21.9
Total VOC (as propane)	2.49	lb/ODT	2	187	820	9.36	41.0	9.36	41.0

Notes:

[1] Unlimited emissions assume maximum hourly throughput at 8,760 hours/year. Limited emissions are based on proposed annual throughput. Controlled emissions are based on proposed short-term and annual throughputs and application of control device efficiencies.

[2] Emission factors for all pollutants except for SO2 are based on stack testing data from the Greenwood plant and include contingency. The emission factors represent uncontrolled emissions.

[3] No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based upon the heat input of the dryer furnace using an emission factor for wood combustion from AP-42, Section 1.6.

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TABLE 4
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
ROTARY DRYER, GHM, AND GREEN CHIP SILO - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS GREENWOOD, LLC

Dryer Inputs

Annual Dried Wood Throughput of Dryer	**660,000**	ODT/year
Max. Hourly Dried Wood Throughput of Dryer	75.3	ODT/hr
Furnace Heat Input (HHV)	200.0	MMBtu/hr
Percent Hardwood	0.0%	
Percent Softwood	100.0%	
Annual Operation	8,760	hr/yr
Annual Heat Input	**1,752,000**	**MMBtu/yr**
Number of RTO Burners	**4**	
RTO Burner Rating	**8**	**MMBtu/hr**
RTO Control Efficiency	**95.00%**	

Potential HAP and TAP Emissions

Pollutant	HAP	VOC	Uncontrolled Emission Factor	Units	Footnote	Uncontrolled & Unlimited Emissions[9]		Controlled & Unlimited Emissions[9]		Controlled & Limited Emissions (PTE)[9]	
						Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
Furnace/Dryer - Biomass Source											
Acetaldehyde	Y	Y	1.9E-01	lb/ODT	1	14.0	61.5	0.70	3.08	0.70	3.08
Acrolein	Y	Y	1.2E-01	lb/ODT	1	9.11	39.9	0.46	2.00	0.46	2.00
Formaldehyde	Y	Y	1.2E-01	lb/ODT	1	9.04	39.6	0.45	1.98	0.45	1.98
Methanol	Y	Y	1.5E-01	lb/ODT	1	11.1	48.7	0.56	2.44	0.56	2.44
Phenol	Y	Y	1.5E-01	lb/ODT	1	11.3	49.5	0.56	2.47	0.56	2.47
Propionaldehyde	Y	Y	5.6E-02	lb/ODT	1	4.23	18.54	0.21	0.93	0.21	0.93
Acetophenone	Y	Y	3.2E-09	lb/MMBtu	2,3	6.40E-07	2.80E-06	3.20E-08	1.40E-07	3.2E-08	1.4E-07
Antimony and compounds	Y	N	7.9E-06	lb/MMBtu	2,4	1.58E-03	6.92E-03	1.15E-04	5.02E-04	1.1E-04	5.0E-04
Arsenic	Y	N	2.2E-05	lb/MMBtu	2,4	4.40E-03	1.93E-02	3.19E-04	1.40E-03	3.2E-04	1.4E-03
Benzene	Y	Y	4.2E-03	lb/MMBtu	2,3	8.40E-01	3.68E+00	4.20E-02	1.84E-01	4.2E-02	1.8E-01
Benzo(a)pyrene	Y	Y	2.6E-06	lb/MMBtu	2,3	5.20E-04	2.28E-03	2.60E-05	1.14E-04	2.6E-05	1.1E-04
Beryllium	Y	N	1.1E-06	lb/MMBtu	2,4	2.20E-04	9.64E-04	1.60E-05	6.99E-05	1.6E-05	7.0E-05
Cadmium	Y	N	4.1E-06	lb/MMBtu	2,4	8.20E-04	3.59E-03	5.95E-05	2.60E-04	5.9E-05	2.6E-04
Carbon tetrachloride	Y	Y	4.5E-05	lb/MMBtu	2,3	9.00E-03	3.94E-02	4.50E-04	1.97E-03	4.5E-04	2.0E-03
Chlorine	Y	N	7.9E-04	lb/MMBtu	2,8	2.18E+00	9.55E+00	1.58E-01	6.92E-01	1.6E-01	6.9E-01
Chlorobenzene	Y	Y	3.3E-05	lb/MMBtu	2,3	6.60E-03	2.89E-02	3.30E-04	1.45E-03	3.3E-04	1.4E-03
Chloroform	Y	Y	2.8E-05	lb/MMBtu	2,3	5.60E-03	2.45E-02	2.80E-04	1.23E-03	2.8E-04	1.2E-03
Chromium VI	-[5]	N	3.5E-06	lb/MMBtu	2,4,5	7.00E-04	3.07E-03	5.08E-05	2.22E-04	5.1E-05	2.2E-04
Chromium-Other compounds	Y	N	1.8E-05	lb/MMBtu	2,4	3.50E-03	1.53E-02	2.54E-04	1.11E-03	2.5E-04	1.1E-03
Cobalt compounds	Y	N	6.5E-06	lb/MMBtu	2,4	1.30E-03	5.69E-03	9.43E-05	4.13E-04	9.4E-05	4.1E-04
Dichloroethane, 1,2-	Y	Y	2.9E-05	lb/MMBtu	2,3	5.80E-03	2.54E-02	2.90E-04	1.27E-03	2.9E-04	1.3E-03
Dichloropropane, 1,2-	Y	Y	3.3E-05	lb/MMBtu	2,3	6.60E-03	2.89E-02	3.30E-04	1.45E-03	3.3E-04	1.4E-03
Dinitrophenol, 2,4-	Y	Y	1.8E-07	lb/MMBtu	2,3	3.60E-05	1.58E-04	1.80E-06	7.88E-06	1.8E-06	7.9E-06
Di(2-ethylhexyl)phthalate	Y	Y	4.7E-08	lb/MMBtu	2,3	9.40E-06	4.12E-05	4.70E-07	2.06E-06	4.7E-07	2.1E-06
Ethyl benzene	Y	Y	3.1E-05	lb/MMBtu	2,3	6.20E-03	2.72E-02	3.10E-04	1.36E-03	3.1E-04	1.4E-03

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TABLE 4
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
ROTARY DRYER, GHM, AND GREEN CHIP SILO - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS GREENWOOD, LLC

Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	N	Y	1.8E-11	lb/MMBtu	2,3	3.58E-09	1.57E-08	1.79E-10	7.84E-10	1.8E-10	7.8E-10
Hydrochloric acid	Y	N	1.9E-02	lb/MMBtu	2,6	3.80E+00	1.66E+01	3.80E-01	1.66E+00	3.8E-01	1.7E+00
Lead	Y	N	4.8E-05	lb/MMBtu	2,4	9.60E-03	4.20E-02	6.96E-04	3.05E-03	7.0E-04	3.0E-03
Manganese	Y	N	1.6E-03	lb/MMBtu	2,4	3.20E-01	1.40E+00	2.32E-02	1.02E-01	2.3E-02	1.0E-01
Mercury	Y	N	3.5E-06	lb/MMBtu	2,4	7.00E-04	3.07E-03	5.08E-05	2.22E-04	5.1E-05	2.2E-04
Methyl bromide	Y	Y	1.5E-05	lb/MMBtu	2,3	3.00E-03	1.31E-02	1.50E-04	6.57E-04	1.5E-04	6.6E-04
Methyl chloride	Y	Y	2.3E-05	lb/MMBtu	2,3	4.60E-03	2.01E-02	2.30E-04	1.01E-03	2.3E-04	1.0E-03
Methyl ethyl ketone	N	Y	5.4E-06	lb/MMBtu	2,3	1.08E-03	4.73E-03	5.40E-05	2.37E-04	5.4E-05	2.4E-04
Methylene chloride	Y	Y	2.9E-04	lb/MMBtu	2,3	5.80E-02	2.54E-01	2.90E-03	1.27E-02	2.9E-03	1.3E-02
Naphthalene	Y	Y	9.7E-05	lb/MMBtu	2,3	1.94E-02	8.50E-02	9.70E-04	4.25E-03	9.7E-04	4.2E-03
Nickel	Y	N	3.3E-05	lb/MMBtu	2,4	6.60E-03	2.89E-02	4.79E-04	2.10E-03	4.8E-04	2.1E-03
Nitrophenol, 4-	Y	Y	1.1E-07	lb/MMBtu	2,3	2.20E-05	9.64E-05	1.10E-06	4.82E-06	1.1E-06	4.8E-06
Pentachlorophenol	Y	N	5.1E-08	lb/MMBtu	2	1.02E-05	4.47E-05	5.10E-07	2.23E-06	5.1E-07	2.2E-06
Perchloroethylene	Y	N	3.8E-05	lb/MMBtu	2	7.60E-03	3.33E-02	3.80E-04	1.66E-03	3.8E-04	1.7E-03
Phosphorus metal, yellow or white	Y	N	2.7E-05	lb/MMBtu	2,4	5.40E-03	2.37E-02	3.92E-04	1.71E-03	3.9E-04	1.7E-03
Polychlorinated biphenyls	Y	Y	8.2E-09	lb/MMBtu	2,3	1.63E-06	7.14E-06	8.15E-08	3.57E-07	8.2E-08	3.6E-07
Polycyclic Organic Matter	Y	N	1.3E-04	lb/MMBtu	2	2.50E-02	1.10E-01	1.25E-03	5.48E-03	1.3E-03	5.5E-03
Selenium compounds	Y	N	2.8E-06	lb/MMBtu	2,4	5.60E-04	2.45E-03	4.06E-05	1.78E-04	4.1E-05	1.8E-04
Styrene	Y	Y	1.9E-03	lb/MMBtu	2,3	3.80E-01	1.66E+00	1.90E-02	8.32E-02	1.9E-02	8.3E-02
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	8.6E-12	lb/MMBtu	2,3	1.72E-09	7.53E-09	8.60E-11	3.77E-10	8.6E-11	3.8E-10
Toluene	Y	Y	3.0E-05	lb/MMBtu	2,3	6.00E-03	2.63E-02	3.00E-04	1.31E-03	3.0E-04	1.3E-03
Trichloroethane, 1,1,1-	Y	N	3.1E-05	lb/MMBtu	2	6.20E-03	2.72E-02	3.10E-04	1.36E-03	3.1E-04	1.4E-03
Trichloroethylene	Y	Y	3.0E-05	lb/MMBtu	2,3	6.00E-03	2.63E-02	3.00E-04	1.31E-03	3.0E-04	1.3E-03
Trichlorofluoromethane	N	Y	4.1E-05	lb/MMBtu	2,3	8.20E-03	3.59E-02	4.10E-04	1.80E-03	4.1E-04	1.8E-03
Trichlorophenol, 2,4,6-	Y	Y	2.2E-08	lb/MMBtu	2,3	4.40E-06	1.93E-05	2.20E-07	9.64E-07	2.2E-07	9.6E-07
Vinyl chloride	Y	Y	1.8E-05	lb/MMBtu	2,3	3.60E-03	1.58E-02	1.80E-04	7.88E-04	1.8E-04	7.9E-04
Xylene	Y	Y	2.5E-05	lb/MMBtu	2,3	5.00E-03	2.19E-02	2.50E-04	1.10E-03	2.5E-04	1.1E-03
			Total HAP Emissions (related to biomass)			**66.6**	**292**	**3.58**	**15.7**	**3.58**	**15.7**

TABLE 4
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
ROTARY DRYER, GHM, AND GREEN CHIP SILO - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS GREENWOOD, LLC

Pollutant	HAP	VOC	Emission Factor	Units	Footnote	Emissions (PTE)[10]	
						Max (lb/hr)	Annual (tpy)
RTO Burner - Natural Gas Source							
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	7	7.5E-07	3.3E-06
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	7	5.0E-07	2.2E-06
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	7	4.8E-07	2.1E-06
Acrolein	Y	Y	1.8E-05	lb/MMscf	7	5.6E-07	2.5E-06
Ammonia	N	N	3.2	lb/MMscf	7	1.0E-01	4.4E-01
Anthracene	Y	Y	2.4E-06	lb/MMscf	7	7.5E-08	3.3E-07
Arsenic	Y	N	2.0E-04	lb/MMscf	4,7	6.3E-06	2.7E-05
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Benzene	Y	Y	2.1E-03	lb/MMscf	7	6.6E-05	2.9E-04
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Beryllium	Y	N	1.2E-05	lb/MMscf	4,7	3.8E-07	1.6E-06
Cadmium	Y	N	1.1E-03	lb/MMscf	4,7	3.5E-05	1.5E-04
Chromium VI	Y	N	1.4E-03	lb/MMscf	4,7	4.4E-05	1.9E-04
Chrysene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Cobalt compounds	Y	N	8.4E-05	lb/MMscf	4,7	2.6E-06	1.2E-05
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	7	3.8E-05	1.6E-04
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	7	9.4E-08	4.1E-07
Fluorene	Y	Y	2.8E-06	lb/MMscf	7	8.8E-08	3.8E-07
Formaldehyde	Y	Y	7.5E-02	lb/MMscf	7	2.4E-03	1.0E-02
Hexane	Y	Y	1.8	lb/MMscf	7	5.6E-02	2.5E-01
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Lead	Y	N	5.0E-04	lb/MMscf	4,7	1.6E-05	6.9E-05
Manganese	Y	N	3.8E-04	lb/MMscf	4,7	1.2E-05	5.2E-05
Mercury	Y	N	2.6E-04	lb/MMscf	4,7	8.2E-06	3.6E-05
Naphthalene	Y	Y	6.1E-04	lb/MMscf	7	1.9E-05	8.4E-05
Nickel	Y	N	2.1E-03	lb/MMscf	4,7	6.6E-05	2.9E-04
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	7	5.3E-07	2.3E-06
Pyrene	Y	Y	5.0E-06	lb/MMscf	7	1.6E-07	6.9E-07
Selenium compounds	Y	N	2.4E-05	lb/MMscf	4,7	7.5E-07	3.3E-06
Toluene	Y	Y	3.4E-03	lb/MMscf	7	1.1E-04	4.7E-04
Total HAP Emissions (related to natural gas)						**0.059**	**0.26**

RAMBOLL

TABLE 4
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
ROTARY DRYER, GHM, AND GREEN CHIP SILO - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS GREENWOOD, LLC

Notes:

1. Emission factors were derived based on stack testing data for the Greenwood plant and comparable Enviva facilities and include contingency. The emission factors represent uncontrolled emissions.
2. Emission factors (criteria and HAP/TAP) for wood combustion in a stoker boiler from NCDAQ Wood Waste Combustion Spreadsheet/AP-42, Fifth Edition, Volume 1, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03.
3. The control efficiency of 95.0% for the RTO is applied to all VOC hazardous and toxic pollutants.
4. The control efficiency of the wet electrostatic precipitator (WESP) for filterable particulate matter is applied to all metal hazardous and toxic pollutants from the dryer and duct burners. Actual design filterable efficiency is estimated to 96.4%, but 92.75% is assumed for toxics permitting.
5. Chromium VI is a subset of chromium compounds, which is accounted for separately as a HAP. As such, Chromium VI is only calculated as a TAP.
6. The WESP employs a caustic solution in its operation in which hydrochloric acid will have high water solubility. This caustic solution will neutralize the acid and effectively control it by 90%, per conversation on October 18, 2011 with Steven A. Jaasund, P.E. of Lundberg Associates, a manufacturer of WESPs.
7. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.
8. It was assumed that chlorine is not oxidized in the RTO.
9. Unlimited emissions assume maximum hourly throughput at 8,760 hours/year. Limited emissions are based on proposed annual throughput. Controlled emissions are based on proposed short-term and annual throughputs and application of control device efficiencies.
10. No control devices or limitations proposed for this unit.

Abbreviations:

CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

TABLE 5
POTENTIAL EMISSIONS - FURNACE BYPASS (COLD START-UP)[1]
ENVIVA PELLETS GREENWOOD, LLC

Calculation Basis

Hourly Heat Input Capacity (HHV)[1]	30	MMBtu/hr
Annual Heat Input Capacity	1,500	MMBtu/yr
Hours of Operation[1]	50	hr/yr
Annual Diesel Usage[2]	200	gal/yr
Hourly Diesel Usage[2]	30	gal/hr

Notes:

[1] The furnace bypass stack will be used when the furnace is started up from a cold shutdown until the secondary combustion zone temperature approaches 600 °F. The heat input rate of the furnace during this initial stage of the start-up is not expected to exceed 15% of the maximum heat input rate of the unit. Once the secondary combustion zone temperature reaches 600 °F, the unit's induced draft fan is started and, although the bypass stack remains open, it is no longer exhausting emissions from the furnace. Instead, the bypass stack remains open to allow ambient air to be pulled through the dryer and during this time emissions are routed to the control devices for the furnace and dryer. Once the secondary combustion zone temperature reaches approximately 900 °F, the furnace bypass stack is closed. Use of the furnace bypass stack for cold start-ups will not exceed 8 hours per start-up and 50 hours per year.

[2] The amount of fuel used per event is typically 15 to 30 gallons and the annual usage is typically 100 to 200 gallons. The 30 gallons per start-up are conservatively assumed to be used in one hour or less for purposes of estimating maximum hourly emissions.

Potential Criteria Pollutant Emissions - Biomass Combustion

Pollutant	Uncontrolled Emission Factor	Units	Uncontrolled & Unlimited Emissions[2]		Controlled & Unlimited Emissions[2]		Controlled & Limited Emissions (PTE)[2]	
			Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
CO	0.60	lb/MMBtu[1]	18.0	78.8	18.0	78.8	18.0	0.45
NO_X	0.22	lb/MMBtu[1]	6.60	28.9	6.60	28.9	6.60	0.17
SO_2	0.025	lb/MMBtu[1]	0.75	3.29	0.75	3.29	0.75	0.019
VOC	0.017	lb/MMBtu[1]	0.51	2.23	0.51	2.23	0.51	0.013
Total PM	0.58	lb/MMBtu[1]	17.3	75.8	17.3	75.8	17.3	0.43
Total PM_{10}	0.52	lb/MMBtu[1]	15.5	67.9	15.5	67.9	15.5	0.39
Total $PM_{2.5}$	0.45	lb/MMBtu[1]	13.4	58.7	13.4	58.7	13.4	0.34

Notes:

[1] CO, NO_X, SO_2, PM, PM_{10}, $PM_{2.5}$ and VOC emission rates based on AP-42, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. PM, PM_{10}, and $PM_{2.5}$ factors equal to the sum of the filterable and condensable factors from Table 1.6-1. VOC emission factor excludes formaldehyde.

[2] Unlimited emissions are based on the maximum hourly heat input for this operating mode at 8,760 hours/year. Limited emissions are based on the proposed annual operating hour limit.

Potential HAP Emissions - Biomass Combustion

Pollutant	Uncontrolled Emission Factor	Units	Footnote	Uncontrolled & Unlimited Emissions[2]		Controlled & Unlimited Emissions[2]		Controlled & Limited Emissions (PTE)[2]	
				Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1	2.49E-02	1.09E-01	2.49E-02	1.09E-01	2.49E-02	6.23E-04
Acrolein	4.00E-03	lb/MMBtu	1	1.20E-01	5.26E-01	1.20E-01	5.26E-01	1.20E-01	3.00E-03
Formaldehyde	4.40E-03	lb/MMBtu	1	1.32E-01	5.78E-01	1.32E-01	5.78E-01	1.32E-01	3.30E-03
Phenol	5.10E-05	lb/MMBtu	1	1.53E-03	6.70E-03	1.53E-03	6.70E-03	1.53E-03	3.83E-05
Propionaldehyde	6.10E-05	lb/MMBtu	1	1.83E-03	8.02E-03	1.83E-03	8.02E-03	1.83E-03	4.58E-05
Acetophenone	3.2E-09	lb/MMBtu	1	9.60E-08	4.20E-07	9.60E-08	4.20E-07	9.60E-08	2.40E-09
Antimony and compounds	7.9E-06	lb/MMBtu	1	2.37E-04	1.04E-03	2.37E-04	1.04E-03	2.37E-04	5.93E-06
Arsenic	2.2E-05	lb/MMBtu	1	6.60E-04	2.89E-03	6.60E-04	2.89E-03	6.60E-04	1.65E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	7.80E-05	3.42E-04	7.80E-05	3.42E-04	7.80E-05	1.95E-06
Beryllium	1.1E-06	lb/MMBtu	1	3.30E-05	1.45E-04	3.30E-05	1.45E-04	3.30E-05	8.25E-07
Cadmium	4.1E-06	lb/MMBtu	1	1.23E-04	5.39E-04	1.23E-04	5.39E-04	1.23E-04	3.08E-06
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	1.35E-03	5.91E-03	1.35E-03	5.91E-03	1.35E-03	3.38E-05
Chlorine	7.9E-04	lb/MMBtu	1	2.37E-02	1.04E-01	2.37E-02	1.04E-01	2.37E-02	5.93E-04
Chlorobenzene	3.3E-05	lb/MMBtu	1	9.90E-04	4.34E-03	9.90E-04	4.34E-03	9.90E-04	2.48E-05
Chromium-Other compounds	2.1E-05	lb/MMBtu	1	6.30E-04	2.76E-03	6.30E-04	2.76E-03	6.30E-04	1.58E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	1.95E-04	8.54E-04	1.95E-04	8.54E-04	1.95E-04	4.88E-06
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	5.40E-06	2.37E-05	5.40E-06	2.37E-05	5.40E-06	1.35E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	1.41E-06	6.18E-06	1.41E-06	6.18E-06	1.41E-06	3.53E-08
Ethyl benzene	3.1E-05	lb/MMBtu	1	9.30E-04	4.07E-03	9.30E-04	4.07E-03	9.30E-04	2.33E-05
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	8.70E-04	3.81E-03	8.70E-04	3.81E-03	8.70E-04	2.18E-05
Hydrochloric acid	1.9E-02	lb/MMBtu	1	5.70E-01	2.50E+00	5.70E-01	2.50E+00	5.70E-01	1.43E-02
Lead	4.8E-05	lb/MMBtu	1	1.44E-03	6.31E-03	1.44E-03	6.31E-03	1.44E-03	3.60E-05
Manganese	1.6E-03	lb/MMBtu	1	4.80E-02	2.10E-01	4.80E-02	2.10E-01	4.80E-02	1.20E-03
Mercury	3.5E-06	lb/MMBtu	1	1.05E-04	4.60E-04	1.05E-04	4.60E-04	1.05E-04	2.63E-06
Methyl bromide	1.5E-05	lb/MMBtu	1	4.50E-04	1.97E-03	4.50E-04	1.97E-03	4.50E-04	1.13E-05
Methyl chloride	2.3E-05	lb/MMBtu	1	6.90E-04	3.02E-03	6.90E-04	3.02E-03	6.90E-04	1.73E-05
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	9.30E-04	4.07E-03	9.30E-04	4.07E-03	9.30E-04	2.33E-05
Naphthalene	9.7E-05	lb/MMBtu	1	2.91E-03	1.27E-02	2.91E-03	1.27E-02	2.91E-03	7.28E-05
Nickel	3.3E-05	lb/MMBtu	1	9.90E-04	4.34E-03	9.90E-04	4.34E-03	9.90E-04	2.48E-05

TABLE 5
POTENTIAL EMISSIONS - FURNACE BYPASS (COLD START-UP)[1]
ENVIVA PELLETS GREENWOOD, LLC

Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	3.30E-06	1.45E-05	3.30E-06	1.45E-05	3.30E-06	8.25E-08
Pentachlorophenol	5.1E-08	lb/MMBtu	1	1.53E-06	6.70E-06	1.53E-06	6.70E-06	1.53E-06	3.83E-08
Perchloroethylene	3.8E-05	lb/MMBtu	1	1.14E-03	4.99E-03	1.14E-03	4.99E-03	1.14E-03	2.85E-05
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	8.10E-04	3.55E-03	8.10E-04	3.55E-03	8.10E-04	2.03E-05
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	2.45E-07	1.07E-06	2.45E-07	1.07E-06	2.45E-07	6.11E-09
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	3.75E-03	1.64E-02	3.75E-03	1.64E-02	3.75E-03	9.38E-05
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	9.90E-04	4.34E-03	9.90E-04	4.34E-03	9.90E-04	2.48E-05
Selenium compounds	2.8E-06	lb/MMBtu	1	8.40E-05	3.68E-04	8.40E-05	3.68E-04	8.40E-05	2.10E-06
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	2.58E-10	1.13E-09	2.58E-10	1.13E-09	2.58E-10	6.45E-12
Trichloroethylene	3.0E-05	lb/MMBtu	1	9.00E-04	3.94E-03	9.00E-04	3.94E-03	9.00E-04	2.25E-05
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	6.60E-07	2.89E-06	6.60E-07	2.89E-06	6.60E-07	1.65E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	5.40E-04	2.37E-03	5.40E-04	2.37E-03	5.40E-04	1.35E-05
Total HAP Emissions (Biomass Combustion)				**0.94**	**4.12**	**0.94**	**4.12**	**0.94**	**0.024**

Notes:

1. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

2. Unlimited emissions are based on the maximum hourly heat input for this operating mode at 8,760 hours/year. Limited emissions are based on the proposed annual operating hour limit.

Potential Criteria Pollutant Emissions - Diesel Fuel Combustion

Pollutant	Uncontrolled Emission Factor	Units	Uncontrolled & Unlimited Emissions		Controlled & Unlimited Emissions		Controlled & Limited Emissions (PTE)	
			Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
CO	5	lb/Mgal[1]	1.50E-01	5.00E-04	1.50E-01	5.00E-04	1.50E-01	5.00E-04
NO_x	20	lb/Mgal[1]	6.00E-01	2.00E-03	6.00E-01	2.00E-03	6.00E-01	2.00E-03
SO_2	0.2	lb/Mgal[1]	6.39E-03	2.13E-05	6.39E-03	2.13E-05	6.39E-03	2.13E-05
VOC	0.2	lb/Mgal[1]	6.00E-03	2.00E-05	6.00E-03	2.00E-05	6.00E-03	2.00E-05
Total $PM/PM_{10}/PM_{2.5}$	3.3	lb/Mgal[1]	9.90E-02	3.30E-04	9.90E-02	3.30E-04	9.90E-02	3.30E-04

Notes:

1. CO, NO_x, SO_2, PM, and VOC emission rates based on AP-42, Chapter 1.3 - Fuel Oil Combustion, 5/10 for distillate fuel oil combustion. Emissions of SO_2 assume a 15 ppm sulfur content in diesel fuel.

Potential HAP Emissions - Diesel Fuel Combustion

Pollutant	Uncontrolled Emission Factor	Units	Footnote	Uncontrolled & Unlimited Emissions		Controlled & Unlimited Emissions		Controlled & Limited Emissions (PTE)	
				Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
Formaldehyde	3.30E-02	lb/Mgal	1	9.90E-04	3.30E-06	9.90E-04	3.30E-06	9.90E-04	3.30E-06
Acenaphthene	2.11E-05	lb/Mgal	1	6.33E-07	2.11E-09	6.33E-07	2.11E-09	6.33E-07	2.11E-09
Acenaphthylene	2.53E-07	lb/Mgal	1	7.59E-09	2.53E-11	7.59E-09	2.53E-11	7.59E-09	2.53E-11
Anthracene	1.2E-06	lb/Mgal	1	3.66E-08	1.22E-10	3.66E-08	1.22E-10	3.66E-08	1.22E-10
Arsenic	4.0E-06	lb/MMBtu	1	1.68E-05	5.60E-08	1.68E-05	5.60E-08	1.68E-05	5.60E-08
Benzene	2.1E-04	lb/Mgal	1	6.42E-06	2.14E-08	6.42E-06	2.14E-08	6.42E-06	2.14E-08
Benz(a)anthracene	4.0E-06	lb/Mgal	1	1.20E-07	4.01E-10	1.20E-07	4.01E-10	1.20E-07	4.01E-10
Benzo(b,k)fluoranthene	1.5E-06	lb/Mgal	1	4.44E-08	1.48E-10	4.44E-08	1.48E-10	4.44E-08	1.48E-10
Benzo(g,h,i)perylene	2.3E-06	lb/Mgal	1	6.78E-08	2.26E-10	6.78E-08	2.26E-10	6.78E-08	2.26E-10
Beryllium	3.0E-06	lb/MMBtu	1	1.26E-05	4.20E-08	1.26E-05	4.20E-08	1.26E-05	4.20E-08
Cadmium	3.0E-06	lb/MMBtu	1	1.26E-05	4.20E-08	1.26E-05	4.20E-08	1.26E-05	4.20E-08
Chromium-Other compounds	3.0E-06	lb/MMBtu	1	1.26E-05	4.20E-08	1.26E-05	4.20E-08	1.26E-05	4.20E-08
Chrysene	2.4E-06	lb/Mgal	1	7.14E-08	2.38E-10	7.14E-08	2.38E-10	7.14E-08	2.38E-10
Copper	6.0E-06	lb/MMBtu	1	2.52E-05	8.40E-08	2.52E-05	8.40E-08	2.52E-05	8.40E-08
Dibenzo(a,h) anthracene	1.7E-06	lb/Mgal	1	5.01E-08	1.67E-10	5.01E-08	1.67E-10	5.01E-08	1.67E-10
Ethyl benzene	6.4E-05	lb/Mgal	1	1.91E-06	6.36E-09	1.91E-06	6.36E-09	1.91E-06	6.36E-09
Fluoranthene	4.8E-06	lb/Mgal	1	1.45E-07	4.84E-10	1.45E-07	4.84E-10	1.45E-07	4.84E-10
Fluorene	4.5E-06	lb/Mgal	1	1.34E-07	4.47E-10	1.34E-07	4.47E-10	1.34E-07	4.47E-10
Indeno(1,2,3-cd)pyrene	2.1E-06	lb/Mgal	1	6.42E-08	2.14E-10	6.42E-08	2.14E-10	6.42E-08	2.14E-10
Lead	9.0E-06	lb/MMBtu	1	3.78E-05	1.26E-07	3.78E-05	1.26E-07	3.78E-05	1.26E-07
Manganese	6.0E-06	lb/MMBtu	1	2.52E-05	8.40E-08	2.52E-05	8.40E-08	2.52E-05	8.40E-08
Mercury	3.0E-06	lb/MMBtu	1	1.26E-05	4.20E-08	1.26E-05	4.20E-08	1.26E-05	4.20E-08
Trichloroethane, 1,1,1-	2.4E-04	lb/Mgal	1	7.08E-06	2.36E-08	7.08E-06	2.36E-08	7.08E-06	2.36E-08
Naphthalene	1.1E-03	lb/Mgal	1	3.39E-05	1.13E-07	3.39E-05	1.13E-07	3.39E-05	1.13E-07
Nickel	3.0E-06	lb/MMBtu	1	1.26E-05	4.20E-08	1.26E-05	4.20E-08	1.26E-05	4.20E-08
Octachlorodibenzodioxin	3.1E-09	lb/Mgal	1	9.30E-11	3.10E-13	9.30E-11	3.10E-13	9.30E-11	3.10E-13
Phenanthrene	1.1E-05	lb/Mgal	1	3.15E-07	1.05E-09	3.15E-07	1.05E-09	3.15E-07	1.05E-09
Pyrene	4.3E-06	lb/Mgal	1	1.28E-07	4.25E-10	1.28E-07	4.25E-10	1.28E-07	4.25E-10
Selenium compounds	1.5E-05	lb/MMBtu	1	6.30E-05	2.10E-07	6.30E-05	2.10E-07	6.30E-05	2.10E-07
Toluene	6.2E-03	lb/Mgal	1	1.86E-04	6.20E-07	1.86E-04	6.20E-07	1.86E-04	6.20E-07
Xylene	1.1E-04	lb/Mgal	1	3.27E-06	1.09E-08	3.27E-06	1.09E-08	3.27E-06	1.09E-08
Zinc	4.0E-06	lb/MMBtu	1	1.68E-05	5.60E-08	1.68E-05	5.60E-08	1.68E-05	5.60E-08
Total HAP Emissions (Diesel Fuel Combustion)				**1.48E-03**	**4.93E-06**	**1.48E-03**	**4.93E-06**	**1.48E-03**	**4.93E-06**

Notes:

1. CO, NO_x, SO_2, PM, and VOC emission rates based on AP-42, Chapter 1.3 - Fuel Oil Combustion, 5/10 for distillate fuel oil combustion.

TABLE 5
POTENTIAL EMISSIONS - FURNACE BYPASS (COLD START-UP)[1]
ENVIVA PELLETS GREENWOOD, LLC

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

TABLE 6
POTENTIAL EMISSIONS - FURNACE BYPASS (IDLE MODE)[1]
ENVIVA PELLETS GREENWOOD, LLC

Calculation Basis

Hourly Heat Input Capacity	12 MMBtu/hr
Annual Heat Input Capacity	6,000 MMBtu/yr
Hours of Operation[1]	500 hr/yr

Potential Criteria Pollutant Emissions

Pollutant	Uncontrolled Emission Factor	Units	Uncontrolled & Unlimited Emissions[3]		Controlled & Unlimited Emissions[3]		Controlled & Limited Emissions (PTE)[3]	
			Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
CO	0.60	lb/MMBtu[2]	7.20	31.5	7.20	31.5	7.20	1.80
NO_X	0.22	lb/MMBtu[2]	2.64	11.6	2.64	11.6	2.64	0.66
SO_2	0.025	lb/MMBtu[2]	0.30	1.31	0.30	1.314	0.30	0.075
VOC	0.017	lb/MMBtu[2]	0.20	0.89	0.20	0.89	0.20	0.051
Total PM	0.58	lb/MMBtu[2]	6.92	30.3	6.92	30.33	6.92	1.73
Total PM_{10}	0.52	lb/MMBtu[2]	6.20	27.2	6.20	27.17	6.20	1.55
Total $PM_{2.5}$	0.45	lb/MMBtu[2]	5.36	23.5	5.36	23.49	5.36	1.34

Notes:

1. Idle mode is defined as operation at up to a maximum heat input rate of 12 MMBtu/hr. The furnace may operate in idle mode for up to 500 hr/yr.

2. CO, NO_X, SO_2, PM, PM_{10}, $PM_{2.5}$, and VOC emission rates based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. PM_{10} and $PM_{2.5}$ factors equal to the sum of the filterable and condensable factors from Table 1.6-1. VOC emission factor excludes formaldehyde.

3. Unlimited emissions are based on the maximum hourly heat input for this operating mode at 8,760 hours/year. Limited emissions are based on the proposed annual operating hour limit.

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TABLE 6
POTENTIAL EMISSIONS - FURNACE BYPASS (IDLE MODE)[1]
ENVIVA PELLETS GREENWOOD, LLC

Potential HAP Emissions

Pollutant	Uncontrolled Emission Factor	Units	Footnote	Uncontrolled & Unlimited Emissions[2]		Controlled & Unlimited Emissions[2]		Controlled & Limited Emissions (PTE)[2]	
				Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1	9.96E-03	4.36E-02	9.96E-03	4.36E-02	9.96E-03	2.49E-03
Acrolein	4.00E-03	lb/MMBtu	1	4.80E-02	2.10E-01	4.80E-02	2.10E-01	4.80E-02	1.20E-02
Formaldehyde	4.40E-03	lb/MMBtu	1	5.28E-02	2.31E-01	5.28E-02	2.31E-01	5.28E-02	1.32E-02
Phenol	5.10E-05	lb/MMBtu	1	6.12E-04	2.68E-03	6.12E-04	2.68E-03	6.12E-04	1.53E-04
Propionaldehyde	6.10E-05	lb/MMBtu	1	7.32E-04	3.21E-03	7.32E-04	3.21E-03	7.32E-04	1.83E-04
Acetophenone	3.2E-09	lb/MMBtu	1	3.84E-08	1.68E-07	3.84E-08	1.68E-07	3.84E-08	9.60E-09
Antimony and compounds	7.9E-06	lb/MMBtu	1	9.48E-05	4.15E-04	9.48E-05	4.15E-04	9.48E-05	2.37E-05
Arsenic	2.2E-05	lb/MMBtu	1	2.64E-04	1.16E-03	2.64E-04	1.16E-03	2.64E-04	6.60E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	3.12E-05	1.37E-04	3.12E-05	1.37E-04	3.12E-05	7.80E-06
Beryllium	1.1E-06	lb/MMBtu	1	1.32E-05	5.78E-05	1.32E-05	5.78E-05	1.32E-05	3.30E-06
Cadmium	4.1E-06	lb/MMBtu	1	4.92E-05	2.15E-04	4.92E-05	2.15E-04	4.92E-05	1.23E-05
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	5.40E-04	2.37E-03	5.40E-04	2.37E-03	5.40E-04	1.35E-04
Chlorine	7.9E-04	lb/MMBtu	1	9.48E-03	4.15E-02	9.48E-03	4.15E-02	9.48E-03	2.37E-03
Chlorobenzene	3.3E-05	lb/MMBtu	1	3.96E-04	1.73E-03	3.96E-04	1.73E-03	3.96E-04	9.90E-05
Chromium-Other compounds	2.1E-05	lb/MMBtu	1	2.52E-04	1.10E-03	2.52E-04	1.10E-03	2.52E-04	6.30E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	7.80E-05	3.42E-04	7.80E-05	3.42E-04	7.80E-05	1.95E-05
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	2.16E-06	9.46E-06	2.16E-06	9.46E-06	2.16E-06	5.40E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	5.64E-07	2.47E-06	5.64E-07	2.47E-06	5.64E-07	1.41E-07
Ethyl benzene	3.1E-05	lb/MMBtu	1	3.72E-04	1.63E-03	3.72E-04	1.63E-03	3.72E-04	9.30E-05
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	3.48E-04	1.52E-03	3.48E-04	1.52E-03	3.48E-04	8.70E-05
Hydrochloric acid	1.9E-02	lb/MMBtu	1	2.28E-01	9.99E-01	2.28E-01	9.99E-01	2.28E-01	5.70E-02
Lead	4.8E-05	lb/MMBtu	1	5.76E-04	2.52E-03	5.76E-04	2.52E-03	5.76E-04	1.44E-04
Manganese	1.6E-03	lb/MMBtu	1	1.92E-02	8.41E-02	1.92E-02	8.41E-02	1.92E-02	4.80E-03
Mercury	3.5E-06	lb/MMBtu	1	4.20E-05	1.84E-04	4.20E-05	1.84E-04	4.20E-05	1.05E-05
Methyl bromide	1.5E-05	lb/MMBtu	1	1.80E-04	7.88E-04	1.80E-04	7.88E-04	1.80E-04	4.50E-05
Methyl chloride	2.3E-05	lb/MMBtu	1	2.76E-04	1.21E-03	2.76E-04	1.21E-03	2.76E-04	6.90E-05
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	3.72E-04	1.63E-03	3.72E-04	1.63E-03	3.72E-04	9.30E-05
Naphthalene	9.7E-05	lb/MMBtu	1	1.16E-03	5.10E-03	1.16E-03	5.10E-03	1.16E-03	2.91E-04
Nickel	3.3E-05	lb/MMBtu	1	3.96E-04	1.73E-03	3.96E-04	1.73E-03	3.96E-04	9.90E-05
Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	1.32E-06	5.78E-06	1.32E-06	5.78E-06	1.32E-06	3.30E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	1	6.12E-07	2.68E-06	6.12E-07	2.68E-06	6.12E-07	1.53E-07
Perchloroethylene	3.8E-05	lb/MMBtu	1	4.56E-04	2.00E-03	4.56E-04	2.00E-03	4.56E-04	1.14E-04
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	3.24E-04	1.42E-03	3.24E-04	1.42E-03	3.24E-04	8.10E-05
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	9.78E-08	4.28E-07	9.78E-08	4.28E-07	9.78E-08	2.45E-08
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	1.50E-03	6.57E-03	1.50E-03	6.57E-03	1.50E-03	3.75E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	3.96E-04	1.73E-03	3.96E-04	1.73E-03	3.96E-04	9.90E-05
Selenium compounds	2.8E-06	lb/MMBtu	1	3.36E-05	1.47E-04	3.36E-05	1.47E-04	3.36E-05	8.40E-06
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	1.03E-10	4.52E-10	1.03E-10	4.52E-10	1.03E-10	2.58E-11
Trichloroethylene	3.0E-05	lb/MMBtu	1	3.60E-04	1.58E-03	3.60E-04	1.58E-03	3.60E-04	9.00E-05
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	2.64E-07	1.16E-06	2.64E-07	1.16E-06	2.64E-07	6.60E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	2.16E-04	9.46E-04	2.16E-04	9.46E-04	2.16E-04	5.40E-05
Total HAP Emissions (Biomass Combustion)				**0.38**	**1.65**	**0.38**	**1.65**	**0.38**	**0.094**

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TABLE 6
POTENTIAL EMISSIONS - FURNACE BYPASS (IDLE MODE)[1]
ENVIVA PELLETS GREENWOOD, LLC

Notes:

1. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
2. Unlimited emissions are based on the maximum hourly heat input for this operating mode at 8,760 hours/year. Limited emissions are based on the proposed annual operating hour limit.

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

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TABLE 7
DRYER DUCT BURNER POTENTIAL EMISSIONS
ENVIVA PELLETS GREENWOOD, LLC

Duct Burner Inputs

Duct Burner Rating	5 MMBtu/hr
Number of Duct Burners	1
Annual Operation	8,760 hr/yr

Potential Criteria Pollutant Emissions - Natural Gas Combustion

Pollutant	Emission Factor	Units	Footnote	Emissions (PTE)[2]	
				Max (lb/hr)	Annual (tpy)
CO	84.0	lb/MMscf	1	0.41	1.80
NO_X	100.0	lb/MMscf	1	0.49	2.15
SO_2	0.60	lb/MMscf	1	0.0029	0.013
VOC	5.50	lb/MMscf	1	0.027	0.12
$PM/PM_{10}/PM_{2.5}$ Condensable	5.70	lb/MMscf	1	0.028	0.12
$PM/PM_{10}/PM_{2.5}$ Filterable	1.90	lb/MMscf	1	0.0093	0.041
Total $PM/PM_{10}/PM_{2.5}$				0.037	0.16

Notes:

[1] Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.

[2] No control devices or limitations are proposed for this unit.

TABLE 7
DRYER DUCT BURNER POTENTIAL EMISSIONS
ENVIVA PELLETS GREENWOOD, LLC

Potential HAP and TAP Emissions

Pollutant	HAP	VOC	Emission Factor	Units	Footnote	Emissions (PTE)[2]	
						Max (lb/hr)	Annual (tpy)
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	1	1.2E-07	5.2E-07
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	1	8.8E-09	3.9E-08
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	1	7.8E-08	3.4E-07
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	1	8.8E-09	3.9E-08
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	1	8.8E-09	3.9E-08
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	1	7.5E-08	3.3E-07
Acrolein	Y	Y	1.8E-05	lb/MMscf	1	8.8E-08	3.9E-07
Ammonia	N	N	3.2	lb/MMscf	1	1.6E-02	6.9E-02
Anthracene	Y	Y	2.4E-06	lb/MMscf	1	1.2E-08	5.2E-08
Arsenic	Y	N	2.0E-04	lb/MMscf	1	9.8E-07	4.3E-06
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	1	8.8E-09	3.9E-08
Benzene	Y	Y	2.1E-03	lb/MMscf	1	1.0E-05	4.5E-05
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	1	5.9E-09	2.6E-08
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	1	8.8E-09	3.9E-08
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	1	5.9E-09	2.6E-08
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	1	8.8E-09	3.9E-08
Beryllium	Y	N	1.2E-05	lb/MMscf	1	5.9E-08	2.6E-07
Cadmium	Y	N	1.1E-03	lb/MMscf	1	5.4E-06	2.4E-05
Chromium VI	Y	N	1.4E-03	lb/MMscf	1	6.9E-06	3.0E-05
Chrysene	Y	Y	1.8E-06	lb/MMscf	1	8.8E-09	3.9E-08
Cobalt compounds	Y	N	8.4E-05	lb/MMscf	1	4.1E-07	1.8E-06
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	1	5.9E-09	2.6E-08
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	1	5.9E-06	2.6E-05
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	1	1.5E-08	6.4E-08
Fluorene	Y	Y	2.8E-06	lb/MMscf	1	1.4E-08	6.0E-08
Formaldehyde	Y	Y	7.5E-02	lb/MMscf	1	3.7E-04	1.6E-03
Hexane	Y	Y	1.8	lb/MMscf	1	8.8E-03	3.9E-02
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	1	8.8E-09	3.9E-08
Lead	Y	N	5.0E-04	lb/MMscf	1	2.5E-06	1.1E-05
Manganese	Y	N	3.8E-04	lb/MMscf	1	1.9E-06	8.2E-06
Mercury	Y	N	2.6E-04	lb/MMscf	1	1.3E-06	5.6E-06
Naphthalene	Y	Y	6.1E-04	lb/MMscf	1	3.0E-06	1.3E-05
Nickel	Y	N	2.1E-03	lb/MMscf	1	1.0E-05	4.5E-05
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	1	8.3E-08	3.7E-07
Pyrene	Y	Y	5.0E-06	lb/MMscf	1	2.5E-08	1.1E-07
Selenium compounds	Y	N	2.4E-05	lb/MMscf	1	1.2E-07	5.2E-07
Toluene	Y	Y	3.4E-03	lb/MMscf	1	1.7E-05	7.3E-05
					Total HAP Emissions	**0.0093**	**0.041**

Notes:

1. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.

2. No control devices or limitations are proposed for this unit.

TABLE 7
DRYER DUCT BURNER POTENTIAL EMISSIONS
ENVIVA PELLETS GREENWOOD, LLC

Abbreviations:

CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NC - North Carolina
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

TABLE 8
POTENTIAL DRY HAMMERMILL EMISSIONS AT OUTLET OF RTO-1 STACK
ENVIVA PELLETS GREENWOOD, LLC

Calculation Basis

Total Plant Throughput	660,000	ODT/yr
% of Total Throughput to the Hammermills	100%	
Hours of Operation	8,760	hr/yr
VOC/HAP Control Efficiency	95.0%	
Particulate Matter Control Efficiency	99.0%	
Hammermills Annual Throughput	660,000	ODT/yr
Hammermills Hourly Throughput	88	ODT/hr
Cyclofilter Control Efficiency	99%	

Potential PM, VOC and HAP Emissions

Pollutant	CAS No.	HAP	VOC	Emission Factor[1]	Uncontrolled & Unlimited Emissions[4]		Controlled & Unlimited Emissions[4]		Controlled & Limited Emissions (PTE)[2,4]	
				(lb/ODT)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
Acetaldehyde	75-07-0	Y	Y	0.0072	0.64	2.79	0.032	0.14	0.032	0.12
Acrolein	107-02-8	Y	Y	0.011	0.96	4.19	0.048	0.21	0.048	0.18
Formaldehyde	50-00-0	Y	Y	0.00024	0.021	0.093	0.0011	0.0046	0.0011	0.0040
Methanol	67-56-1	Y	Y	0.0059	0.52	2.27	0.026	0.11	0.03	0.10
Phenol	108-95-2	Y	Y	0.0028	0.24	1.07	0.012	0.053	0.012	0.045
Propionaldehyde	123-38-6	Y	Y	0.012	1.09	4.79	0.055	0.24	0.055	0.20
Total HAP Emissions:					**3.47**	**15.2**	**0.17**	**0.76**	**0.17**	**0.65**
Total VOC (as propane)	--	--	Y	1.23	109	477	5.44	23.8	5.44	20.3
$PM/PM_{10}/PM_{2.5}$ (Filterable + Condensable)	--	--	--	0.17	1,506	6,596	15.1	66.0	15.1	56.3

Thermal Generated Potential Criteria Pollutant Emissions

Maximum high heating value of VOC constituents	1.8E-02	MMBtu/lb
Uncontrolled VOC emissions	407	tons/yr
Uncontrolled VOC emissions	109	lb/hr
Heat input of uncontrolled VOC emissions	15,038	MMBtu/yr
Heat input of uncontrolled VOC emissions	2.0	MMBtu/hr

TABLE 8

POTENTIAL DRY HAMMERMILL EMISSIONS AT OUTLET OF RTO-1 STACK

ENVIVA PELLETS GREENWOOD, LLC

Pollutant	Emission Factor[3]	Units	Uncontrolled & Unlimited Emissions[4]		Controlled & Unlimited Emissions[4]		Controlled & Limited Emissions (PTE)[4]	
			Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
CO	8.2E-02	lb/MMBtu	0.00	0.00	0.17	0.73	0.17	0.62
NO_x	9.8E-02	lb/MMBtu	0.00	0.00	0.20	0.86	0.20	0.74

Notes:

1. Emission factors were derived based on stack testing data for the Greenwood plant and comparable Enviva facilities and include contingency. The emission factors represent uncontrolled emissions with the exception of the PM factor, which is controlled.
2. VOC and HAP emissions controlled by furnace or RTO1 at 95%
3. CO and NO_x emission factors are from AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers.
4. Unlimited emissions assume maximum hourly throughput at 8,760 hours/year. Limited emissions are based on proposed annual throughput. Controlled emissions are based on proposed short-term and annual throughputs and application of control device efficiencies.

Abbreviations:

CAS - chemical abstract service
HAP - hazardous air pollutant
hr - hour
lb - pound
ODT - oven dried tons
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

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TABLE 9

POTENTIAL PELLET PRESS AND COOLER EMISSIONS AT OUTLET OF RTO-2/RCO-1 STACK

ENVIVA PELLETS GREENWOOD, LLC

Calculation Basis

Annual Throughput	330,000	ODT/yr
Hourly Throughput	45	ODT/hr
Hours of Operation	8,760	hr/yr
Number of Burners	1	burners
RTO/RCO Burner Rating	5.2	MMBtu/hr
RTO/RCO Control Efficiency	95%	
Baghouse Control Efficiency	99%	

Pellet Mill and Cooler Potential CO, NO_X, VOC and HAP Emissions

Pollutant	CAS No.	HAP	VOC	Emission Factor[1]	Uncontrolled & Unlimited Emissions[4]		Controlled & Unlimited Emissions[4]		Controlled & Limited Emissions (PTE)[2,4]	
				(lb/ODT)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
Acetaldehyde	75-07-0	Y	Y	0.034	1.52	6.68	0.076	0.33	0.076	0.28
Acrolein	107-02-8	Y	Y	0.050	2.26	9.91	0.11	0.50	0.11	0.41
Formaldehyde	50-00-0	Y	Y	0.13	5.77	25.3	0.29	1.26	0.29	1.05
Methanol	67-56-1	Y	Y	0.0060	0.27	1.19	0.014	0.059	0.014	0.049
Phenol	108-95-2	Y	Y	0.025	1.14	5.01	0.057	0.25	0.057	0.21
Propionaldehyde	123-38-6	Y	Y	0.015	0.66	2.90	0.033	0.14	0.033	0.12
Total HAP Emissions					**11.6**	**50.9**	**0.58**	**2.55**	**0.58**	**2.12**
Total VOC (as propane)	--	--	Y	2.97	135	590	6.74	29.5	6.74	24.5
CO	--	--	--	0.11	0.00	0.0	4.84	21.2	4.84	17.6
NO_X	--	--	--	0.018	0.00	0.00	0.82	3.58	0.82	2.97
Total PM	--	--	--	--[5]	428.57	1877.14	4.29	18.77	4.29	18.77
Total PM_{10}	--	--	--	--[5]	111.86	489.93	1.12	4.90	1.12	4.90
Total $PM_{2.5}$[6]	--	--	--	0.015	69.13	251.46	0.69	2.51	0.69	2.51

Notes:

1. Emission factors were derived based on stack testing data from the Greenwood plant and comparable Enviva facilities, and include contingency. The emission factors represent uncontrolled emissions.
2. A 95.0% control efficiency for the RCO is applied to VOC and organic HAP emissions.
3. Emissions from the pellet mills and pellet coolers are controlled by an RCO that operates primarily in catalytic mode with thermal (RTO) mode as a backup. The RTO and RCO modes have the same control efficiency so there is no impact on emissions when operating in thermal mode.
4. Unlimited emissions assume maximum hourly throughput at 8,760 hours/year. Limited emissions are based on proposed annual throughput. Controlled emissions are based on proposed short-term and annual throughputs and application of control device efficiencies.
5. PM emissions based on an outlet grain loading of 0.010 gr/scf and an exhaust flow rate of 50,000 scfm. PM_{10} emissions based on PM emissions and speciation based on data for similar Enviva facility.
6. $PM_{2.5}$ emissions factor represents post-control emissions and includes both process and combustion emissions with contingency.

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TABLE 9

POTENTIAL PELLET PRESS AND COOLER EMISSIONS AT OUTLET OF RTO-2/RCO-1 STACK

ENVIVA PELLETS GREENWOOD, LLC

Natural Gas Combustion Potential Criteria Pollutant Emissions

Pollutant	Emission Factor[1]	Units	Emissions (PTE)[3]	
			Max (lb/hr)	Annual (tpy)
SO_2	5.9E-04	lb/MMBtu	0.0031	0.013
Total PM	7.5E-03	lb/MMBtu	0.039	0.17
Total PM_{10}	7.5E-03	lb/MMBtu	0.039	0.17

Natural Gas Combustion Potential HAP and TAP Emissions

Pollutant	HAP	VOC	Emission Factor	Units	Footnote	Emissions (PTE)[3]	
						Max (lb/hr)	Annual (tpy)
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	2	1.2E-07	5.4E-07
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	2	9.2E-09	4.0E-08
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	2	8.2E-08	3.6E-07
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	2	9.2E-09	4.0E-08
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	2	9.2E-09	4.0E-08
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	2	7.7E-08	3.4E-07
Acrolein	Y	Y	1.8E-05	lb/MMscf	2	9.2E-08	4.0E-07
Ammonia	N	N	3.2	lb/MMscf	2	0.016	0.071
Anthracene	Y	Y	2.4E-06	lb/MMscf	2	1.2E-08	5.4E-08
Arsenic	Y	N	2.0E-04	lb/MMscf	2	1.0E-06	4.5E-06
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	2	9.2E-09	4.0E-08
Benzene	Y	Y	2.1E-03	lb/MMscf	2	1.1E-05	4.7E-05
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	2	6.1E-09	2.7E-08
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	2	9.2E-09	4.0E-08
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	2	6.1E-09	2.7E-08
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	2	9.2E-09	4.0E-08
Beryllium	Y	N	1.2E-05	lb/MMscf	2	6.1E-08	2.7E-07
Cadmium	Y	N	1.1E-03	lb/MMscf	2	5.6E-06	2.5E-05
Chromium VI	Y	N	1.4E-03	lb/MMscf	2	7.1E-06	3.1E-05
Chrysene	Y	Y	1.8E-06	lb/MMscf	2	9.2E-09	4.0E-08
Cobalt compounds	Y	N	8.4E-05	lb/MMscf	2	4.3E-07	1.9E-06
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	2	6.1E-09	2.7E-08
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	2	6.1E-06	2.7E-05
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	2	1.5E-08	6.7E-08
Fluorene	Y	Y	2.8E-06	lb/MMscf	2	1.4E-08	6.3E-08
Formaldehyde	Y	Y	7.5E-02	lb/MMscf	2	3.8E-04	1.7E-03
Hexane	Y	Y	1.8	lb/MMscf	2	9.2E-03	0.040
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	2	9.2E-09	4.0E-08
Lead	Y	N	5.0E-04	lb/MMscf	2	2.5E-06	1.1E-05
Manganese	Y	N	3.8E-04	lb/MMscf	2	1.9E-06	8.5E-06
Mercury	Y	N	2.6E-04	lb/MMscf	2	1.3E-06	5.8E-06
Naphthalene	Y	Y	6.1E-04	lb/MMscf	2	3.1E-06	1.4E-05
Nickel	Y	N	2.1E-03	lb/MMscf	2	1.1E-05	4.7E-05
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	2	8.7E-08	3.8E-07
Pyrene	Y	Y	5.0E-06	lb/MMscf	2	2.5E-08	1.1E-07
Selenium compounds	Y	N	2.4E-05	lb/MMscf	2	1.2E-07	5.4E-07
Toluene	Y	Y	3.4E-03	lb/MMscf	2	1.7E-05	7.6E-05
					Total HAP Emissions	**0.010**	**0.042**

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TABLE 9

POTENTIAL PELLET PRESS AND COOLER EMISSIONS AT OUTLET OF RTO-2/RCO-1 STACK

ENVIVA PELLETS GREENWOOD, LLC

Notes:

1. Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98. Emission factors converted from lb/MMscf to lb/MMBtu based on assumed heating value of 1,020 Btu/scf for natural gas per AP-42 Section 1.4.
2. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.
3. No control devices or limitations are proposed for this unit.

Abbreviations:

CAS - chemical abstract service
HAP - hazardous air pollutant
hr - hour
lb - pound
NC - North Carolina
ODT - oven dried tons
RCO - regenerative catalytic oxidizer
RTO - regenerative thermal oxidizer
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

TABLE 10
POTENTIAL PELLET PRESS AND COOLER EMISSIONS AT OUTLET OF RTO-3/RCO-2 STACK
ENVIVA PELLETS GREENWOOD, LLC

Calculation Basis

Annual Throughput	330,000	ODT/yr
Hourly Throughput	45	ODT/hr
Hours of Operation	8,760	hr/yr
Number of Burners	2	burners
RTO/RCO Burner Rating	5.2	MMBtu/hr
RTO/RCO Control Efficiency	95%	
Baghouse Control Efficiency	99%	

Pellet Mill and Cooler Potential CO, NO_x, VOC and HAP Emissions

Pollutant	CAS No.	HAP	VOC	Emission Factor[1]	Uncontrolled & Unlimited Emissions[4]		Controlled & Unlimited Emissions[4]		Controlled & Limited Emissions (PTE)[2,4]	
				(lb/ODT)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
Acetaldehyde	75-07-0	Y	Y	0.034	1.52	6.68	0.076	0.33	0.076	0.28
Acrolein	107-02-8	Y	Y	0.050	2.26	9.91	0.11	0.50	0.11	0.41
Formaldehyde	50-00-0	Y	Y	0.13	5.77	25.3	0.29	1.26	0.29	1.05
Methanol	67-56-1	Y	Y	0.0060	0.27	1.19	0.014	0.059	0.014	0.049
Phenol	108-95-2	Y	Y	0.025	1.14	5.01	0.057	0.25	0.057	0.21
Propionaldehyde	123-38-6	Y	Y	0.015	0.66	2.90	0.033	0.14	0.033	0.12
Total HAP Emissions					**11.6**	**50.9**	**0.58**	**2.55**	**0.58**	**2.12**
Total VOC (as propane)	--	--	Y	2.97	135	590	6.74	29.5	6.74	24.5
CO	--	--	--	0.11	0.00	0.0	4.84	21.2	4.84	17.6
NO_x	--	--	--	0.018	0.00	0.00	0.82	3.58	0.82	2.97
Total PM	--	--	--	--[5]	428.57	1877.14	4.29	18.77	4.29	18.77
Total PM_{10}	--	--	--	--[5]	111.86	489.93	1.12	4.90	1.12	4.90
Total $PM_{2.5}$[6]	--	--	--	0.015	69.13	251.46	0.69	2.51	0.69	2.51

Notes:

1. Emission factors were derived based on stack testing data from the Greenwood plant and comparable Enviva facilities, and include contingency. The emission factors represent uncontrolled emissions.
2. A 95.0% control efficiency for the RCO is applied to VOC and organic HAP emissions.
3. Emissions from the pellet mills and pellet coolers are controlled by an RCO that operates primarily in catalytic mode with thermal (RTO) mode as a backup. The RTO and RCO modes have the same control efficiency so there is no impact on emissions when operating in thermal mode.
4. Unlimited emissions assume maximum hourly throughput at 8,760 hours/year. Limited emissions are based on proposed annual throughput. Controlled emissions are based on proposed short-term and annual throughputs and application of control device efficiencies.
5. PM emissions based on an outlet grain loading of 0.010 gr/scf and an exhaust flow rate of 50,000 scfm. PM_{10} emissions based on PM emissions and speciation based on data for similar Enviva facility.
6. $PM_{2.5}$ emissions factor represents post-control emissions and includes both process and combustion emissions with contingency.

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TABLE 10
POTENTIAL PELLET PRESS AND COOLER EMISSIONS AT OUTLET OF RTO-3/RCO-2 STACK
ENVIVA PELLETS GREENWOOD, LLC

Natural Gas Combustion Potential Criteria Pollutant Emissions

Pollutant	Emission Factor[1]	Units	Emissions (PTE)[3]	
			Max (lb/hr)	Annual (tpy)
SO_2	5.9E-04	lb/MMBtu	0.0061	0.027
Total PM	7.5E-03	lb/MMBtu	0.077	0.34
Total PM_{10}	7.5E-03	lb/MMBtu	0.077	0.34

Natural Gas Combustion Potential HAP and TAP Emissions

Pollutant	HAP	VOC	Emission Factor	Units	Footnote	Emissions (PTE)[3]	
						Max (lb/hr)	Annual (tpy)
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	2	2.4E-07	1.1E-06
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	2	1.8E-08	8.0E-08
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	2	1.6E-07	7.1E-07
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	2	1.8E-08	8.0E-08
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	2	1.8E-08	8.0E-08
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	2	1.5E-07	6.8E-07
Acrolein	Y	Y	1.8E-05	lb/MMscf	2	1.8E-07	8.0E-07
Ammonia	N	N	3.20	lb/MMscf	2	0.033	0.14
Anthracene	Y	Y	2.4E-06	lb/MMscf	2	2.4E-08	1.1E-07
Arsenic	Y	N	2.0E-04	lb/MMscf	2	2.0E-06	8.9E-06
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	2	1.8E-08	8.0E-08
Benzene	Y	Y	2.1E-03	lb/MMscf	2	2.1E-05	9.4E-05
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	2	1.2E-08	5.4E-08
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	2	1.8E-08	8.0E-08
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	2	1.2E-08	5.4E-08
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	2	1.8E-08	8.0E-08
Beryllium	Y	N	1.2E-05	lb/MMscf	2	1.2E-07	5.4E-07
Cadmium	Y	N	1.1E-03	lb/MMscf	2	1.1E-05	4.9E-05
Chromium VI	Y	N	1.4E-03	lb/MMscf	2	1.4E-05	6.3E-05
Chrysene	Y	Y	1.8E-06	lb/MMscf	2	1.8E-08	8.0E-08
Cobalt compounds	Y	N	8.4E-05	lb/MMscf	2	8.6E-07	3.8E-06
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	2	1.2E-08	5.4E-08
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	2	1.2E-05	5.4E-05
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	2	3.1E-08	1.3E-07
Fluorene	Y	Y	2.8E-06	lb/MMscf	2	2.9E-08	1.3E-07
Formaldehyde	Y	Y	7.5E-02	lb/MMscf	2	7.6E-04	3.3E-03
Hexane	Y	Y	1.8	lb/MMscf	2	1.8E-02	0.080
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	2	1.8E-08	8.0E-08
Lead	Y	N	5.0E-04	lb/MMscf	2	5.1E-06	2.2E-05
Manganese	Y	N	3.8E-04	lb/MMscf	2	3.9E-06	1.7E-05
Mercury	Y	N	2.6E-04	lb/MMscf	2	2.7E-06	1.2E-05
Naphthalene	Y	Y	6.1E-04	lb/MMscf	2	6.2E-06	2.7E-05
Nickel	Y	N	2.1E-03	lb/MMscf	2	2.1E-05	9.4E-05
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	2	1.7E-07	7.6E-07
Pyrene	Y	Y	5.0E-06	lb/MMscf	2	5.1E-08	2.2E-07
Selenium compounds	Y	N	2.4E-05	lb/MMscf	2	2.4E-07	1.1E-06
Toluene	Y	Y	3.4E-03	lb/MMscf	2	3.5E-05	1.5E-04
					Total HAP Emissions	**0.019**	**0.084**

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TABLE 10

POTENTIAL PELLET PRESS AND COOLER EMISSIONS AT OUTLET OF RTO-3/RCO-2 STACK

ENVIVA PELLETS GREENWOOD, LLC

Notes:

1. Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98. Emission factors converted from lb/MMscf to lb/MMBtu based on assumed heating value of 1,020 Btu/scf for natural gas per AP-42 Section 1.4.
2. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.
3. No control devices or limitations are proposed for this unit.

Abbreviations:

CAS - chemical abstract service
HAP - hazardous air pollutant
hr - hour
lb - pound
NC - North Carolina
ODT - oven dried tons
RCO - regenerative catalytic oxidizer
RTO - regenerative thermal oxidizer
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

TABLE 11

DRIED WOOD HANDLING POTENTIAL EMISSIONS
(DRY CHIP SILO AND PELLETIZER FEED SILO)
ENVIVA PELLETS GREENWOOD, LLC

Calculation Basis

Hourly Throughput[1]	88 ODT/hr
Annual Throughput[1]	660,000 ODT/yr

Potential VOC and HAP Pollutant Emissions

Pollutant	Emission Factor[2] (lb/ODT)	Unlimited Emissions[3]		Limited Emissions (PTE)[3]	
		Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
Formaldehyde	8.4E-04	0.074	0.32	0.074	0.28
Methanol	2.0E-03	0.17	0.75	0.17	0.64
Total HAP Emissions		**0.25**	**1.08**	**0.25**	**0.92**
VOC as propane from Chip Silo	1.42E-02	1.25	5.50	1.25	4.69
VOC as propane from Pelletizer Feed Silo	2.19E-04	0.019	0.085	0.019	0.072
Total VOC Emissions		**1.27**	**5.58**	**1.27**	**4.76**

Notes:

1. Provided by Enviva

2. HAP/TAP emission factors derived from NCASI's Wood Products Database (February 2013) for dry wood handling operations at an OSB mill, mean emission factors. The emission factors were converted from lb/MSF (3/8") to lb/ODT using the typical density and moisture content of an OSB panel. The VOC emission factor was derived based on Greenwood bag sampling data and includes 20% contingency.

3. Unlimited emissions assume maximum hourly throughput at 8,760 hours/year. Limited emissions are based on the proposed annual throughput. No VOC/HAP/TAP control devices are proposed for these silos.

Abbreviations:

hr - hour
lb - pound
ODT - oven dried tons
tpy - tons per year
VOC - volatile organic compound
yr - year

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TABLE 12
DEBARKER POTENTIAL EMISSIONS
ENVIVA PELLETS GREENWOOD, LLC

Calculation Basis

Annual Throughput	876,000	tons/year (dry wood)[1]
Short-term Throughput	115.0	tons/hr (dry wood)[1]
Approximate Moisture Content	50%	of total weight

Pollutant	Emission Factor		Unlimited Emissions[3]		Limited Emissions (PTE)[3]	
			Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
PM[2]	1.17E-02	lb/ton	2.70	11.8	2.70	10.3
PM_{10}[2]	3.17E-04	lb/ton	0.073	0.32	0.073	0.28
$PM_{2.5}$[2]	5.40E-05	lb/ton	0.012	0.054	0.012	0.047

Notes:

[1] Annual throughput used for the debarker provided by Enviva. The short-term throughput is based upon the maximum capacity of the debarker.

[2] Emission factor for $PM_{2.5}$ from draft November 2019 NCASI White Paper based on measurements at a mill debarker, where logs are processed dry (i.e., without water spray). Emission factor for PM was back-calculated based on the $PM_{2.5}$ factor and the $PM_{2.5}$ fraction for fresh bark provided in the White Paper. Emission factor for PM_{10} was calculated based on the calculated PM factor and the PM_{10} fraction for fresh bark. Contingency was added to the factors.

[3] Unlimited emissions assume maximum hourly throughput at 8,760 hours/year. Limited emissions are based on the proposed annual throughput. No control devices are proposed for this unit.

TABLE 13
ELECTRIC POWERED CHIPPER EMISSIONS
ENVIVA PELLET GREENWOOD, LLC

Calculation Basis

Annual Throughput of Chipper	766,500	tons/year (dry wood)[1]
Short Term Throughput	87.5	tons/hr (dry wood)[1]
Approximate Moisture Content	50%	of total weight

Pollutant	Emission Factor		Unlimited Emissions[5]		Limited Emissions (PTE)[5]	
			Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
THC as Carbon[2]	4.10E-03	lb/ODT	0.36	1.57	0.36	1.57
VOC as propane[3]	5.00E-03	lb/ODT	0.44	1.92	0.44	1.92
Methanol[2]	1.00E-03	lb/ODT	0.088	0.38	0.088	0.38
PM[4]	1.92E-02	lb/ODT	1.68	7.36	1.68	7.36
PM_{10}[4]	9.60E-03	lb/ODT	0.84	3.68	0.84	3.68
$PM_{2.5}$[4]	9.60E-03	lb/ODT	0.84	3.68	0.84	3.68

Notes:

[1] Chipper throughputs provided by Enviva.

[2] Emission factor obtained from available emissions factors for chippers in AP-42 Section 10.6.3, Medium Density Fiberboard, 08/02, Table 7 and Section 10.6.4, Hardboard and Fiberboard, 10/02, Tables 7 and 9. Emission factors for THC and Methanol are the same across all three tables.

[3] Emission factor for VOC as propane is from AP-42, Section 10.6.3., Medium Density Fiberboard, 08/02, Table 7.

[4] PM factor from Assessment of Fugitive Particulate Emission Factor for Industrial Processes, EPA-450/3-78-107 (September 1978), Table 2-47. Emission factor reduced by 60% to account for enclosed nature of operation. PM10/PM2.5 emissions assumed one-half of PM emissions.

[5] Unlimited emissions assume maximum hourly throughput at 8,760 hours/year. Limited emissions are based on the proposed annual throughput. No control devices are proposed for this unit.

TABLE 14
GREEN WOOD SCREENING EMISSIONS
ENVIVA PELLET GREENWOOD, LLC

Calculation Basis

Hourly Throughput	87.5	ODT/hr
Annual Throughput	766,500	ODT/yr

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor[1]		Unlimited Emissions[2]		Limited Emissions (PTE)[2]	
			Max	Annual	Max	Annual
$PM/PM_{10}/PM_{2.5}$	0.0038	lb/ODT	0.33	1.46	0.33	1.46

Notes:

1. Emission factor from NCASI Technical Bulletin No. 1020 Table 9.1 for chip screening converted from units of bone dry tons (BDT) to ODT based on a moisture content of 50%.
2. Unlimited emissions assume maximum hourly throughput at 8,760 hours/year. Limited emissions are based on the proposed annual throughput. No control devices are proposed for this unit.

Abbreviations:

hr - hour
lb - pound
ODT - oven dried tons
THC - total hydrocarbon
tpy - tons per year
yr - year

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TABLE 15
SUMMARY OF POTENTIAL EMISSIONS FROM OTHER BAGHOUSES AND CYCLONES
ENVIVA PELLETS GREENWOOD, LLC

Emission Unit ID	Source Description	Control Device ID	Control Device Description	Exhaust Flow Rate[1]	Pollutant Loading[1]	Annual Operation	Particulate Speciation		Uncontrolled Emissions[3]						Controlled Emissions (PTE)[3]					
									PM		PM_{10}		$PM_{2.5}$		PM		PM_{10}		$PM_{2.5}$	
				(cfm)	(gr/cf)	(hours)	PM_{10} (% of PM)	$PM_{2.5}$ (% of PM)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
E13	Dry Chip Silo	CD4	One (1) existing Bin Vent Filter[2]	2,000	0.010	8,760	100.0%	100.0%	17.1	75.1	17.1	75.1	17.1	75.1	0.17	0.75	0.17	0.75	0.17	0.75
E19	Pelletizer Feed Silo	CD10	One (1) existing Bin Vent Filter[2]	2,000	0.010	8,760	100.0%	100.0%	17.1	75.1	17.1	75.1	17.1	75.1	0.17	0.75	0.17	0.75	0.17	0.75
E40, E41	Pellet Silo 1 and Pellet Silo 2	CD20	One (1) existing Cyclofilter[2]	2,000	0.010	8,760	100.0%	100.0%	17.1	75.1	17.1	75.1	17.1	75.1	0.17	0.75	0.17	0.75	0.17	0.75
E42	Loadout	CD21	One (1) existing Cyclone[2]	23,000	0.005	8,760	100.0%	100.0%	98.6	432	98.6	432	98.57	431.74	0.99	4.32	0.99	4.32	0.99	4.32
		CD22	One (1) existing baghouse[2]																	
E43	Dust Silo	CD23	One (1) existing Cyclofilter[2]	3,300	0.010	8,760	100.0%	100.0%	28.3	124	28.3	124	28.3	124	0.28	1.24	0.28	1.24	0.28	1.24
								Total PM Emissions:	178	781	178	781	178	781	1.8	7.8	1.78	7.8	1.78	7.81

Notes:

[1] Provided by Enviva.

[2] Conservatively assumes $PM_{10}/PM_{2.5}$ are equal to total PM.

[3] PM emissions for these sources are not based on annual throughput or operating hour limitations. Uncontrolled emissions are back-calculated from controlled emissions assuming a control efficiency of 99.0%.

Abbreviations:

cf - cubic feet
cfm - cubic feet per minute
ES - Emission Sources
IES - Insignificant Emission Source
gr - grain
hr - hour
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year

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TABLE 16
GREEN WOOD HANDLING
ENVIVA PELLETS GREENWOOD, LLC

Source	Transfer Activity[1]	Number of Drop Points	Material Moisture Content[1]	PM Emission Factor[2]	PM_{10} Emission Factor[2]	$PM_{2.5}$ Emission Factor[2]	Potential Throughput (wet basis)		Unlimited PM Emissions[3]		Unlimited PM_{10} Emissions[3]		Unlimited $PM_{2.5}$ Emissions[3]		Limited PM Emissions (PTE)[3]		Limited PM_{10} Emissions (PTE)[3]		Limited $PM_{2.5}$ Emissions (PTE)[3]	
			(%)	(lb/ton)	(lb/ton)	(lb/ton)	(tph)	(tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
E4	Material feed conveyance to fuel storage piles (bark)	1	45%	3.89E-05	1.84E-05	2.79E-06	175	1,533,000	6.8E-03	3.0E-02	3.2E-03	1.4E-02	4.9E-04	2.1E-03	6.8E-03	3.0E-02	3.2E-03	1.4E-02	4.9E-04	2.1E-03
	Material feed conveyance to raw wood chip storage pile (stacker/reclaimer pile)	1	48%	3.55E-05	1.68E-05	2.55E-06	175	1,533,000	6.2E-03	2.7E-02	2.9E-03	1.3E-02	4.5E-04	2.0E-03	6.2E-03	2.7E-02	2.9E-03	1.3E-02	4.5E-04	2.0E-03
E46, E47	Truck Dump 1 and Truck Dump 2	2	50%	3.36E-05	1.59E-05	2.40E-06	175	1,533,000	1.2E-02	5.1E-02	5.6E-03	2.4E-02	8.4E-04	3.7E-03	1.2E-02	5.1E-02	5.6E-03	2.4E-02	8.4E-04	3.7E-03
								Total Emissions:	**2.5E-02**	**1.1E-01**	**1.2E-02**	**5.1E-02**	**1.8E-03**	**7.8E-03**	**2.5E-02**	**1.1E-01**	**1.2E-02**	**5.1E-02**	**1.8E-03**	**7.8E-03**

Notes:

[1] Moisture content provided by Enviva on 1/11/2019.

[2] Emission factor calculation based on formula from AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, Equation 1, (11/06).

where: E = emission factor (lb/ton)

k = particle size multiplier (dimensionless) for PM	0.74
k = particle size multiplier (dimensionless) for PM_{10}	0.35
k = particle size multiplier (dimensionless) for $PM_{2.5}$	0.053
U = mean wind speed (mph)	6.06

[3] Unlimited emissions assume maximum hourly throughput at 8,760 hours/year. Limited emissions are based on the proposed annual throughput. No control devices are proposed for these emission sources.

Abbreviations:

hr - hour
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
yr - year

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TABLE 17
STORAGE PILE WIND EROSION
ENVIVA PELLETS GREENWOOD, LLC

Source	Description	PM Emission Factor[1]		VOC Emission Factor[2]		Pile Width/ Diameter	Pile Length	Pile Height	Outer Surface Area of Pile[3]	PM Emissions (PTE)[5]		PM_{10} Emissions (PTE)[5]		$PM_{2.5}$ Emissions (PTE)[5]		VOC Emissions as propane (PTE)[4,5]	
		(lb/day/acre)	($lb/hr/ft^2$)	(lb/day/acre)	($lb/hr/ft^2$)	(ft)	(ft)	(ft)	(ft^2)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
P0, E5	Stacker/Reclaimer Pile	4.1	3.9E-06	3.6	3.4E-06	260	--	40	66,659	0.26	1.14	0.13	0.57	0.020	0.086	0.28	1.23
	Pellet Mill Waste	4.1	3.9E-06	3.6	3.4E-06	100	200	10	31,200	0.12	0.54	0.061	0.27	9.17E-03	0.040	0.13	0.57
	Legacy Piles 1 through 4	4.1	3.9E-06	3.6	3.4E-06	100	150	12	25,200	0.10	0.43	0.049	0.22	7.40E-03	0.032	0.11	0.46
	Chip Bin Pile	4.1	3.9E-06	3.6	3.4E-06	14	21	8	1,025	4.01E-03	0.018	2.01E-03	8.79E-03	3.01E-04	1.32E-03	4.31E-03	0.019
	Fuel Storage Pile 1	4.1	3.9E-06	3.6	3.4E-06	100	200	20	38,400	0.15	0.66	0.075	0.33	0.011	0.049	0.16	0.71
	Fuel Storage Feeder Bin	4.1	3.9E-06	3.6	3.4E-06	20	40	10	2,400	9.40E-03	0.041	4.70E-03	0.021	7.05E-04	3.09E-03	0.01	0.04
									Total Emissions:	**0.65**	**2.83**	**0.32**	**1.41**	**0.048**	**0.21**	**0.69**	**3.03**

Notes:

[1] TSP emission factor based on U.S. EPA Control of Open Fugitive Dust Sources. Research Triangle Park, North Carolina, EPA-450/3-88-008. September 1988, Page 4-17.

$$E = 1.7\left(\frac{s}{1.5}\right)\left(\frac{(365-p)}{235}\right)\left(\frac{f}{15}\right) \text{(lb/day/acre)}$$

where:			
	s, silt content of wood chips (%):	8.4	s - silt content (%) for lumber sawmills (mean) from AP-42, Section 13.2.2 - Unpaved Roads, 11/06, Table 13.2.2-1
	p, number of days with rainfall greater than 0.01 inch:	120	Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Greenwood, SC).
	f (time that wind exceeds 5.36 m/s - 12 mph) (%):	6.2	Based on meteorological data averaged for 2012-2016 for Greenwood County Airport, SC National Weather Service (NWS) Station
	PM_{10}/TSP ratio:	50%	PM_{10} is assumed to equal 50% of TSP based on U.S. EPA Control of Open Fugitive Dust Sources, Research Triangle Park, North Carolina, EPA-450/3-88-008. September 1988.
	$PM_{2.5}$/TSP ratio:	7.5%	$PM_{2.5}$ is assumed to equal 7.5 % of TSP U.S. EPA Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors. November 2006.

[2] Emission factors obtained from NCASI document provided by the South Carolina Department of Health and Environmental Control (DHEC) for the calculation of fugitive VOC emissions from Douglas Fir wood storage piles. Emission factors ranged from 1.6 to 3.6 lb C/acre-day. As Enviva has engineering data that shows VOC emissions from greenwood storage piles are less than the low end of the range of the factors listed; however, Enviva chose to employ the maximum emission factor from the NCASI document for purposes of conservatism.

[3] The surface area for rectangular piles is calculated as [2*H*L+2*W*H+L*W] + 20% to consider the sloping pile edges. Pile dimensions were provided by Enviva.
The surface area for circular piles is calculated as $[\Pi*R*(R^2+H^2)^{0.5}]$ + 20% to consider the sloping pile edges. Diameter and height were provided by Enviva.

[4] Emissions are calculated in tons of carbon per year by the following formula:
tons C/year = 5 acres * 365 days * 3.6 lb C/acre-day / 2000 lb/ton
Emission factor converted from as carbon to as propane by multiplying by 1.22.

[5] No operational restrictions or control devices are proposed for these sources.

Abbreviations:

EPA - Environmental Protection Agency
ft - feet
ft^2 - square feet
lb - pound
mph - miles per hour
NC - North Carolina
NCASI - National Council for Air and Stream Improvement, Inc.
NWS - National Weather Service
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
TSP - total suspended particulate
yr - year
VOC - volatile organic compound

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TABLE 18
ENGINE 1 (GENERATOR) AND ENGINE 2 (FIRE PUMP) POTENTIAL EMISSIONS
ENVIVA PELLETS GREENWOOD, LLC

Engine 1 (Generator)

Equipment and Fuel Characteristics

Engine Power	865 hp (brake)
Hours of Operation	500 hr/yr[1]
Heating Value of Diesel	19,300 Btu/lb
Power Conversion	7,000 Btu/hr/hp

Criteria Pollutant Emissions

Pollutant	Category	Emission Factor	Units	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
TSP	PSD	1.80E-02	g/hp-hr (2)	0.03	8.58E-03
PM_{10}	PSD	1.80E-02	g/hp-hr (2)	0.03	8.58E-03
$PM_{2.5}$	PSD	1.80E-02	g/hp-hr (2)	0.03	8.58E-03
NO_x	PSD	5.74	g/hp-hr (2)	10.95	2.74E+00
SO_2	PSD	15	ppmw (3)	9.41E-03	2.35E-03
CO	PSD	4.00E-01	g/hp-hr (2)	0.76	1.91E-01
VOC (NMHC)	PSD	1.00E-02	g/hp-hr (2)	1.91E-02	4.77E-03

Hazardous Air Pollutant Emissions

Pollutant[6]	Category	Emission Factor	Units	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	HAP	5.37E-06	lb/hp-hr (4)	4.64E-03	1.16E-03
Acrolein	HAP	6.48E-07	lb/hp-hr (4)	5.60E-04	1.40E-04
Benzene	HAP	6.53E-06	lb/hp-hr (4)	5.65E-03	1.41E-03
Benzo(a)pyrene	HAP	1.32E-09	lb/hp-hr (4,5)	1.14E-06	2.85E-07
1,3-Butadiene	HAP	2.74E-07	lb/hp-hr (4)	2.37E-04	5.92E-05
Formaldehyde	HAP	8.26E-06	lb/hp-hr (4)	7.14E-03	1.79E-03
Polycyclic Organic Matter	HAP	1.18E-06	lb/hp-hr (4)	1.02E-03	2.54E-04
Toluene	HAP	2.86E-06	lb/hp-hr (4)	2.48E-03	6.19E-04
Xylene	HAP	2.00E-06	lb/hp-hr (4)	1.73E-03	4.31E-04
Highest HAP (Formaldehyde)				7.14E-03	1.79E-03
Total HAPs				2.35E-02	5.86E-03

Notes:

[1] NSPS allows for only 100 hrs/yr of non-emergency operation. Potential emissions for the emergency generator are conservatively based on 500 hr/yr.
[2] Emissions factors from technical data sheet for engine.
[3] Sulfur content in accordance with Year 2010 standards of 40 CFR 80.510(a) as required by NSPS Subpart IIII.
[4] Emission factor obtained from AP-42 Section 3.3, Tables 3.3-1 Table 3.3-2.
[5] Benzo(a)pyrene is included as a HAP in Total PAH.

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TABLE 18
ENGINE 1 (GENERATOR) AND ENGINE 2 (FIRE PUMP) POTENTIAL EMISSIONS
ENVIVA PELLETS GREENWOOD, LLC

Engine 2 (Fire Pump)

Equipment and Fuel Characteristics

Engine Power	305 hp
Hours of Operation	500 hr/yr[1]
Heating Value of Diesel	19,300 Btu/lb
Power Conversion	7,000 Btu/hr/hp

Criteria Pollutant Emissions

Pollutant	Category	Emission Factor	Units	Potential Emissions	
				Max lb/hr	Annual tpy
TSP	PSD	0.15	g/hp-hr (2)	0.10	2.52E-02
PM_{10}	PSD	0.15	g/hp-hr (2)	0.10	2.52E-02
$PM_{2.5}$	PSD	0.15	g/hp-hr (2)	0.10	2.52E-02
NO_x	PSD	3.00	g/hp-hr (2,5)	2.02	5.04E-01
SO_2	PSD	15	ppmw (3)	3.32E-03	8.30E-04
CO	PSD	2.60	g/hp-hr (2)	1.75	4.37E-01
VOC (NMHC)	PSD	2.51E-03	lb/MMBtu (4)	5.36E-03	1.34E-03

Hazardous Air Pollutant Emissions

Pollutant[6]	Category	Emission Factor	Units	Potential Emissions	
				Max lb/hr	Annual tpy
Acetaldehyde	HAP	5.37E-06	lb/hp-hr (4)	1.64E-03	4.09E-04
Acrolein	HAP	6.48E-07	lb/hp-hr (4)	1.97E-04	4.94E-05
Benzene	HAP	6.53E-06	lb/hp-hr (4)	1.99E-03	4.98E-04
Benzo(a)pyrene	HAP	1.32E-09	lb/hp-hr (4)	4.01E-07	1.00E-07
1,3-Butadiene	HAP	2.74E-07	lb/hp-hr (4)	8.35E-05	2.09E-05
Formaldehyde	HAP	8.26E-06	lb/hp-hr (4)	2.52E-03	6.30E-04
Polycyclic Organic Matter	HAP	1.18E-06	lb/hp-hr (4)	3.59E-04	8.97E-05
Toluene	HAP	2.86E-06	lb/hp-hr (4)	8.73E-04	2.18E-04
Xylene	HAP	2.00E-06	lb/hp-hr (4)	6.08E-04	1.52E-04
			Highest HAP (Formaldehyde)	2.52E-03	6.30E-04
			Total HAPs	8.27E-03	2.07E-03

Notes:

[1] NSPS allows for only 100 hrs/yr of non-emergency operation. Potential emissions for the emergency generator are conservativeiy based on 500 hr/yr.

[2] Emissions standards from NSPS Subpart IIII (or 40 CFR 89.112 where applicable) in compliance with post-2009 construction.

[3] Sulfur content in accordance with Year 2010 standards of 40 CFR 80.510(a) as required by NSPS Subpart IIII.

[4] Emission factor obtained from AP-42 Section 3.3, Tables 3.3-1 Table 3.3-2.

[5] Emission standard for NO_x + NMHC (Non-Methane Hydrocarbons ~~or VOC~~) from Table 4 of NSPS Subpart IIII. Conservatively assumed entire standard is attributable to NO_x.

[6] Benzo(a)pyrene is included as a HAP in Total PAH.

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TABLE 19
DIESEL STORAGE TANKS
ENVIVA PELLETS GREENWOOD, LLC

Calculation Constants

Description	AST-1	AST-2	AST-4	Units	Notes
α - Tank Paint Solar Absorptance		0.17		dimensionless	AP-42, Chapter 7 - Table 7.1-6 for White Tank, Good Condition (default)
I - Annual Avg Total Solar Insolation Factor		1380		dimensionless	AP-42, Chapter 7 - Table 7.1-7 for Columbia, SC
T_{AX} - Annual Avg Maximum Ambient Temperature		534.97		R	AP-42, Chapter 7 - Table 7.1-7 for Columbia, SC
T_{AN} - Annual Avg Minimum Ambient Temperature		510.87		R	AP-42, Chapter 7 - Table 7.1-7 for Columbia, SC
R - Ideal Gas Constant		10.731		psia*ft^3/lb-mole R	AP-42, Chapter 7 - Page 7.1-16
Kp - Product Factor		1		dimensionless	Assume conservative value of 1
ΔP_V - Daily Vapor Pressure Range		0.008		psia	Calculated per Figure 7.1-14b
ΔP_b - Breather Vent Pressure Setting Range		0.06		psia	AP-42, Chapter 7 - Page 7.1-13 Note 3 (default)
P_a - Atmospheric Pressure		14.7		psia	AP-42, Chapter 7

Calculation Inputs

Description	AST-1	AST-2	AST-4	Units	Notes
Tank Diameter	5.3	3.3	3.7	ft	Dimensions were provided by Enviva
Tank Length	12.3	6.0	12.5	ft	Dimensions were provided by Enviva
Tank Design Volume	2,000	359.00	660.00	gal	Conservative design specifications
Tank Working Volume	1,000	179.5	330	gal	50% of tank design volume because tanks will not be full at all times
Tank Throughput	99,800	17,914	32,934	gal/yr	Max monthly site-wide throughput for 2018, scaled to an annual basis. Individual tank throughputs are scaled based on size the of each tank.
Equivalent Tank Diameter (D_E)	9.11	5.02	7.63	ft	AP-42, Chapter 7 - Equation 1-13 (SQRT(LD/(PI/4)))
Effective Height (H_E)	4.16	2.59	2.87	ft	AP-42, Chapter 7 - Equation 1-14 (PI/4*D)
V_v - Vapor Space Volume	135.68	25.66	65.63	ft^3	AP-42, Chapter 7 - Equation 1-3 ($PI/4*D^2*H_{VO}$), substitute D_E for D for horizontal tanks
H_{vo} - Vapor Space Outage	2.08	1.30	1.44	ft	AP-42, Chapter 7 - $H_{VO} = 0.5*H_E$ for horizontal tanks
P_{va} - Vapor Pressure	0.009	0.009	0.009	psia	Vapor pressure for distillate fuel oil no. 2 at 70F (daily average liquid surface temp is lower; therefore, this Pva is conservative)
M_v - Vapor Molecular Weight	130	130	130	lb/lb.mole	AP-42, Chapter 7 - Table 7.1-2 for diesel
Q - Throughput	2376.19	426.53	784.14	bbl/yr	

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TABLE 19
DIESEL STORAGE TANKS
ENVIVA PELLETS GREENWOOD, LLC

Calculated Values

Description	AST-1	AST-2	AST-4	Units	Notes
K_e - Vapor Space Expansion Factor	0.04	0.03	0.03	dimensionless	AP-42, Chapter 7 - Equation 1-7 (ΔTv/Taa + ((ΔPv - ΔPb)/(Pa - ΔPva))
ΔT_v - Daily Vapor Temperature Range	23.92	17.35	17.35	R	AP-42, Chapter 7 - Equation 1-8 (0.72*ΔTa + 0.028*α*I)
ΔT_a - Daily Ambient Temperature Range	24.1	24.1	24.1	R	AP-42, Chapter 7 - Equation 1-12 (Tax - Tan)
K_s - Vented Vapor Saturation Factor	1.00	1.00	1.00	dimensionless	AP-42, Chapter 7 - Equation 1-20 (1/(1 + 0.53Pva*Hvo))
W_v - Stock Vapor Density	0.000208	0.000208	0.000208	lb/ft^3	AP-42, Chapter 7 - Equation 1-21 (Mv * Pva) / (R * Tla)
T_{la} - Daily Average Liquid Surface Temperature	524.78	522.93	522.93	R	AP-42, Chapter 7 - Equation 1-26 (0.44*Taa + 0.56Tb + 0.0079α*I)
T_{aa} - Daily Average Ambient Temperature	522.92	522.92	522.92	R	AP-42, Chapter 7 - Equation 1-27 ((Tax + Tan)/2)
T_b - Liquid Bulk Temperature	522.94	522.94	522.94	R	AP-42, Chapter 7 - Equation 1-28 (Taa + 6α - 1)
N - Number of Turnovers	99.80	99.80	99.80	dimensionless	
K_n - Saturation Factor	0.47	0.47	0.47	dimensionless	AP-42, Chapter 7 - Page 7.1-18 (For N>36, Kn = (180 + N)/6N; For N<36, Kn = 1)

Potential VOC Emissions

Description	AST-1	AST-2	AST-4	Units	Notes
L_s - Standing Loss	0.43	0.06	0.15	lbs/yr	AP-42, Chapter 7 - Equation 1-2 (365 * Vv * Wv * Ke * Ks)
L_w - Working Loss	1.30	0.23	0.43	lbs/yr	AP-42, Chapter 7 - Equation 1-29 (0.0010 * Mv * Pva * Q * Kn * Kp)
L_t - Total Loss	1.73	0.29	0.58	lbs/yr	AP-42, Chapter 7 - Equation 1-1 (Ls + Lw)
Total VOC Emissions per Tank	1.73	0.29	0.58	lbs/yr	
Total VOC Emissions	**8.7E-04**	**1.5E-04**	**2.9E-04**	**tons/yr**	

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TABLE 20
POTENTIAL FUGITIVE PM EMISSIONS FROM UNPAVED ROADS
ENVIVA PELLETS GREENWOOD, LLC

Source Data

Vehicle Activity	Distance Traveled per Roundtrip[1] (ft)	Trips Per Day[1]	Daily VMT	Events Per Year (days)	Empty Truck Weight (lb)	Loaded Truck Weight (lb)	Average Truck Weight (ton)	Annual VMT
Log Delivery to Wood Yard	2,900	168	92	365	30,000	90,000	30.0	33,680
Wood Chips to Truck Tippers	1,800	192	65	365	30,000	90,000	30.0	23,891
Bark to Fuel Pile	5,500	48	50	365	30,000	90,000	30.0	18,250
Employee Parking	400	40	3	365	4,000	4,000	2.0	1,106
							29.6	**76,927**

Notes:

1. Distance traveled per round trip and annual average daily trip counts were provided by Enviva

Emission Calculations Unpaved Road:

Pollutant	Empirical Constant (k)[1]	Silt Content (S)[2]	Particle Constant a[1]	Particle Constant b[1]	Emission Factor[3]	Emissions (PTE)[4]	
	(lb/VMT)	(%)	(-)	(-)	(lb/VMT)	(lb/hr)	(tpy)
PM	4.9	8.4	0.7	0.45	7.18	6.30	27.6
PM_{10}	1.5	8.4	0.9	0.45	2.05	1.80	7.87
$PM_{2.5}$	0.15	8.4	0.9	0.45	0.20	0.18	0.79

Notes:

1. Constants (k, a, & b) based on AP-42, Section 13.2.2 (Unpaved Roads), Table 13.2.2-2 for Industrial Roads, November 2006
2. Silt loading factor based on AP-42, Section 13.2.2 (Unpaved Roads), Table 13.2.2-1, Lumber Sawmills, November 2006
3. Emission factors calculated based on Equation 1a from AP-42 Section 13.2.2 - Unpaved Roads, 11/06.

Particulate Emission Factor: $E_{ext} = k\,(s/12)^a \times (W/3)^b * ((365-P)/365)$

k = particle size multiplier for particle size range and units of interest

E = size-specific emission factor (lb/VMT)

s = surface material silt content (%)

W = mean vehicle weight (tons)

P=number of days with at least 0.01 in of precipitation during the averaging period =

= 120 Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Greenwood, SC).

4. Potential emissions calculated from appropriate emission factor times vehicle miles traveled with control efficiency of 90% for water / dust suppression activities. Hourly emissions calculated based on annual emissions and 8,760 hours/year.

Abbreviations:

ft - feet
hr - hour
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
yr - year
VMT - vehicle miles traveled
VOC - volatile organic compound

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TABLE 21
POTENTIAL FUGITIVE PM EMISSIONS FROM PAVED ROADS
ENVIVA PELLETS GREENWOOD, LLC

Vehicle Activity	Distance Traveled per Roundtrip[1] (ft)	Trips Per Day[1]	Daily VMT	Events Per Year (days)	Empty Truck Weight (lb)	Loaded Truck Weight (lb)	Average Truck Weight (ton)	Annual VMT	PM Emission Factor[2] (lb/VMT)	PM_{10} Emission Factor[2] (lb/VMT)	$PM_{2.5}$ Emission Factor[2] (lb/VMT)	PM Emissions (PTE)[3,4] (lb/day)	PM Emissions (PTE)[3,4] (lb/hr)	PM Emissions (PTE)[3,4] (tpy)	PM_{10} Emissions (PTE)[3,4] (lb/day)	PM_{10} Emissions (PTE)[3,4] (lb/hr)	PM_{10} Emissions (PTE)[3,4] (tpy)	$PM_{2.5}$ Emissions (PTE)[3,4] (lb/day)	$PM_{2.5}$ Emissions (PTE)[3,4] (lb/hr)	$PM_{2.5}$ Emissions (PTE)[3,4] (tpy)
Log Delivery to Wood Yard	700	168	22	365	30,000	90,000	30.0	8,130	2.2	0.44	0.11	4.90	0.20	0.89	0.98	0.041	0.18	0.24	0.010	0.044
Wood Chips to Truck Tippers	700	192	25	365	30,000	90,000	30.0	9,291	2.2	0.44	0.11	5.60	0.23	1.02	1.12	0.047	0.20	0.27	0.011	0.050
Bark to Fuel Pile	700	48	6	365	30,000	90,000	30.0	2,323	2.2	0.44	0.11	1.40	0.058	0.26	0.28	0.012	0.051	0.069	0.0029	0.013
Employee Parking	400	40	3.03	365	4,000	4,000	2.0	1,106	0.1	0.03	0.01	0.042	1.75E-03	7.68E-03	8.42E-03	3.51E-04	1.54E-03	2.07E-03	8.61E-05	3.77E-04
											Total Emissions:	**11.9**	**0.50**	**2.18**	**2.39**	**0.10**	**0.44**	**0.59**	**0.024**	**0.11**

Notes:

[1] Distance traveled per round trip and annual average daily trip counts were provided by Enviva.

[2] Emission factors calculated based on Equation 2 from AP-42 Section 13.2.1 - Paved Roads, 01/11.

where:

E = emission factor (lb/ton)

k = particle size multiplier (dimensionless) for PM 0.011

k = particle size multiplier (dimensionless) for PM_{10} 0.0022

k = particle size multiplier (dimensionless) for $PM_{2.5}$ 0.00054

sL - mean road surface silt loading from AP-42 Table 13.2.1-3 for quarries (g/m^2) 8.2

P - No. days with rainfall greater than 0.01 inch 120 Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Greenwood, SC).

[3] Potential emissions calculated from appropriate emission factor times vehicle miles traveled with control efficiency of 90% for water / dust suppression activities followed by sweeping. Per Table 5 in Chapter 4 of the Air Pollution Engineering Manual, Air and Waste Management Association, page 141. Control efficiency (%) = 96-0.263*V, where V is the number of vehicle passes since application of water.

[4] Hourly emissions calculated based on annual emissions and 8,760 hours/year.

Abbreviations:

ft - feet
hr - hour
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
yr - year
VMT - vehicle miles traveled
VOC - volatile organic compound

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TABLE 22
POTENTIAL SITE-WIDE GHG EMISSIONS
ENVIVA PELLET GREENWOOD, LLC

Operating Data:

Dryer Heat Input	200.0 MMBtu/hr	RTO-2/RCO-1 Heat Input	63,686.0 MMBtu/yr
Annual Heat Input	1,752,000 MMBtu/yr	Number of Burners	1.0
		Operating Schedule	8,760 hrs/yr
Dryer Duct Burner Heat Input	5 MMBtu/hr		
Number of Burners	1	RTO-3/RCO-2 Heat Input	63,686.0 MMBtu/yr
Operating Schedule	8,760 hrs/yr	Number of Burners	2.0
		Operating Schedule	8,760 hrs/yr
RTO-1 Heat Input	8.0 MMBtu/hr		
Number of Burners	4.0	Emergency Generator Output	865 bhp
Operating Schedule	8,760 hrs/yr	Operating Schedule	500 hrs/yr
		Power Conversion	7,000 Btu/hr/hp
Furnace Bypass Heat Input	7,500 MMBtu/yr	Energy Input	6.06 MMBtu/hr
		Fire Water Pump Output	305 bhp
RTO-4/RCO-3 Burner(s) and Emissions Combustion Heat Input	15,037.8 MMBtu/yr	Operating Schedule	500 hrs/yr
Operating Schedule	8,760 hrs/yr	Power Conversion	7,000 Btu/hr/hp
		Energy Input	2.14 MMBtu/hr

Source Description	Fuel Type	Emission Factors from Table C-1 (kg/MMBtu)[1]			Tier 1 Emissions (short tons)			
		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total CO_2e
Dryer	Wood and Wood Residuals	93.80	0.18	1.07	181,149	348	2,072	183,569
Dryer Duct Burner	Natural Gas	66.88	0.025	0.030	3,229	1.21	1.44	3,232
RTO-1	Natural Gas	66.88	0.025	0.030	20,666	7.72	9.21	20,683
Furnace Bypass	Wood and Wood Residuals	93.80	0.18	1.07	775	1.49	8.87	786
RTO-2/RCO-1	Natural Gas	66.88	0.025	0.030	4,695	1.76	2.09	4,699
RTO-3/RCO-2	Natural Gas	66.88	0.025	0.030	9,390	3.51	4.18	9,398
RTO-4/RCO-3	Natural Gas	66.88	0.025	0.030	1,109	0.41	0.49	1,110
Engine 1 (Generator)	No. 2 Fuel Oil (Distillate)	73.96	0.075	0.18	247	0.25	0.60	248
Engine 2 (Fire Pump)	No. 2 Fuel Oil (Distillate)	73.96	0.075	0.18	87.0	0.088	0.21	87.3

Notes:

[1] Emission factors from Table C-1 and C-2 of GHG Reporting Rule. Emission factors for methane and N_2O already multiplied by their respective GWPs of 25 and 298.

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TABLE 23
PROCESS WEIGHT RATE LIMITS AND POTENTIAL EMISSION RATES
ENVIVA PELLET GREENWOOD, LLC

Process ID	EU ID	Source Description	Maximum Unlimited Hourly Throughput	Units	Process Weight Rate PM Limit[1] (lb/hr)	Potential Emission Rate[2] (lb/hr)
P0	E1	Debarker	230	tph	60.04	2.70
	E2	Electric Powered Chipper	175	tph	57.07	1.68
	E3	Green Wood Screening	175	tph	57.07	0.33
	E4	Pile Drop	350	tph	64.76	0.01
	E5	Storage Pile Wind Erosion	350	tph	64.76	0.65
	E46	Truck Dump 1	175	tph	57.07	0.01
	E47	Truck Dump 2	175	tph	57.07	0.01
P1	E6	Green Hammermill 1	435	tph	67.29	2.57
	E7	Green Hammermill 2				
	E8	Green Hammermill 3				
	E9	Green Hammermill 4				
	E58	Green Hammermill 5				
	E10	Green Chip Silo				
P2	E11	Furnace				
	E12	Dryer				
	E11	Furnace Bypass	85	tph	49.62	24.33
	E13	Dry Chip Silo	85	tph	49.62	0.17
P3	E59 - E94	Vertical Dry Hammermill 1 - 36	96	tph	50.87	15.06
	E19	Pelletizer Feed Silo	96	tph	50.87	0.17
P4	E20	Pelletizer 1	48	tph	44.20	4.29
	E21	Pelletizer 2				
	E22	Pelletizer 3				
	E24	Pelletizer 4				
	E25	Pelletizer 5				
	E26	Pelletizer 6				
	E28	Pelletizer 7				
	E29	Pelletizer 8				
	E30	Pelletizer 9				
	E23	Pellet Cooler 1				
	E27	Pellet Cooler 2				
	E31	Pellet Cooler 3				
	E32	Pelletizer 10	48	tph	44.20	4.29
	E33	Pelletizer 11				
	E34	Pelletizer 12				
	E36	Pelletizer 13				
	E37	Pelletizer 14				
	E38	Pelletizer 15				
	E49	Pelletizer 16				
	E50	Pelletizer 17				
	E51	Pelletizer 18				
	E35	Pellet Cooler 4				
	E39	Pellet Cooler 5				
	E52	Pellet Cooler 6				
P5	E40	Pellet Silo 1	96	tph	50.87	0.17
	E41	Pellet Silo 2				
	E42	Loadout	150	tph	55.44	0.99
	E43	Dust Silo	5	tph	12.05	0.28

Notes:

[1] SC Regulation 61-62.5, Standard No. 4, Section VIII Control of PM Emissions

[2] Represents controlled/limited emissions.

TABLE 24
PELLET SILO 1 AND PELLET SILO 2
ENVIVA PELLETS GREENWOOD, LLC

Calculation Basis

Hourly Throughput[1]	91 ODT/hr
Annual Throughput[1]	660,000 ODT/yr

Potential VOC and HAP Pollutant Emissions

Pollutant	Emission Factor [lb/MSF (3/8")]	Emission Factor[2]		Unlimited Emissions[3]		Limited Emissions (PTE)[3]	
				Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
Formaldehyde	4.90E-04	3.9E-03	lb/hr	0.004	0.02	0.004	0.02
Methanol	1.14E-03	9.1E-03	lb/hr	0.01	0.04	0.01	0.04
Total HAP Emissions				**0.01**	**0.06**	**0.01**	**0.06**
VOC as propane	--	1.31E-02	lb/hr	0.013	0.06	0.01	0.06
CO	--	4.98E-03	lb/hr	0.005	0.02	0.005	0.02

Notes:

1. Provided by Enviva
2. The VOC and CO emissions factors are derived based on November 2018 Greenwood bag sampling data for the wood pellet storage silos summarized below and include 20% contingency.

   HAP/TAP emissions are calculated by conservatively allocating the VOC emissions between formaldehyde and methanol based on the NCASI's Wood Products Database (February 2013) factors for dry wood handling operations at an OSB mill (mean emission factors).

   CO (ppm) = 1.8 CO MW= 28.01
   VOC (ppm) = 3.0 Propane MW= 44.1
   Flow rate (dscfm) = 549
3. Unlimited emissions assume maximum hourly throughput at 8,760 hours/year. Limited emissions are based on the proposed annual throughput. No VOC/HAP/TAP control devices are proposed for these silos.

Abbreviations:

hr - hour
lb - pound
ODT - oven dried tons
tpy - tons per year
VOC - volatile organic compound
yr - year

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TABLE - MODEL TAP
FACILITY-WIDE HAP EMISSIONS SUMMARY
ENVIVA PELLETS GREENWOOD, LLC

Description	HAP	Dryer & GHM (RTO-1) (lb/day)	Furnace Bypass (lb/day)	Dryer Duct Burner (lb/day)	DHM (RTO-1) (lb/day)	Pellet Coolers (RTO-2/RCO-1) (lb/day)	Pellet Coolers (RTO-3/RCO-2) (lb/day)	Dry Chip & Pelletizer Feed Silos (lb/day)	Wood Pellet Silos (lb/day)	Chipper (lb/day)	Emergency Engine (lb/day)	Fire Pump Engine (lb/day)	Total (lb/day)
Acetaldehyde	Y	16.86	0.84	1.79E-06	0.76	1.83	1.83	-	-	-	0.11	0.04	22.267
Acrolein	Y	10.94	4.03	2.12E-06	1.15	2.71	2.71	-	-	-	0.01	4.74E-03	21.563
Formaldehyde	Y	10.91	4.46	8.82E-03	0.03	6.93	6.94	1.78	0.09	-	0.17	0.06	31.381
Methanol	Y	13.34	-	-	0.62	0.33	0.33	4.13	0.22	2.10	-	-	21.071
Phenol	Y	13.55	0.05	-	0.29	1.37	1.37	-	-	-	-	-	16.640
Propionaldehyde	Y	5.08	0.06	-	1.31	0.79	0.79	-	-	-	-	-	8.043
Acetophenone	Y	7.68E-07	3.23E-06	-	-	-	-	-	-	-	-	-	3.99E-06
Ammonia	N	2.41	-	0.38	-	0.39	0.78	-	-	-	-	-	3.960
Antimony and compounds	Y	2.75E-03	7.96E-03	-	-	-	-	-	-	-	-	-	0.011
Arsenic	Y	7.81E-03	0.02	2.35E-05	-	2.45E-05	4.89E-05	-	-	-	-	-	0.030
Benzene	Y	1.01	1.54E-04	2.47E-04	-	2.57E-04	5.14E-04	-	-	-	0.14	0.05	1.194
Benzo(a)pyrene	Y	6.25E-04	2.62E-03	1.41E-07	-	1.47E-07	2.94E-07	-	-	-	2.73E-05	9.63E-06	3.28E-03
Beryllium	Y	3.92E-04	1.41E-03	1.41E-06	-	1.47E-06	2.94E-06	-	-	-	-	-	1.81E-03
1,3-Butadiene	Y	-	-	-	-	-	-	-	-	-	5.68E-03	2.00E-03	7.69E-03
Cadmium	Y	2.26E-03	4.44E-03	1.29E-04	-	1.35E-04	2.69E-04	-	-	-	-	-	7.22E-03
Carbon tetrachloride	Y	0.01	0.05	-	-	-	-	-	-	-	-	-	0.056
Chlorine	Y	3.79	0.80	-	-	-	-	-	-	-	-	-	4.588
Chlorobenzene	Y	7.92E-03	0.03	-	-	-	-	-	-	-	-	-	0.041
Chloroform	Y	6.72E-03	-	-	-	-	-	-	-	-	-	-	6.72E-03
Chromium VI	Y	2.27E-03	-	1.65E-04	-	1.71E-04	3.43E-04	-	-	-	-	-	2.95E-03
Chromium-Other compounds	Y	6.09E-03	0.02	-	-	-	-	-	-	-	-	-	0.028
Cobalt compounds	Y	2.33E-03	6.55E-03	9.88E-06	-	1.03E-05	2.06E-05	-	-	-	-	-	8.92E-03
Copper	N	-	6.05E-04	-	-	-	-	-	-	-	-	-	6.05E-04
Dichlorobenzene	Y	9.04E-04	-	1.41E-04	-	1.47E-04	2.94E-04	-	-	-	-	-	1.49E-03
Dichloroethane, 1,2-	Y	6.96E-03	0.03	-	-	-	-	-	-	-	-	-	0.036
Dichloropropane, 1,2-	Y	7.92E-03	0.03	-	-	-	-	-	-	-	-	-	0.041
Dinitrophenol, 2,4-	Y	4.32E-05	1.81E-04	-	-	-	-	-	-	-	-	-	2.25E-04
Di(2-ethylhexyl)phthalate	Y	1.13E-05	4.74E-05	-	-	-	-	-	-	-	-	-	5.87E-05
Ethyl benzene	Y	7.44E-03	0.03	-	-	-	-	-	-	-	-	-	0.039
Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	N	4.30E-09	-	-	-	-	-	-	-	-	-	-	4.30E-09
Hexane	Y	1.36	-	0.21	-	0.22	0.44	-	-	-	-	-	2.228
Indeno(1,2,3-cd)pyrene	Y	1.36E-06	1.54E-06	2.12E-07	-	2.20E-07	4.40E-07	-	-	-	-	-	3.77E-06
Hydrochloric acid	Y	9.12	19.15	-	-	-	-	-	-	-	-	-	28.272
Lead	Y	0.02	0.05	5.88E-05	-	6.12E-05	1.22E-04	-	-	-	-	-	0.067
Manganese	Y	0.56	1.61	4.47E-05	-	4.65E-05	9.30E-05	-	-	-	-	-	2.171
Mercury	Y	1.41E-03	3.83E-03	3.06E-05	-	3.18E-05	6.36E-05	-	-	-	-	-	5.37E-03
Methyl bromide	Y	3.60E-03	0.02	-	-	-	-	-	-	-	-	-	0.019
Methyl chloride	Y	5.52E-03	0.02	-	-	-	-	-	-	-	-	-	0.029
3-Methylchloranthrene	Y	1.36E-06	-	2.12E-07	-	2.20E-07	4.40E-07	-	-	-	-	-	2.23E-06
Methylene chloride	Y	0.07	-	-	-	-	-	-	-	-	-	-	0.070
Naphthalene	Y	0.02	0.10	7.18E-05	-	7.46E-05	1.49E-04	-	-	-	-	-	0.123
Nickel	Y	0.01	0.03	2.47E-04	-	2.57E-04	5.14E-04	-	-	-	-	-	0.048
Nitrophenol, 4-	Y	2.64E-05	1.11E-04	-	-	-	-	-	-	-	-	-	1.37E-04
Octachlorodibenzodioxin	N	-	2.23E-09	-	-	-	-	-	-	-	-	-	2.23E-09
Pentachlorophenol	Y	1.22E-05	5.14E-05	-	-	-	-	-	-	-	-	-	6.36E-05
Perchloroethylene	Y	9.12E-03	0.04	-	-	-	-	-	-	-	-	-	0.047
Phosphorus metal, yellow or white	Y	9.40E-03	0.03	-	-	-	-	-	-	-	-	-	0.037
Polychlorinated biphenyls	Y	1.96E-06	8.22E-06	-	-	-	-	-	-	-	-	-	1.02E-05
Polycyclic Organic Matter	Y	0.03	0.13	-	-	8.54E-05	1.71E-04	-	-	-	0.02	8.61E-03	0.189
Selenium compounds	Y	9.92E-04	4.33E-03	2.82E-06	-	2.94E-06	5.87E-06	-	-	-	-	-	5.34E-03
Styrene	Y	0.46	-	-	-	-	-	-	-	-	-	-	0.456
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	2.06E-09	8.67E-09	-	-	-	-	-	-	-	-	-	1.07E-08
Toluene	Y	9.76E-03	4.46E-03	4.00E-04	-	4.16E-04	8.32E-04	-	-	-	0.06	0.02	0.096
Trichloroethane, 1,1,1-	Y	7.44E-03	0.03	-	-	-	-	-	-	-	-	-	0.039
Trichloroethylene	Y	7.20E-03	0.03	-	-	-	-	-	-	-	-	-	0.037
Trichlorofluoromethane	N	9.84E-03	-	-	-	-	-	-	-	-	-	-	9.84E-03
Trichlorophenol, 2,4,6-	Y	5.28E-06	2.22E-05	-	-	-	-	-	-	-	-	-	2.75E-05
Vinyl chloride	Y	4.32E-03	0.02	-	-	-	-	-	-	-	-	-	0.022
Xylene	Y	6.00E-03	7.85E-05	-	-	-	-	-	-	-	0.04	0.01	0.062
Zinc	N	-	4.03E-04	-	-	-	-	-	-	-	-	-	4.03E-04
	TOTAL HAP	**87.24**	**31.64**	**0.22**	**4.16**	**14.19**	**14.42**	**5.91**	**0.31**	**2.10**	**0.56**	**0.20**	**160.967**

RAMBOLL

NCASI Emission Factor Conversion

Typical OSB Density[1] [lb/ft^3]	Typical OSB Moisture Content[2]	Conversion Factor[3] [ODT/MSF (3/8")]
39.3	5%	0.58

1. Average density for OSB containing pine from: https://www.fpl.fs.fed.us/documnts/pdf2004/fpl_2004_
2. Moisture content of OSB when produced is typically 2-8%. http://www.roseburg.com/UserFiles/Library,
3. Conversion factor is calculated as follows:

   Conversion Factor [ODT/MSF (3/8")] = OSB Density [lb/ft^3] / (2,000 lb/ton) * (1,000 SF/MSF * [3/8 inch] /

wang004.pdf
/Moisture_related_Dimensional_Stability.pdf

[12 ft/inch]) * (100% - OSB Moisture Content [%])

Enviva Pellets Greenwood, LLC
Technical Information Request and Follow-up to DHEC

I. DHEC Must Incorporate Stronger Fugitive Dust Provisions Into the Permit to Protect Public Health and Wellbeing.

Condition C.10 of the Draft Permit requires that Enviva implement a Best Management Practices (BMP) Plan for dust control at the site. The BMP Plan submitted by Enviva to DHEC on August 17, 2020 requires Enviva to implement dust control practices that meet or exceed both state requirements and best industry practices.

Enviva has reviewed the plan submitted to DHEC on August 17, 2020 to further support the fugitive dust concerns. The revised BMP Dust Control plan was submitted under separate cover for DHEC acceptance to further support the suppression of fugitive dust and address all stipulations of Permit Condition C.10 and further support the suppression of fugitive dust.

II. Enviva has Underestimated Hazardous Air Pollutants (HAP) Emissions and is Almost Certainly a Major Source of HAPs)

EIP/SELC argue that Enviva underestimated HAP emissions associated with the following sources: wood pellet storage silos, dry chip and pelletizer feed silos, and the wood chipper. To the contrary, as detailed below for each source, HAP emissions authorized by the Draft Permit are not underestimated and, in fact, are conservatively over-estimated.

Table 1. Emission Source and Emission Factor Source Comparison

Emission Source	EIP/SELC Attachment D – Basis of Emission Factor	Enviva Greenwood – Basis of Emission Factor
Rotary Dryer Direct Wood Fired Processing Green Softwood	AP-42 w/ applied control efficiency	Site Specific Data and future testing schedule (RTO-1)
Hammermill	Georgia Biomass testing and prorated Pellet Cooler test data	Emissions will be routed and controlled via the Dryer WESP and RTO – site specific data and future testing schedule (RTO-1)
Pelletizer/Pellet Cooler	Georgia Biomass Testing	Site Specific Data and future testing schedule (RCO-1 & RCO-2)
Storage/Handling	Georgia Biomass testing and prorated Pellet Cooler test data	NCASI, AP-42 and Greenwood Grab Sampling as applicable

Wood Pellet Storage Silos (E40 & E41)

As described in Enviva's permit application, volatile organic compound (VOC) emissions and, therefore, HAP emissions from the wood pellet storage silos are negligible. However, as requested by DHEC, Enviva is providing the attached updated emission calculations to include VOC and HAP emissions estimates for these silos. These estimates are based on Greenwood bag sampling conducted in November 2018. Two bag samples were collected at the outlet of the baghouse controlling both silos and analyzed for

hydrocarbons, which detected concentrations of 3 ppm as propane. This concentration is equivalent to emission rates of 0.013 lb/hr and 0.06 tpy based on a flow rate of 549 dry standard cubic foot per minute (dscfm) measured at the time of the bag sampling.

The combined organic HAP emissions will be a fraction of the VOC emissions; however, Enviva conservatively assumed that all VOC emitted represents HAP emissions. Therefore, emissions of formaldehyde and methanol were calculated by allocating the VOC emissions between these two pollutants based on emission factors obtained from the National Council for Air and Stream Improvement (NCASI) Wood Products Database for dry wood handling operations at an oriented strand board mill. All other HAPs in the NCASI database were listed as non-detectable for dry wood handling operations. The NCASI emission factors are attached to this letter.

Given that air dispersion modeling conducted as part of the application for the Draft Permit demonstrated that formaldehyde and methanol impacts were significantly below their respective Maximum Allowable Ambient Concentrations and that the additional emissions from the wood pellet storage silos estimated above are negligible, no additional air dispersion modeling is warranted.

Dry Chip and Pelletizer Feed Silos (E13 & E19)

Enviva's HAP emission estimates for these sources are based on the best available and most conservative information. HAP emissions are based on emission factors obtained from the NCASI Wood Products Database for dry wood handling operations at an oriented strand board mill, which includes emission factors for formaldehyde and methanol only (as noted above, all other HAPs in the database were listed as non-detectable for dry wood handling operations). The NCASI emission factors are attached to this letter and the conversion of the NCASI factors from units of pounds per thousand square feet to units of pounds per oven-dried ton are detailed in the NCASI Emission Factor Conversion table in the update emissions calculation spreadsheet provided with this response.

In addition, emissions testing for dried wood handling operations at other Enviva facilities resulted in a total HAP emission factor of 0.0016 pounds per ton (lb/ton), which is lower than the sum of HAP emission factors used in the application for the Draft Permit (0.0028 lb/ton). Furthermore, the 0.0016 lb/ton factor is based on testing of emissions from baghouses controlling post-dryer conveyors, when the temperature of the material is expected to be higher than in downstream dry chip and pelletizer feed silos.

Therefore, Enviva's estimates of HAP emissions from the dry chip and pelletizer feed silos are in fact conservative rather than underestimated as argued by EIP/SELC.

Wood Chipper (E2)

Similar to the dry chip and pelletizer feed silos, Enviva's estimates of HAP emissions from the wood chipper are based on best available information. Wood chipper emissions are estimated based on emission factors obtained from the U.S. Environmental Protection Agency (EPA) AP-42 Compilation of Emission Factors, Section 10.6.3 and Section 10.6.4 for log chippers. These AP-42 sections, included with

this letter, provide emission factors for methanol only and indicate that emissions of all other listed HAPs (which include acetaldehyde, acrolein, formaldehyde, phenol, and propionaldehyde) are below the test method detection limit.

Even if Enviva were to conservatively assume that all VOC emissions from the wood chipper represent HAP emissions, this would result in an additional 1.54 tpy of HAP emissions (i.e., 1.92 tpy of VOC minus the currently quantified 0.38 tpy of methanol), which would not cause facility-wide emissions to exceed major source HAP levels when added to Enviva's current facility-wide HAP emissions (22.4 tpy).

Contrary to the comments from EIP/SELC, HAP emissions from wood pellet storage silos, dry chip and pelletizer feed silos, and the wood chipper were conservatively estimated by Enviva and after the issuance of the draft permit the facility will remain minor for HAPs.

III. Enviva Must Quantify CO Emissions from Wood Pellet Storage Silos and DHEC must Require Emissions Testing on the Silos for CO

The facility has two pellet storage silos prior to rail loadout each with a capacity of 1000 short tons. An annual average storage temperature would be about 35 C as noted by SELC but the retention time in the storage silos is closer to one day (660,000 tpy/365 = 1808 ton per day). Our review of the data referred to by EIP/SELC noted that Kuang 2008, Svedberg 2004 and Tumuluru 2015 (SELC appendices E and H respectively) actually indicate that potential to emit CO emission estimates are close to the insignificant levels as presented in the application and do not support the conclusion made by SELC. It is also interesting to note that Tumuluru is a co-author of both the Kuang 2008 and Kuang 2009 papers.

Furthermore, based on bag sampling data collected from the Greenwood pellet storage silos (and also contrary to arguments presented by EIP/SELC) emissions of carbon monoxide (CO) from these silos are negligible. Three bag samples were collected at the outlet of the baghouse controlling both silos in November 2018 and analyzed for CO, which detected concentrations of 0, 2.664 and 2.73 ppm, averaging to 1.8 ppm. This average concentration is equivalent to emission rates of approximately 0.005 lb/hr and 0.02 tpy based on a flow rate of 549 dscfm measured at the time of the bag sampling. Although the emissions are negligible, Enviva is providing the attached updated emission calculations to include CO emissions for the wood pellet storage silos.

Unit conversion CO ppm to CO lb/hr and ton/yr

- Part Per Million (ppm) unitless = ppm/1,000,000
- Molecular Weight CO = 28.01 g/mol
- Ideal Gas Constant = 24.05514 L/mol
- Volumetric Conversion = 28.32 L/ft3
- Mass Conversion = 453.6 g/lb

Pellet Storage Silos (E40 &41) Carbon Monoxide Emission Calculations

$$1.80\ ppm\ CO \times \frac{1}{1{,}000{,}000} \times 28.01 \frac{g}{mol} \times \left[24.05514 \frac{L}{mol}\right]^{-1} \times 28.32 \frac{L}{ft^3} \times \left[453.6 \frac{g}{lb}\right]^{-1} = 1.31E^{-7}\ lb\ CO/_{ft^3}$$

$$1.31E^{-7} \frac{lb\ CO}{ft^3} \times 549 \frac{ft^3}{min} \times 60 \frac{min}{hr} = 4.32E^{-3}\ lb\ CO/_{hr}$$

$$4.32E^{-3} \frac{lb\ CO}{hr} \times 8760 \frac{hr}{yr} \times \left[2000 \frac{lb}{ton}\right]^{-1} = 0.02\ ton\ CO/_{yr}$$

Finally, the stack associated with pellet storage silo baghouse at Greenwood is not of sufficient size to accommodate stack testing in accordance with EPA reference method test procedures, and testing upstream of the pellet storage silo baghouse would pose a fire hazard due to elevated dust concentrations. Therefore, given both the negligible amount of emissions and the challenges inherent to conducting formal stack testing for the wood pellet storage silos, Enviva does not believe that emissions testing requirements are warranted.

IV. Enviva Greenwood is Exceeding the Legal Limits for NOx and CO.

On September 10, 2020 Enviva submitted a response to Greenwood's historical and future synthetic minor status for NOx and CO. The synthetic status for NOx is unchanged based on additional comments and CO maintains synthetic minor status for both historical and future state of the facility. The insignificant 0.02 tpy emissions of CO from the Pellet Silos (E40 & E41) discussed in this letter do not result in the exceedance of any legal limit for CO as well these have been included in the *Enviva Greenwood – Response to Major Source Status 2020_1007.pdf*.

Enviva Pellets Greenwood, LLC
Response to Statements Regarding Carbon Monoxide (CO) and Nitrogen Oxide (NOx) PSD Major Source Status

1. Summary

This memo compares the Original Colombo Permit and Potential Emission Calculation Summary with Draft Permit Number 1240-0133-CC ("Draft Permit") to demonstrate that the Greenwood facility never exceeded Prevention of Significant (PSD) major source thresholds for Carbon Monoxide (CO) or Nitrogen Oxide (NOx) on a potential or actual emissions basis. Factors presented in this memo include potential/designed production rates, emission factors, and calculation methodologies.

One can easily confirm that the Greenwood facility is, and has always been, a minor PSD source of NOx and CO emissions by reviewing the pending NOx and CO potential to emit (PTE) emission rates of 125.0 tpy and 100.3 tpy presented in the application that serves as the basis for the Draft Permit. No emission reductions of CO and NOx emissions have occurred at the facility since initial construction and operation of the facility. As documented in the Draft Permit, Enviva is proposing to increase the facility's permitted capacity resulting in additional NOx and CO emissions from combustion in from RTO1 as it controls the new Dry Hammermills and Green Hammermills, and from RTO3/RTO2 as it controls emissions from the new pellet cooler and pelletizers. As the proposed new and higher PTE emission rates of NOx and CO in the Draft Permit are well below the PSD major source threshold of 250 tpy, it would be impossible for the facility to have ever exceeded the major source threshold as originally constructed and operated. This conclusion is supported by compliance testing of RTO1 and the RTO/RCOs at the facility as discussed below.

2. Emissions Rates Provided in Form D-2569

In response to a request from the South Carolina Department of Health and Environmental Control (SCDHEC) during review of the permit application that serves as the basis for the Draft Permit, Enviva submitted Table 1 below as part of a revised Form D-2569. The table included the following three sets of emission rates:

1. Emission Rates Prior to Construction / Modification (tons/yr) Colombo Basis
    a. Colombo Permitted Rates
2. Emission Rates Prior to Construction / Modification (tons/yr) Colombo Permitted Plus Existing Unpermitted Emissions
    a. Colombo Permitted Rates **plus** previously unquantified emissions from: furnace bypass cold startups, furnace bypass idle mode, dryer duct burner, unpaved roads, and paved roads
3. Emission Rates After Construction / Modification (tons/yr) Enviva Basis
    a. These values reflect submitted application and Draft Permit 1240-0133-CC

Table 1. Comparison of Facility-wide Potential Emissions

Pollutants	1. Emission Rates Prior to Construction / Modification (tons/year) Colombo Basis			2. Emission Rates Prior to Construction / Modification (tons/year) Colombo Permitted Emissions Plus Existing Unpermitted Emissions			3. Emission Rates After Construction / Modification (tons/year) Enviva Basis		
	Uncontrol.	Control.	Limited	Uncontrol.	Control.	Limited	Uncontrol.	Control.	Limited
PM	13,948	151	148	14,289	281	174	12,684	283	168
PM10	13,948	151	148	14,109	253	157	9,667	206	103
PM2.5	11,958	132	128	12,047	215	131	9,102	179	89

Pollutants	1. Emission Rates Prior to Construction / Modification (tons/year) Colombo Basis			2. Emission Rates Prior to Construction / Modification (tons/year) Colombo Permitted Emissions Plus Existing Unpermitted Emissions			3. Emission Rates After Construction / Modification (tons/year) Enviva Basis		
	Uncontrol.	Control.	Limited	Uncontrol.	Control.	Limited	Uncontrol.	Control.	Limited
SO_2	22.5			27.1	27.1	22.6	27	27	22.1
NO_X	249			292	292	252	158	166	125
CO	249			361	361	253	173	216	100
VOC	2,906	305	247	2,909	308	247	2,491	138	120
Pb	0	0	0	5.10E-02	1.20E-02	3.34E-03	5.10E-02	1.20E-02	3.34E-03
Formaldehyde	17.2	1.60	1.33	18.0	2.41	1.35	91.39	5.67	4.40
Total HAP Emissions	52.1	5.10	4.22	57.9	10.9	4.38	416.35	29.18	22.40

As previously discussed with SCDHEC, column 2 of Table 1 consists simply of the sum of Colombo's emissions estimates plus the addition of Enviva's estimates for units not accounted for by Colombo in their application. These numbers did not reflect any revisions or corrections to Colombo's estimates, and were never intended to represent facility PTE emission rates. An explanation of the basis for Colombo's estimated NO_X and CO emissions, as well as Enviva's estimated emissions resulting from the addition of previously unaccounted for sources, is provided below. These sections focus on the controlled and limited emission rates only as these are the rates that represent the facility's PTE.

2.1 Colombo's NO_X and CO Emission Rate Calculations

Emissions of CO and NOx from fuel combustion in the Dryer/Furnace and RTO1 in Colombo's original submittal were based on emission factors back-calculated from proposed annual CO and NO_X facility-wide emission limits of 249 tpy. Colombo back-calculated and assigned 245 tpy and 241 tpy, respectively, to CO and NOx from the Dryer/Furnace and RTO1. Other sources of CO and NOx quantified by Colombo include fuel combustion in RTO2/RCO1 and RTO3/RCO2 (the pellet cooler RTO/RCOs), E44 (Engine 1 Generator), and E45 (Engine 2 Fire Pump). Emissions from the Dryer/Furnace and RTO1, when added to emissions from these other sources of CO and NOX at the facility, resulted compliance with the proposed facility-wide emissions of 249 tpy for both CO and NOX.

Colombo's calculation methodology for CO and NO_X emissions from the Dryer/Furnace, RTO1, RTO2/RCO1, and RTO3/RCO2 are described below (the engines are not significant sources of these pollutants and emission calculations for these units are, therefore, not described in detail).

- Table 28. Process 2: Dryer/Furnace
    - Design Basis
        - Furnace: 200 MMBtu/hr
        - RTO: 5 MMBtu/hr

- Emission Factors[1]
  - $CO = 245 \frac{tons}{yr} \times \frac{hr}{(200+5)\ MMBtu} \times 2000 \frac{lb}{ton} \times \frac{yr}{8760\ hr} = 0.273 \frac{lb}{MMBtu}$
  - $NOx = 241 \frac{tons}{yr} \times \frac{hr}{(200+5)\ MMBtu} \times 2000 \frac{lb}{ton} \times \frac{yr}{8760\ hr} = 0.268 \frac{lb}{MMBtu}$
- Annual Emissions
  - $CO = 205 \frac{MMBtu}{hr} \times 8760 \frac{hr}{yr} \times 0.273 \frac{lb\ CO}{MMBtu} \times \frac{ton}{2000\ lb} = 245\ ton\ CO/_{yr}$
  - $NOx = 205 \frac{MMBtu}{hr} \times 8760 \frac{hr}{yr} \times 0.269 \frac{lb\ NOx}{MMBtu} \times \frac{ton}{2000\ lb} = 241\ ton\ NOx/_{yr}$

- Tables 32 and 33. Process 4: Pellet Coolers 1, 2, and 3, and Pellet Coolers 4 and 5
  - Design Basis
    - RTO/RCO: 5 MMBtu/hr
    - Higher heating value of natural gas = 1,000 MMBtu/MMscf
  - Emission Factors (AP-42, Section 1.4)
    - CO = 84 lb/MMscf
    - NO_X = 100 lb/MMscf
  - Annual Emissions per RTO/RCO
    - $CO = 5 \frac{MMBtu}{hr} \times 84 \frac{lb}{MMscf} \times \frac{MMscf}{1000\ MMBtu} \times \frac{8760\ hr}{yr} \times \frac{ton}{2000\ lb} = 1.84\ tons\ CO\ /\ year$
    - $NOx = 5 \frac{MMBtu}{hr} \times 100 \frac{lb}{MMscf} \times \frac{MMscf}{1000\ MMBtu} \times \frac{8760\ hr}{yr} \times \frac{ton}{2000\ lb} = 2.19\ tons\ NOx\ /\ year$

2.2 Enviva's Estimates of NO_X and CO Emissions from Previously Unpermitted Sources

There are several additional existing sources of CO and NOx emissions which were not included in Colombo's original potential emissions estimates. In order to accurately represent PTE emissions from the Greenwood facility, Enviva also quantified NOx and CO emissions associated with furnace bypass cold start-ups, furnace bypass idle mode operation, and a dryer duct burner. These emission rates are summarized in Table 2 below and are the same rates that were supplied to SCDHEC in the Draft Permit application *Enviva GRE Emission for SCDHEC (rev1 2020-0626).xlsx* tabs 5-Dryer 1 (F Bypass Startup), 6-Dryer 1 (F Bypass Idle) and 7-Dryer DB.

Table 2. Additional Unpermitted Emissions – Controlled & Limited

Emission Source/Process	CO (tpy)	NOx (tpy)
Dryer 1 (F Bypass Startup)	0.45	0.17
Dryer 1 (F Bypass Idle)	1.80	0.66
Dryer DB	1.80	2.15
Controlled & Limited Total	**4.05**	**2.98**

2.5 Calculation of Total Emissions Rates Prior to Construction

The calculation of the emission rates presented column 2 of Table 1, which again are not intended to represent the facility's PTE emission rates, but include Colombo's permitted emission rates plus Enviva's emission rates for sources not quantified by Colombo, is summarized in Table 3 below.

[1] **Note, although the Colombo application references AP-42, Section 1.6 as the basis for the NO_X and CO emission factors, these factors are not AP-42 factors and, as noted above, were back-calculated to obtain facility-wide emissions of 249 tpy for CO and NO_X.**

Table 3. Total Emission Rates Prior to Construction – Controlled & Limited

Emission Source/Process	Colombo Emission Rates for Originally Permitted Sources		Enviva Emission Rates for Unpermitted Sources		Total Emission Rates	
	CO (tpy)	NOx (tpy)	CO (tpy)	NOx (tpy)	CO (tpy)	NOx (tpy)
Dryer/Furnace and RTO1	245	241	--	--	245	241
Pellet Coolers 1, 2, and 3 RTO2/RCO1	1.84	2.19	--	--	1.84	2.19
Pellet Coolers 4 and 5 RTO3/RCO2	1.84	2.19	--	--	1.84	2.19
Engine 1	0.19	2.74	--	--	0.19	2.74
Engine 2	0.07	0.96	--	--	0.07	0.96
Dryer 1 (F Bypass Startup)	--	--	0.45	0.17	0.45	0.17
Dryer 1 (F Bypass Idle)	--	--	1.80	0.66	1.80	0.66
Dryer DB	--	--	1.80	2.15	1.80	2.15
			Controlled & Limited Total		**253**	**252**

3. Corrections to Colombo's Original Estimates

As discussed above, Colombo did not quantify Dryer/Furnace and RTO1 NOx and CO emissions based on either published emission factors or stack test-based emission factors. Rather, potential emissions from these units were assumed by Colombo to not exceed 245 tpy for CO and 241 tpy for NO_X, solely in order to limit facility-wide emissions of these pollutants to 249 tpy each. In addition, Enviva determined that NO_X and CO emissions from the pellet cooler RTO/RCOs were based on AP-42 factors for natural gas combustion and, therefore, did not account for additional thermally generated emissions resulting from the combustion of VOC-containing exhaust in the RTO/RCOs. As such, these numbers clearly do not accurately represent the facility's PTE emission rates. What follows is a far more accurate estimate of CO and NO_X emissions for these units, prepared by Enviva, which is based on site-specific stack test data with added contingency factors based on engineering judgement to account for the inherent variability in stack test results.

- Dryer/Furnace
  - Design Basis (currently permitted throughput)
    - 521,000 ODT/yr
  - Emission Factors (site-specific stack test results with contingency)
    - CO = 0.181 lb/ODT
    - NO_X = 0.340 lb/OT
  - Annual Emissions
    - $CO = 521{,}000 \frac{ODT}{yr} \times 0.181 \frac{lb\ CO}{ODT} \times \frac{ton}{2000\ lb} = 47.15\ tons\ CO\ /\ yr$
    - $NOx = 521{,}000 \frac{ODT}{yr} \times 0.340 \frac{lb\ NOx}{ODT} \times \frac{ton}{2000\ lb} = 88.57\ ton\ NOx\ /\ yr$

- Pellet Cooler RTO/RCOs
  - Design Basis (currently permitted throughput)
    - Pellet Coolers 1, 2, and 3 (RTO2/RCO1) = 313,500 ODT/yr
    - Pellet Coolers 4 and 5 (RTO3/RCO2) = 209,000 ODT/yr
  - Emission Factors (site-specific stack test results with contingency)
    - CO = 0.107 lb/ODT
    - NO_X = 0.018 lb/ODT

- Annual Emissions
  - $RTO2, RCO1\ CO = 313{,}500 \frac{ODT}{yr} \times 0.107 \frac{lb\ CO}{ODT} \times \frac{ton}{2000\ lb} = 16.77\ tons\ CO\ /\ yr$
  - $RTO2, RCO1\ NOx = 313{,}500 \frac{ODT}{yr} \times 0.018 \frac{lb\ NOx}{ODT} \times \frac{ton}{2000\ lb} = 2.82\ tons\ NOx\ /\ yr$
  - $RTO3, RCO2\ CO = 209{,}000 \frac{ODT}{yr} \times 0.107 \frac{lb\ CO}{ODT} \times \frac{ton}{2000\ lb} = 11.18\ tons\ CO\ /\ yr$
  - $RTO3, RCO2\ NOx = 209{,}000 \frac{ODT}{yr} \times 0.018 \frac{lb\ NOx}{ODT} \times \frac{ton}{2000\ lb} = 1.88\ tons\ NOx\ /\ yr$

Furthermore, even though emissions of CO from wood pellet storage silos are negligible, following the submittal of the Draft Permit application, DHEC requested that Enviva quantify these emissions. The emissions were quantified based on bag sampling data collected from for the Greenwood wood pellet storage silos. Three bag samples were collected at the outlet of the baghouse controlling both wood pellet silos in November 2018 and analyzed for CO, which detected concentrations of 0, 2.664 and 2.73 ppm, averaging to 1.8 ppm. This average concentration is equivalent to emission rates of approximately 0.005 lb/hr and 0.02 tpy based on a flow rate of 549 dscfm measured at the time of the bag sampling.

Unit conversion CO ppm to CO lb/hr and ton/yr

- Part Per Million (ppm) unitless = ppm/1,000,000
- Molecular Weight CO = 28.01 g/mol
- Ideal Gas Constant = 24.05514 L/mol
- Volumetric Conversion = 28.32 L/ft3
- Mass Conversion = 453.6 g/lb

Pellet Storage Silos (E40 &41) Carbon Monoxide Emission Calculations

$$1.80\ ppm\ CO \times \frac{1}{1{,}000{,}000} \times 28.01 \frac{g}{mol} \times \left[24.05514 \frac{L}{mol}\right]^{-1} \times 28.32 \frac{L}{ft^3} \times \left[453.6 \frac{g}{lb}\right]^{-1} = 1.31E^{-7}\ lb\ CO/_{ft^3}$$

$$1.31E^{-7} \frac{lb\ CO}{ft^3} \times 549 \frac{ft^3}{min} \times 60 \frac{min}{hr} = 4.32E^{-3}\ lb\ CO/_{hr}$$

$$4.32E^{-3} \frac{lb\ CO}{hr} \times 8760 \frac{hr}{yr} \times \left[2000 \frac{lb}{ton}\right]^{-1} = 0.02\ ton\ CO/_{yr}$$

A comparison of the original Colombo emission rates to the corrected rates described above, as well as the additional sources not originally addressed by Colombo (Table 2 sources and CO emissions from the wood pellet storage silos), is provided in Table 4 below. As shown below, when emissions are corrected to reflect true PTE emission rates as opposed to simply backing into an assumed emission rate based on a proposed synthetic minor limit, the facility-wide PTE emissions rates are well below the major source threshold of 250 tpy for both CO and NOx.

Table 4. Comparison of Original Colombo Emission Rates with Corrected Rates – Controlled & Limited

Emission Source/Process	Original Colombo Emission Rates		Corrected Colombo Emission Rates	
	CO (tpy)	NOx (tpy)	CO (tpy)	NOx (tpy)
Dryer/Furnace	245	241	47.15	88.57
Pellet Coolers 1, 2, and 3 RTO2/RCO1	1.84	2.19	16.77	2.82
Pellet Coolers 4 and 5 RTO3/RCO2	1.84	2.19	11.18	1.88
Engine 1	0.19	2.74	0.19	2.74
Engine 2	0.07	0.96	0.07	0.96
Dryer 1 (F Bypass Startup)	--	--	0.45	0.17
Dryer 1 (F Bypass Idle)	--	--	1.80	0.66
Dryer DB	--	--	1.80	2.15
Wood Pellet Storage Silos	--	--	0.02	--
Total/Permitted	**249**	**249**	**79.43**	**99.95**

4. Conclusion

When correctly calculated as presented in Table 4 above, at no time did emissions from the Greenwood facility exceed PSD thresholds, on either a PTE basis or on an actual production basis, since actual production was always significantly lower than PTE. Furthermore, even following the increase in permitted capacity and increase in NOx and CO emissions associated with the Draft Permit the facility remains well below the PSD major source thresholds.