Appendix A: Fuel Acceptance Plan

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SPI Anderson Biomass Boiler

Urban Wood Fuel Acceptance Plan

1.0 Objective

This plan defines procedures for acceptance of urban wood fuel for use as a fuel for the SPI Anderson Cogen Facility. The procedures are intended to ensure that the composition of the urban wood fuel remains consistent with that used during criteria and air toxics compliance source testing demonstrations; and that non-wood waste contaminants (such as plastics, rubber, paint, metals, paper, etc.) in the fuel are within acceptable standards.

2.0 Definitions

2.1 Urban wood fuel

Urban wood fuel is the "woody" portion recovered from the (1) municipal waste stream, (2) industrial operations including woodworking shops and retail/wholesale lumber yards (including truss and pallet companies), (3) construction and demolition debris, and (4) land clearings.

Urban wood fuel can include:

- Used, sawn, dimensioned, lumber
- Pruned branches, stumps, whole trees, brush, and trimmings from residential and municipal maintenance
- Plywood, particle board, and medium density fiber board
- Construction and demolition wood materials
- Wood pallets, crates, and boxes

Urban wood fuel can **not** include the following materials in levels that would cause the fuel to fail a bucket test:

- Gypsum wallboard
- Carpeting
- Non-wood roofing materials
- Wood that is painted or coated or treated.
- Paper or pulp materials
- Hazardous, as defined in CCR, Title 22, Section 66261.3
- Purtrescible wastes

2.2 Contaminants

Contaminants are all non-wood wastes, including, but not limited to:

- Plastics or rubber
- Asbestos containing materials
- Painted or treated wood
- Metals
- Non-wood roofing materials
- Paper
- Materials containing sewage sludge or industrial, hazardous, radioactive or municipal solid waste

2.3 Contaminated urban wood fuel

Contaminated urban wood fuel is urban wood fuel that contains contaminants at a level, which result in a failure of a bucket test.

2.4 Bucket test

The bucket test was developed in conjunction with Placer County and PCAPCD, as a means to assure the board that contaminated urban wood fuel was not being received and burned in SPI's Lincoln Cogen Facility. If an incoming load of urban wood fuel is suspected of being contaminated or a particular load has been pre-designated as an inspection or test load, the load of fuel will be isolated and spread for inspection. SPIA personnel, for a duration time of three (3) minutes, will hand sort and collect contaminant materials, if any are present, from the isolated load, and put the contaminants into a three (3) gallon bucket. The bucket test is failed if the bucket is completely filled with contaminants in the allotted three minutes.

3.0 Acceptance Program

3.1 Source/Supplier Contract

The fuel purchasing contract between SPI Anderson and the urban wood fuel source/supplier will include language committing the fuel source/supplier to the delivery of fuel that is not contaminated and the use of fuel sorting procedures are in place to maintain the degree of contaminants are within acceptable standards during the processing of the urban wood fuel.

3.2 Fuel Receipt Screening

SPIA fuel handling personnel will be trained to perform the initial visual inspect of urban wood fuel loads upon arrival to the yard prior to dumping. They will use their training to

also do visual inspections of the arriving urban wood fuel after dumping has been completed. If contamination is suspected as a result of either inspection, the load of fuel will be isolated and a bucket test will be performed. If a load fails the bucket test, it will be reloaded on a truck and returned to the supplier for proper handling and the supplier will be put on notice of shipping contaminated fuel.

In addition to the fuel receipt screening described above, at least once a week a bucket test will be conducted on a random load from each urban wood fuel supplier. Procedures for conducting the bucket test are described above in section 2.4 of the definition section of this document. The result of the bucket test, being the level of the bucket that is filled by the contaminants, if any, will be recorded. If the bucket test is failed, meaning the bucket is completely filled with contaminants, the load will be rejected and returned to the supplier.

3.3 Recordkeeping

SPIA will retain receipts for all loads of urban wood fuel received. The receipt at a minimum shall contain the name and location of the source of the fuel, the amount of fuel delivered, the date and time of delivery and a description of the fuel condition. Results of all bucket tests will also be recorded. Records are to be kept for a minimum of two (2) years.

Appendix B: GHG Quantification Worksheets

Completed by: TSS Consultants, Inc.

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Operations-Related GHG Emissions of the Proposed SPI Anderson Biomass Power Plant	
Source	**CO2e(MT/year)**
Operational Emissions	
Biomass Combustion at Power Plant	317,497
Natural Gas Combustion at Power Plant	3,419
Fuel Yard Loader	926
Truck Idling at Power Plant	18
Employee trips	39
Biomass Hauling	1,979
Ash Hauling	26
Biomass Harvesting/Processing	5,944
Subtotal of emissions generated	**329,848**
Avoided Emissions	
Decomposition of Urban Wood Waste	10,586
Agricultural Woody Waste Burning	35,294
Forest Thinning/Slash Burning	62,246
Subtotal of emissions avoided	108,126
NET INCREASE IN OPERATIONAL EMISSIONS	**221,722**

Total CO2 emitted	**488,808,030**	**lb/CO2e**
Pounds of CO2 per mWhr	**1800.0**	**lbCO2e/mWhr**
Metric Tons per mWhr	**0.816**	**MTCO2e/mWhr**

GHG Efficiency of Electricity Production

GHG Efficiency of Proposed Biomass Power Plant

	Value	Units	Source
Net Increase in operational CO2e emissions	221,722	MT/year	Worksheet: Main Summary Table
Power plant electrical generation capacity	31	MW	Project description
Annual operating hours	8,760	hr/year	total hours in a year
Annual electricity production	271,560	Mwhr/year	calculated
GHG efficiency of SPI Anderson plant	0.816	MT CO2e/Mwhr	calculated

Annual GHG Emissions from On-Site Woody Biomass Combustion
Existing 4 MW Biomass Power Plant at SPI Anderson
Assume 4 MW consumes 32,000 Bone Dry Tons of Mill Residues per year*

Facility Specifications	Total Plant Value	Units	Source & Notes
Amount of biomass combusted	32,000	Tons/year	Project description and assumption of fuel used
High heat value	15.38	MMBtu/ton	Source 1 - Appendix A, Table 4
Emission Factors			
CO2	93.8	kg/MMBtu	Source 1 - Appendix A, Table 4
CH4	30	g/MMBtu	Source 1 - Appendix A, Table 6
N2O	4	g/MMBtu	Source 1 - Appendix A, Table 6
Annual Emissions			
CO2	46,165	MT/year	Source 2, Chap. 13, Equation 1
CH4	15	MT/year	Source 2, Chap. 13, Equation 1
N2O	2	MT/year	Source 2, Chap. 13, Equation 1
CO2e	46,181	MT/year	Global Warming Potential calc.

*A biomass industry general "rule of thumb" is that for every 1 MW in plant capacity requires 8,000 BDT per year

Sources

1 - CA Regulations for the Mandatory Reporting of GHG Emissions (§§95100 to 95133 Title 17 CA Code of Regulations). At: www.arb.ca.gov/regact/2007/ghg2007/frofinoal.pdf

2 - CA Air Resources Board, December 2008. Instructional Guidance for Mandatory GHG Emission Reporting. At: www.arb.ca.gov/cc/reporting/ghg-rep/ghg-reg-guid/ghg-rep-guid.htm

GHG Emissions from Agricultural Woody Waste Burning (Current Fate)

Annual Consumption of Forest Wood Waste by the Power Plant

	Value	Units	Source
Annual BDT	25,000	BDT/yr	Table 1 Biomass Fuel Consumption
Annual kilograms	22,680,000	kg/yr	conversion
Combustion Factor	0.95	unitless	Assumption - Source 1

Emission factors (per dry matter unit burned)

CO2	CH4	N20	units	Source
1,550	6.1	0.06	g/kg	Source 2 - Tabel 2.5

Annual Emissions

CO2	CH4	N20	units	Source
35,154	138.3	1.4	MT/year	Source 2 - Equation 2.27

Annual CO2e Emissions

value	units	Source
35,294	MT/year	calculated

Global Warming Potential for Coversion to CO2e

Global warming potential of CH4	23 times CO2	Source 3
Global warming potential of N20	296 times CO2	Source 3

Sources

1 - It is assumed that farmers will burn off as much piled agriculature woody wastes as possible

2 - Intergovernmental Panel on Climate Change (IPCC), 2006. Guidelines for National Greenhouse Gas Inventories, Volume 4, Agriculture, Forestry, and Other Land Use. Available at: www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_02_Ch2_Generic.pdf.

3 - IPPC, 2001. Third Assessment Report. Available at: www.ipcc.ch/ipccreports/tar/index.htm

Ash Hauling Trip Characteristics

Truck loads associated with hauling away of ash to landfill

	Units	Value	Source/notes
Yearly production of ash	tons	11,155	project description
Amount per truck load	tons	18	assumption
Maximum daily truck loads (assume 6 days/wk, 312 days/year)	trucks	2.0	calculated
Average annual daily truck loads	trucks	2.0	
Associatd trips per day per truck	trips/load	4.0	calculated
Number of trips per year	trips	1248	calculated
Trip length (SPI facility to landfill and return)	miles	14.6	Google maps
Total Truck VMT	miles	18,221	caluclated

CO2 Emission Factor for Ash Haul Truck

	CO2	Source
Emission rate @45 miles per hour with HHD-DSL truck (g/mile)	1,450	Source 1

Conversion rates used

	Value	Units	Source
Mass conversion rate	454	g/lb	onlineconversion.com
Mass conversion rate	2,000	lb/ton	onlineconversion.com
Mass conversion rate	1,000,000	g/MT	onlineconversion.com
Time conversion	312	days	assume ash hauling 6 days a week

Annual Emissions for Ash Hauling Trucks	**26.4**	**MT/year**	Calculated

Sources

1 - California Climate Action Registry General Reporting Protocol, Version 3.1, Table C.3, January 2009.

**Due to the comparatively very small level of emissions from N2O and CH4, even when factoring in their global warming potential, these emissions would not significantly change the CO2 emission levels*

Biomass Fuel Types and Amounts

Annual Fuel Use	Mill	Harvest Slash	Thinning	Agricultural	Urban Wood	Total
BDT per year	140,000	20,000	20,000	25,000	15,000	**220,000**
Percentage of BDT	64%	9%	9%	11%	7%	**100%**

Source
Project Description

Emissions from Biomass Hauling to Power Plant

	Mill Residues	Forest Slash and Thinnings	Agricultural Wood Waste	Urban Wood Waste
Percentage breakdown as BDT	64%	18%	11%	7%
BDT	140,000	40,000	25,000	15,000

Percentage Breakdown by Fuel Type, Origin, and Average VMT

	Amount in BDT	Percentage of Mill Residue Fuel Type	Percentage of Total Fuel Types	Average BDT per Truck	Calculated number of Trucks	Average VMT*	VMT per Round Trip	Total Number of Miles
Mill Residues from SPI Anderson Plant	91,000	65%	64%	13.5	6,741	0	0	0
Mill Residues from SPI Shasta Lake	30,135	22%		13.5	2,232	18	36	80,360
Mill Residues from SPI Red Bluff	15,043	11%		13.5	1,114	26	52	57,943
Mill Residues from SPI Arcata	3,724	3%		13.5	276	155	310	85,514
Forest Slash and Thinning	40,000		18%	13.5	2,963	68	136	402,963
Agricultural Wood Waste	25,000		11%	13.5	1,852	108	216	400,000
Urban Wood Waste	15,000		7%	13.5	1,111	152	304	337,778
							TOTAL	1,364,558

Biomass Hauling Emissions

	Value	Units	Source
Biomass Haul Miles	1,364,558	Miles	Calculated
Heavy Duty Diesel Vehicle Emission Factor	1,450	g/mile	Source 1

Total Annual Hauling Emissions **1,979 MT/year**

***VMT - vehicle mile traveled**

Sources

1 - California Climate Action Registry General Reporting Protocol, Version 3.1, Table C.3, January 2009.

Annual GHG Emissions from On-Site Woody Biomass Combustion (Including Natural Gas Start-up and Flame Stabilization)

Combustion of Biomass During Normal Operations

Facility Specifications	Total Plant Value	Total Mill Residuals	Units	Source & Notes
Amount of biomass combusted	220,000	140,000	Tons/year	Project description
High heat value	15.38		MMBtu/ton	Source 1 - Appendix A, Table 4
Emission Factors				
CO2	93.8		kg/MMBtu	Source 1 - Appendix A, Table 4
CH4	30		g/MMBtu	Source 1 - Appendix A, Table 6
N2O	4		g/MMBtu	Source 1 - Appendix A, Table 6
Annual Emissions				
CO2	317,382	201,970	MT/year	Source 2, Chap. 13, Equation 1
CH4	102	65	MT/year	Source 2, Chap. 13, Equation 1
N2O	14	9	MT/year	Source 2, Chap. 13, Equation 1
CO2e	317,497	202,043	MT/year	Global Warming Potential calc.

Combustion of Natural Gas During Start Up and Flame Stablization

				Annual heat input from firing natural gas	N.G.MMscf/yr at	N.G.MMscf/yr at
Amount of natural gas	61.2		MMscf/year	based on 500 hours	500 hours	2981 hours
Heat content	1,027		Btu/scf	Source 1 - Appendix A, Table 4	61.2	365.36
Amount of natural gas	62,852.4		MMBtu/yr.	Calcuated		
Emission Factors						
CO2	0.0544		kg/scf	Source 1 - Appendix A, Table 4		
CH4	0.9		g/MMBtu	Source 1 - Appendix A, Table 6		
N2O	0.1		g/MMBtu	Source 1 - Appendix A, Table 6		
Annual Emissions						
CO2	3,419		MT/year	Source 2, Chap. 13, Equation 1		
CH4	0.06		MT/year	Source 2, Chap. 13, Equation 1		
N2O	0.01		MT/year	Source 2, Chap. 13, Equation 1		
CO2e	3,419		MT/year	Global Warming Potential calc.		

Conversion Rates			
Mass conversion rate	1,000	kg/MT	www.onlineconversion.com
Mass conversion rate	1,000,000	g/MT	www.onlineconversion.com
Natural gas volume conversion rate	1,000,000	scf/MMscf	www.onlineconversion.com
Energy conversion rate	1,000,000	Btu/MMBtu	www.onlineconversion.com
Global Warming Potential Compared to CO2			
CH4	23	unitless	IPCC Assessment Report 2001
N20	296	unitless	IPCC Assessment Report 2001

Sources

1 - CA Regulations for the Mandatory Reporting of GHG Emissions (§§95100 to 95133 Title 17 CA Code of Regulations). At:
www.arb.ca.gov/regact/2007/ghg2007/frofinoal.pdf
2 - CA Air Resources Board, December 2008. Instructional Guidance for Mandatory GHG Emission Reporting. At:
www.arb.ca.gov/cc/reporting/ghg-rep/ghg-reg-guid/ghg-rep-guid.htm

GHG Emissionf from Composting/Decomposition of Urban Wood Waste (Current Fate)

Assumptions

The principal alternative fates of urban wood waste, if not used for biomass power generation is that it is chipped and used as either mulch

Avoided emissions from Decomposition of Chipped Urban Wood Waste

	Total	Units	Source
Urban wood waste to be used by SPI Anderson	15,000	BDT/year	Biomass Consumption wksht

Mulch and soil amendment GHG emissions (no gas recovery)	CH4	N2O	Units	Source
Emission rate for composting (g/kg - dry weight)	10	0.6	g/kg	Source 1, Table 4.1
Emissions from mulch and soil amendment applications	150,000	9,000	g/year	Source 1, Equation 4.1
Emissions from mulch and soil amendment applications	0.15	0.009	MT/year	Calculated

The IPCC defines "composting as an aerobic porcess and a large fraction of the degradable organic carbon (DOC) in the waste material is converted into CO

For the express purpose of this GHG analysis, the amount of CO2 generated by composting of urban wood waste will nonetheless be estimated so the com

Proportion of decomposing urban wood waste

	Total	Units	Source
Urban wood waste to be used by SPI Anderson	15,000	BDT/year	Biomass Consumption wksht
Portion that results in CO2 emissions during decomposing	7500	BDT/year	Calculated
Mass conversion rate	907	kg/ton	Calculated
Mass of urban wood waste decomposing to CO2	6802500	kg/year	Calculated

Combustion Factor 1 unitless Assumption - Source 1

0.95 unitless Assumption - Source 1

Emission factors (per dry matter unit burned)

CO2	CH4	N20	units	Source
1,550	6.1	0.06	g/kg	Source 1 - Tabel 2.5

Annual Emissions

CO2	CH4	N20	units	Source
10,543.9	41.5	0.4	MT/year	Source 1 - Equation 2.27

Annual CO2e Emissions

value	units	Source
10,586	MT/year	calculated

Global Warming Potential for Coversion to CO2e

		Sources
Global warming potential of CH4	23 times CO2	Source 2
Global warming potential of N20	296 times CO2	Source 2

Sources

1 - Intergovernmental Panel on Climate Change (IPCC), 2006. Guidelines for National Greenhouse Gas Inventories, Volume 4, Agriculture, Forestry, and Other Land Use. Available at: www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_02_Ch2_Generic.pdf.
2 - IPPC, 2001. Third Assessment Report. Available at: www.ipcc.ch/ipccreports/tar/index.htm

Employee Trip Emissions

Employee Trip Generation Rate

	Units	Value	Source/notes
Daily employees	employees	6	Project description
Employee trips per day	trip/day	12	To/from site
Trip length	miles/trip	14.7	URBEMIS default trip length
Total miles/day	miles	176.4	Calculated
Total miles/year	miles	64,386	Calculated using 365 days

Fleet Mix for Employee Trips

Vehicle type	Proportion used in Model run %	No. of vehicle type miles	Average MPG	Gallons	Fuel Type
Light auto	38%	24,338	22	1,106	gasoline
Light truck <3,750 lb	29%	18,350	18	1,019	gasoline
Light truck 3,751 to 5,750 lb	23%	14,744	10	1,474	gasoline
Medium truck 5,751 to 8,500 lb	11%	6,889	7	984	diesel
TOTAL	100%				

Maximum Daily Emissions from Employee Trips

	CO2*	Source
Maximum daily (lb/year)	86,325	Calculated
Annual (ton/year)	43	Calculated

	Value	Units	Source
Mass conversion rate	0.907	MT/ton	onlineconversion.com
CO2 Emissions per year	**39**	**MT/year**	Calculated

**Due to the comparatively very small level of emissions from N2O and CH4, even when factoring in their global warming potential, these emissions would not significantly change the CO2 emission levels*

	Emission Factor	Emission Factor Units			Emission Factor Source
Mobile Combustion					
Gasoline	8.81	kg CO2/gallon	17.86	lbs/CO2 gal	California Climate Action Registry General Reporting Protocol, Version 3.1, Table C.3, January 2009.
Diesel	10.15	kg CO2/gallon	22.38	lbs/CO2gal	California Climate Action Registry General Reporting Protocol, Version 3.1, Table C.3, January 2009.

GHG Emissions from Forest Thinnings and Harvest Slash Burning (Current Fate)

Annual Consumption of Forest Wood Waste by the Power Plant

	Value	Units	Source
Annual BDT	40,000	BDT/yr	Table 1 Biomass Fuel Consumption
Annual kilograms	36,288,000	kg/yr	Conversion

Combustion Factor	0.95	unitless	Assumption - Source 1

Emission factors (per dry matter unit burned)

CO2	CH4	N20	units	Source
1,550	6.1	0.06	g/kg	Source 2 - Table 2.5

Annual Emissions

CO2	CH4	N20	units	Source
62,000	244	2.4	MT/year	Source 2 - Equation 2.27

Annual CO2e Emissions

value	units	Source
62,246	MT/year	Calculated

Global Warming Potential for Coversion to CO2e

Global warming potential of CH4	23 times CO2	Source 3
Global warming potential of N20	296 times CO2	Source 3

Sources/Notes

Source 1 - It is assumed that forest contractors will burn off as much piled fforest thinning and slash woody wastes as possible and Other Land Use. Available at: www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_02_Ch2_Generic.pdf.
Source 3 - IPPC, 2001. Third Assessment Report. Available at: www.ipcc.ch/ipccreports/tar/index.htm

Fuel Yard Equipment CO2 Emissions

Equipment Specifications

	Value	Units	Description	Source/notes
Front end bucket loader	1	Unit	CAT 980 B	Letter dated 7/13/11 from Sierra Pacific to Shasta County
Daily hours	16	hr/day		Letter dated 7/13/11 from Sierra Pacific to Shasta County
Days per week	7	days/week		Letter dated 7/13/11 from Sierra Pacific to Shasta County
Weeks per year	52	weeks/yr		Calculated
Hours per year	5824	hours/yr		Letter dated 7/13/11 from Sierra Pacific to Shasta County
Year of fleet	2011			
Mass conversion	2,000	lb/ton		onlineconversion.com
Mass conversion	2,205	lb/MT		onlineconversion.com

		Units	Source
Emission Factor for Loader	159	kg/hour	Source 1

Annual Emissions	**926**	MT/year

Sources

1 - California Climate Action Registry General Reporting Protocol, Version 3.1, Table C.3, January 2009.

**Due to the comparatively very small level of emissions from N2O and CH4, even when factoring in their global warming potential, these emissions would not significantly change the CO2 emission levels*

Summary of CO2 Emission Rate Associated with Harvesting and Processing of Biomass Per Bone Dry Ton

(does not include biomass haul to power plant)

	Value	Units
Forest Thinning, Harvested/Processed Biomass		
Off-Road Equipment		
Horizontal grinder	25.54	lbCO2/BDT
Small excavator loader	2.92	lbCO2/BDT
Large excavator loader	6.3	lbCO2/BDT
Feller bundher	24.96	lbCO2/BDT
Grapple skidder	9.04	lbCO2/BDT
On-Road Vehicles		
Truck/chip van	8.48	lbCO2/BDT
Water truck	9.95	lbCO2/BDT
Service truck	45.78	lbCO2/BDT
Crew truck	45.78	lbCO2/BDT
Low bed truck	84.78	lbCO2/BDT
TOTAL	263.53	lbCO2/BDT
	4,775	**MT/year**
Agricultural Waste, Harvested/Processed Biomass		
Off-Road Equipment		
Horizontal grinder	25.54	lbCO2/BDT
Large excavator loader	6.3	lbCO2/BDT
On-Road Vehicles		
Truck/chip van	8.48	lbCO2/BDT
Crew truck	45.78	lbCO2/BDT
TOTAL	86.1	975
	975	**MT/year**
Urban Wood Waste, Harvested/Processed Biomass*		
Off-Road Equipment		
Horizontal grinder	25.54	lbCO2/BDT
Small excavator loader	2.92	lbCO2/BDT
On-Road Vehicles None		
TOTAL	28.46	
	193	**MT/year****
Biomass Harvested/Processed Total Emissions	**5,944**	**MT/year**

Methodology: *Off-road CO2 emissions derived from the CARB OFFROAD 2007 model. On-road CO2 emissions derived from the EMFAC2007 model. The above equipment list is based upon a demonstration project conducted for the Sierra Nevada Conservancy in 2008 in the Tahoe National Forest.*

** A conservative assumption is made here that urban wood waste consumed at the biomass power plant would need to be chipped even though all urban wood waste is nonetheless chipped prior to diversion to other uses (i.e., mulch, soil amendment, daily cover, fuel to biomass plants, etc.)*

***Due to the comparatively very small level of emissions from N2O and CH4, even when factoring in their global warming potential, these emissions would not significantly change the CO2 emission levels*

Truck Idling Emissions

Truck Idling Hours On-Site

	Value	Units	Source
Trucks hauling biomass to site (140,000 BDT @ 13.5 BDT per truck)	10,370	trucks/year	Calculated
Trucks hauling ash (11,155 tons @ 18 tons per truck)	620	trucks/year	Calculated
Combined truck visits	10,990	trucks/year	Calculated
Average length of truck visit w/idle	0.25	hours/visit	Assumption
Truck idle hours	2748	hours/year	Calculated
Emission factor truck idle HHD-DSL (Heavy duty diesel truck)	6,542	g/idle hour	EMFAC 2007
Truck idling emissions			
Annual (tons/year)	19.8	ton/year	Calculated
Annual (MT/year)	**18.0**	**MT/year**	Calculated

**Due to the comparatively very small level of emissions from N2O and CH4, even when factoring in their global warming potential, these emissions would not significantly change the CO2 emission levels*