Covered Source Permit No. 0650-01-C

APPLICATION NO.: Initial permit application no. 0650-01

ORGANIZATION NAME: Green Energy Team, LLC

EQUIPMENT LOCATION: Old Government Road, Koloa, Kauai
UTM Coordinates: Zone 4
452,443 m E; 2,429,060 m N
NAD-27

RESPONSIBLE OFFICIAL: Eric Knutzen
Partner, Green Energy Team, LLC
4313 Kapuna Road
Kilauea, Hawaii 96754

SICC: 4911 Electric Services (electric power generation, transmission, or distribution)

PROPOSED PROJECT:

Green Energy Team, LLC has applied for an initial covered source permit to construct and operate an agricultural biomass-to-energy plant to be located in an agricultural area of Koloa, Kauai.

Emission sources at the facility include:

1. Two 50 MMBtu/hr biomass gasifier/boiler systems equipped with the following controls:

   a. One multicyclone for <u>each</u> gasifier/boiler system for particulate matter control; and

   b. One electrostatic precipitator (ESP) for <u>both</u> gasifier/boiler systems for particulate matter control.

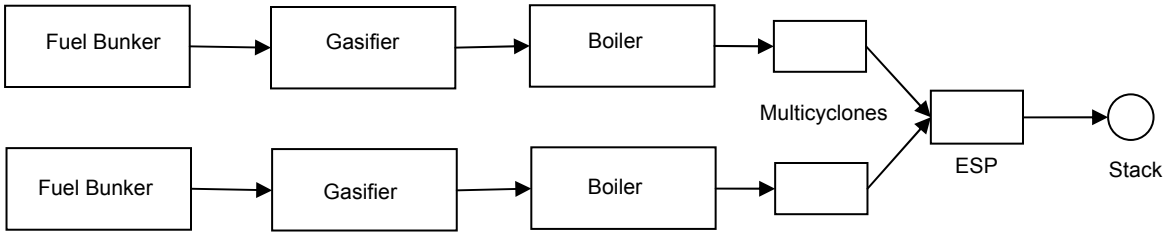
2. One evaporative cooler: removes heat from the cooling water return stream so that water can be recycled and reused as cooling water.

3. One 670 bhp standby diesel engine generator that provides a backup supply of electricity to meet the electricity demands of the plant when the boilers are not operating and electricity is not available from the local utility. The engine will be fired on diesel fuel with a fuel sulfur content not exceeding 0.05% sulfur by weight. The engine will be limited to operating a maximum of 200 hours per rolling twelve months.

4. One emergency diesel fire pump engine to drive an emergency fire pump. The engine will be operated for mandatory testing and maintenance on average one hour per week. This engine is considered an <u>insignificant activity</u> under HAR § 11-60.1-82(g)(6) Fire water system pump engines dedicated for fire-fighting and maintaining fire water system pressure, which are operated only during fire fighting and periodically for engine maintenance, and fired exclusively by natural or synthetic gas; or liquefied petroleum gas; or fuel oil No. 1 or No. 2; or diesel fuel No. 1D or No. 2D. <u>As an insignificant activity, the fire pump engine is not included in the permit.</u>

5. Fuel and ash storage and handling systems

Biomass Gasifier/Boiler Systems



The two biomass gasifier/boiler systems and one steam turbine generator will be used to produce an estimated 7.1 MW gross (6.4 MW net) of electricity that will be sold to the local utility. Albizia and eucalyptus wood chips will fuel the gasifier/boiler systems. The application indicates all biomass materials are expected to come from the island of Kauai.

The majority of albizia and eucalyptus wood chip fuel will be generated by transporting the trees to the Green Energy Team facility where they will be processed into wood chips. Some wood fuel will be chipped at remote locations and then delivered to the site. The wood chips will be dried in storage for up to two days before being pushed by a front-end loader into an underground chip pit. The chips are then conveyed to surge bins that meter the chips into the gasification chamber.

The gasification process can be described as follows:

The gasification chamber operates at an elevated temperature and under deprived oxygen conditions. Three processes occur in the gasification chamber:

1. Pyrolysis or devolatization: As the wood heats up, volatiles are released and char is produced.
2. Combustion: The volatile products and some char react with oxygen to form carbon dioxide and carbon monoxide providing heat for the gasification process.
3. Gasification: Char reacts with carbon dioxide and steam to produce carbon monoxide and hydrogen gas.

A description of gasifier/boiler system operations follows:

Gasifier startup: The gasification chamber is filled with wood chips to approximately 1/2 to 2/3 of capacity and approximately five gallons of diesel is sprayed on the fuel pile. The fuel pile is ignited and during this period, for <u>up to two hours</u>, the rear access doors to the gasifier will remain open to provide combustion air until enough charcoal has been developed and wood gas released to allow the wood gas burner to ignite when the rear access doors are closed. An induced draft fan will operate from the beginning of gasifier startup to the end of gasifier shutdown to draw combustion gases through the gasifier/boiler system and out the stack.

The multicyclone <u>will operate</u> from the beginning of and throughout gasifier startup. The electrostatic precipitator <u>will not be operating</u> during gasifier startup.

Boiler startup: Once the wood gas burner is ignited and the rear access doors are closed, the boiler will continue to operate at a reduced load for up to eight hours until the boiler is heated and is up to the minimum operating temperature and pressure at which point the system can be placed in automatic operation (end of boiler startup). Boiler startups of up to eight hours would only occur when the boiler is cold. If the boiler is hot (one of the gasifier/boiler systems is already in operation or the gasifier/boilers systems have only been shut down for a few hours) the boiler will take less than eight hours to start up.

The multicyclone will operate throughout boiler startup. The electrostatic precipitator will not be operating during boiler startup.

Normal operation: Normal operation begins at the end of boiler startup and ends at the beginning of boiler shutdown. The multicyclone and electrostatic precipitator will operate throughout normal operation.

The hydrogen gas (wood gas) generated in the gasification chamber is fired in a burner in the gasification chamber. The heated exhaust is sent through the boiler (steam generation), the multicyclone, and the electrostatic precipitator before exhausting to the stack. A steam turbine generator will be used to generate an estimated 7.1 MW gross (6.4 MW net) of electricity.

Boiler shutdown: Boiler shutdown begins when the fuel feed is turned off. During this period, the fuel pile in the gasification chamber continues to burn down. The production of wood gas will begin to taper after the wood chip fuel feed is stopped. Boiler shutdown ends when the wood gas burner shuts off due to lack of wood gas. The duration of boiler shutdown is approximately one hour.

The multicyclone and electrostatic precipitator will operate throughout boiler shutdown.

Gasifier shutdown: Gasifier shutdown begins when the wood gas burner shuts off due to lack of wood gas. The fuel pile will continue to burn down for up to three hours after the wood gas burner shuts off.

The multicyclone will operate throughout gasifier shutdown. The electrostatic precipitator will not be operating during gasifier shutdown.

According to PPC Industries, the manufacturer of the electrostatic precipitator, the ESP is not capable of being energized until the end of the boiler startup and not capable of operating to the end of gasifier shutdown. When O_2 in the boiler combustion gas is present in a sufficient quantity to support combustion, an occurrence of “sparking” (where the presence of dust particles causes the breakdown of the gas between the discharge electrodes and the collecting plates) can cause the ash to ignite and the uncombusted fuel collected to begin to smolder and if left unattended, to collect in sufficient quantities to warp the steel in the precipitator. The warping of the collection plates and discharge electrodes will cause changes to the clearances needed to generate the high voltage between the discharge electrodes and plates. A reduction in this clearance would result in the reduced efficiency of the ESP.

In addition, operation of the boiler in an oxygen starved environment will result in the generation of uncombusted carbon. Based on this information normal combustion gases must be above 3% and below 11% O_2 for the ESP to operate. The system will be equipped with lockouts preventing the ESP from operating when the O_2 concentration of the combustion gases falls outside the normal operating range. The O_2 concentration of the boiler combustion gases falls

outside the normal operating range during gasifier and boiler startup and gasifier shutdown. The permit conditions reflect the required operation of the ESP beginning at the end of boiler startup and until combustion is terminated at the wood gas burner and the oxygen level in the boiler exceeds 11% (sometime during gasifier shutdown).

The following limits will be incorporated into the permit:

1. The two gasifier/boiler systems will be limited to a maximum wood chip heat input of 840,000 MMBtu per rolling twelve months. To determine compliance with this emission limit, the wood chip heat input will be monitored as follows:

    a. As a function of steam production during normal operation; and

    b. By recording the total number of startups and shutdowns for each gasifier along with the duration each. These records are to be maintained on a monthly basis.

2. Operation of the diesel engine generator for a maximum of 200 hours per rolling twelve month period and 8 hours per day.

EQUIPMENT:

1. Two biomass gasifier/boiler systems

Gasifier/Boiler Design Specifications	
manufacturer	Chiptec or equivalent system as allowed by the permit
model	to be determined
fuel	albizia and eucalyptus wood chips, and other agricultural material upon approval from the Department of Health
maximum heat input to gasifier	wood chip heat input is 50 MMBtu/hr each gasifier
nominal fuel feed rate	5.96 tons per hour (each unit) at a typical moisture content of 30%
exhaust temperature	340˚ F
emission control	multicyclone and electrostatic precipitator for particulate matter control

The fuel feed rate will vary depending on the moisture content of the wood. The typical moisture content is about 30%, and the nominal fuel feed rate reflects a heat input of 50 MMBtu/hr (HHV) at 30% moisture content. The fuel feed rate may vary from the nominal rate as the moisture content of the wood varies between 10 to 50%, but the maximum heat input for <u>any</u> wood moisture content is 50 MMBtu/hr.

Typical wood fuel characteristics:

albizia wood fuel characteristics	
nitrogen, wt %	0.25 (typical)
sulfur, wt %	0.05 (maximum)
moisture, wt %	30 (typical)
ash, wt %	1.25 (typical)
heat content, Btu/lb HHV (dry)	8,400 (typical)

eucalyptus wood fuel characteristics	
nitrogen, wt %	0.5 (typical)
sulfur, wt %	0.02 (maximum)
moisture, wt %	30 (typical)
ash, wt %	1.75 (typical)
heat content, Btu/lb HHV (dry)	8,400 (typical)

2. Evaporative cooler

The evaporative cooler has a maximum operation of 24 hours per day and 8,760 hours per year. The evaporative cooler removes heat from the cooling water return stream so that the water can be recycled and reused as cooling water.

Evaporative Cooler Design Specifications	
manufacturer	Marley
model	MHF702D061 or equivalent as allowed by the permit
recirculation rate (gpm)	4,000
drift rate (wt %)	0.005
total dissolved solids (mg/L)	1,500

3. 670 bhp kW diesel engine generator

The permittee has proposed an operating limit of 200 hours per year and 8 hours per day. The diesel engine generator will provide backup power for the plant when the boilers are not operating and when electricity is not available from the electric power utility.

500 kW DEG Design Specifications	
manufacturer	Caterpillar or equivalent as allowed by the permit
model	C15 ATAAC or equivalent as allowed by the permit
emission certification	EPA Tier 2
fuel	Diesel
generator power output (kW)	500
engine work output (bhp)	670
fuel feed rate (gal/hr)	37.4
maximum heat input (MMBtu/hr)	5.2
annual heat input limit (MMBtu/yr)	520
heat rate (Btu/bhp-hr)	7,756
exhaust temperature (˚ F)	948.4
exhaust flow rate (wacfm)	3,927
stack height (feet)	15
stack diameter (inches)	12

4. Fuel and ash preparation, storage and handling systems

Fugitive dust from the fuel and ash preparation, storage, and handling systems will be controlled by a water sprinkler system.

AIR POLLUTION CONTROLS:

Each gasifier/boiler system exhausts through its own multicyclone. The maximum PM emission rate at the exit of the multicyclone is 0.20 lb/MMBtu and is guaranteed by the manufacturer. The multicyclone pre-cleans the exhaust of larger particles before treatment by the electrostatic precipitator.

The exhaust from both multicyclone systems is directed to a single electrostatic precipitator (ESP) which further cleans the exhaust of PM. The manufacturer guaranteed PM emission rate from the ESP is 0.025 lb/MMBtu when operating at design conditions or the removal of 95% by weight of the inlet particulate load if the inlet particulate load is greater than design conditions.

Electrostatic Precipitator	
manufacturer	PPC Industries or equivalent as allowed by the permit
design exhaust volume (acfm)	34,728
exhaust temperature (˚ F)	340
gas velocity (ft/sec)	4.35
treatment time (seconds)	5.5
SCA (sq. ft./1,000 acfm)	191.9
number/spacing of gas passages	11 @ 11.5 inches
number of discharge electrodes	176
guaranteed emission rate (lb/MMBtu)	0.025

APPLICABLE REQUIREMENTS:

Hawaii Administrative Rules (HAR)

Chapter 11-59, Ambient Air Quality Standards
- Chapter 11-60.1 Air Pollution Control
  - Subchapter 1, General Requirements
  - Subchapter 2, General Prohibitions
    - 11-60.1-31 Applicability
    - 11-60.1-32 Visible Emissions
    - 11-60.1-38 Sulfur Oxides from Fuel Combustion
    - 11-60.1-39 Storage of Volatile Organic Compounds
  - Subchapter 5, Covered Sources
  - Subchapter 6, Fees for Covered Sources, Noncovered Sources, and Agricultural Burning
    - 11-60.1-111 Definitions
    - 11-60.1-112 General Fee Provisions for Covered Sources
    - 11-60.1-113 Application Fees for Covered Sources
    - 11-60.1-114 Annual Fees for Covered Sources
  - Subchapter 7, Prevention of Significant Deterioration Review
  - Subchapter 8, Standards of Performance for Stationary Sources
    - 11-60.1-161 (1) Subpart A, General Provisions
    - 11-60.1-161 (5) Subpart Dc, Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units
  - Subchapter 9, Hazardous Air Pollutant Sources

Part 51, Subpart A, Emission Inventory Reporting Requirements – Consolidated Emissions Reporting Rule (CERR)

40 CFR Part 51, Subpart A, Emission Inventory Reporting Requirements, determines the applicability of compliance emissions reporting based on the emissions of each air pollutant from the facility. If the facility emits at or above the CER triggering levels shown in the following table, the facility is subject to CERR.

Minimum Point Source Reporting Thresholds by Pollutant			
Pollutant	Annual Cycle type A sources	Three-year cycle type B sources	Green Energy Team, LLC
	tons/year	tons/year	tons/year
SO_x	≥ 2500	≥ 100	52.9
VOC	≥ 250	≥ 100	11.8
NO_x	≥ 2500	≥ 100	109.8
CO	≥ 2500	≥1000	108.7
Pb		≥ 5	2.02E-02
PM_{10}	≥ 250	≥ 100	14.9
$PM_{2.5}$[a]	≥ 250	≥ 100	14.9
Ammonia	≥ 250	≥ 100	not anticipated

[a] All PM_{10} assumed to be $PM_{2.5}$.

The facility is a potential Type B CERR source.

Annual Emissions Reporting Requirements

As a covered source the facility is subject to the requirements of annual emissions reporting.

NSPS Applicability

The two boilers are subject to 40 Code of Federal Regulations (CFR) Part 60, Subpart Dc Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units. According to subpart Dc, to be subject to the regulation the boiler maximum design heat input capacity would fall within the range of 10 and 100 MMBtu/hr and commence construction after June 9, 1989. The maximum design heat input capacity of each boiler is less than 100 MMBtu/hr.

The 500 kW diesel engine generator is subject to 40 CFR Part 60, Subpart IIII Standards of Performance for Stationary Compression Ignition Internal Combustion Engines. According to subpart IIII, to be subject to the regulation the diesel engine would have to be constructed (ordered) after July 11, 2005 and manufactured after April 1, 2006. The subject diesel engine will be constructed and manufactured after the listed dates.

BACT Applicability:

A Best Available Control Technology (BACT) analysis is required for each air pollutant with a net increase in emissions equal to or greater than the significant levels as defined in HAR § 11-60.1-1. BACT is defined as "...an emission limitation (including a visible emissions standard) based on the maximum degree of reduction subject to regulation under the Act... which the Administrator, on a case-by-case basis, taking into account energy, environmental and economic impacts, and other costs, determines is achievable for each source...".

For those pollutants requiring a BACT determination, U.S. Environmental Protection Agency (EPA) guidelines specify that a "top-down" BACT analysis be performed. The analysis: 1) identifies available control alternatives for each affected pollutant, 2) evaluates each control for technical feasibility, 3) ranks, based on control effectiveness, those control alternatives determined technically feasible, 4) determines the economic, environmental, and energy impacts of the control alternative, and 5) selects as BACT the top remaining control alternative which has not been eliminated through technical infeasibility or economic, environmental, and energy impacts.

The following table compares emissions from the project to significant levels.

Comparison of Potential to Emit (PTE) to Significant Levels			
pollutant	PTE [a]	significant level	PTE exceeds significant levels?
	tons/year	tons/year	
Nitrogen Oxides	109.75	40	yes
Sulfur Dioxide	52.9	40	yes
Carbon Monoxide	108.7	100	yes
Volatile Organic Compounds	11.8	40	no
Particulate Matter - TSP	14.9	25	no
Particulate Matter - PM10	14.9	15	yes
Lead	2.02E-02	6.00e-01	no
Sulfuric Acid Mist	4.4	7	no
Beryllium	4.62E-04	4.00e-04	yes
Mercury	1.47E-03	1.00e-01	no
Fluorides	na	3	no
Arsenic	2.05E-03	any amount	yes
Benzene	1.76	any amount	yes

[a] Detailed emission calculations are in the **Project Emissions** section.

Emissions of NO_x, SO_2, CO, VOC, PM and PM_{10} are based on operation of the two gasifiers/boilers at the heat input limit of 840,000 MMBtu/yr plus emissions from startup and shutdown periods. Emissions from normal operation (assuming 840,000 MMBtu/yr of

normal operation) and emissions from startup and shutdown are accounted for here because startup and shutdown emission rates are higher than during normal operations. Note that the heat input limit includes heat input from periods of startup and shutdown as well as normal operation.

HAP emissions are based on operation of the two gasifiers/boilers at the heat input limit of 840,000 MMBtu/yr. Periods of normal operation, startup, and shutdown should be included when tracking the heat input for compliance with the heat input limit of 840,000 MMBtu per rolling twelve months. HAP emission factors are in lb/MMBtu.

Nitrogen Oxides (NO_x)

Information on wood-fired boilers with a heat input less than 100 MMBtu/hr was located in EPA's RBLC database. The NO_x emission rates for each of these facilities are met without add-on air pollution control and are achieved using boiler design and good combustion practices. The NO_x emission rates from the boilers/heaters at these facilities are comparable or greater than the proposed emission limit for the gasifier/boiler systems on a lb/MMBtu basis.

Potential add-on air pollution controls for NO_x control includes selective catalytic reduction (SCR) and selective noncatalytic reduction (SNCR). The use of these control technologies is determined infeasible for the gasifiers/boilers system for the following reasons:

1. SCR

   The applicant looked at the application of SCR in the areas of "high dust" (before the multicyclone) and "low dust" (between the multicyclone and ESP, and after the ESP).

   a. "high dust" SCR system before the multicyclone

      SCR systems are generally not used in operations with high particulate matter loading, such as the area upstream of the multicyclone and ESP. Problems associated with an SCR located in the "high dust" area include solid particle deposition in catalyst pores and on catalyst surface and poisoning by compounds such as arsenic, lead, and alkali compounds. These problems lead to an increase in shutdowns for catalyst replacement, increased catalyst replacement costs, reduced NO_x control and increased ammonia slip.

   b. "low dust" SCR system between the multicyclone and ESP

      This location also has a particulate matter concentration higher than is seen in usual applications of SCR. In addition, the temperature of the exhaust following the multicyclone is approximately 340˚ F. This temperature is below the exhaust temperatures required for proper SCR control, including the optimal temperatures of conventional or low temperature SCR systems.

      In addition, the SCR system would have to be designed to ensure that the flue gases entering the SCR reactor are completely mixed with ammonia. Because of the small size of the gasifiers/boilers and the variation in flue gas flow rates in both of the "low dust" areas (one SCR for both systems), the mixing of the flue gas would present problems.

c. "low dust" SCR system after the ESP

Flue gas reheat would be required for an SCR located in this area. In addition this location would present problems in the adequate mixing of ammonia with the flue gases as discussed for an SCR located between the multicyclone and ESP.

2. SNCR

The dimensions of the gasifier do not provide adequate residence time for the NO_x reactions to take place, which is needed for effective NO_x control.

Sulfur Dioxide (SO_2)

The proposed SO_2 emission rate is based on analyses of albizia and eucalyptus wood which is anticipated to have a maximum fuel sulfur content of 0.05% by weight.

Carbon Monoxide (CO)

Information on CO emission rates for the same boilers discussed in the NO_x BACT section show that the CO emission rates on a lb/MMBtu basis are higher than the emission limit proposed for the Green Energy Team, LLC gasifier/boiler systems.

Available add on pollution control for CO includes an oxidation catalyst. The use of an oxidation catalyst is determined infeasible for the gasifiers/boilers system for the following reasons:

1. Oxidation Catalyst

Particulate matter concentrations in the location between the multicyclone and ESP are higher than the concentrations seen in the typical application of oxidation catalysts. In addition, the temperature of the exhaust following the multicyclone is less than the effective temperature for oxidation catalysts.

Particulate Matter ≤ 10 μm in diameter (PM_{10})

Information on PM_{10} emission rates for the same boilers discussed in the NO_x BACT section show that the PM_{10} emission rates on a lb/MMBtu basis are higher than the emission limit proposed for the Green Energy Team, LLC gasifier/boiler systems.

Add on control technologies for PM_{10} include multicyclones, ESPs, wet scrubbers and baghouses. A multicyclone on each gasifier/boiler system and a single ESP for both systems has been proposed as the control for PM_{10} from the gasifier/boiler systems. The multicyclones have a guaranteed control efficiency of 0.2 lb/MMBtu. The ESP has a guaranteed control efficiency of 0.025 lb/MMBtu when inlet concentrations are at or below design levels and a 95% control efficiency when inlet concentrations are above design conditions.

Wet scrubbers are generally not as effective as ESPs. Baghouses are generally not used for combustion devices that handle fibrous solid fuels such as wood and bagasse due to the potential for burning fuel particles to cause a fire or explosion within the baghouse.

The following emissions limits are proposed as BACT for the project:

Emission Limits Proposed as BACT	
pollutant	lb/MMBtu
NO_x	0.25
SO_2	0.10
CO	0.20
PM_{10}	0.025

NON-APPLICABLE REQUIREMENTS:

PSD Applicability

The information included in the May 22, 2007 application regarding PSD applicability is superseded by an email from the applicant's representative (Sierra Research) dated June 22, 2007. The definition of 'major stationary source' in 40 CFR § 51.21 lists source categories subject to the 100 ton per year trigger for PSD applicability. Included on this list are fuel conversion plants. It is determined that the proposed facility is not a fuel conversion plant based on a June 4, 2007 EPA Region 4 letter which indicates the gasification plant that is the subject of the letter is not a fuel conversion plant because it does not involve fossil fuel. Based on this information, the Department is applying the 250 ton per year trigger level for PSD determination for the proposed Green Energy Team, LLC facility.

The proposed project is not subject to PSD applicability because it is a new facility that is not a listed source in the definition of "major stationary source" and potential emissions of any regulated pollutant is below 250 tons per year.

Facility Emissions	
Pollutant	Maximum Potential to Emit
	tons/year
SO_2	52.9
NO_x	109.8
CO	108.7
PM	14.9
VOC	11.8

NESHAP/MACT Applicability:

There are no applicable standards for DEGs under 40 CFR Part 61 and 63.
Compliance Assurance Monitoring Applicability:

40 CFR Part 64 Compliance Assurance Monitoring (CAM) rule. To be subject to this rule a unit must meet all of the following criteria:

1. The unit must be located at a major source that is required to obtain a Part 70 or 71 permit;
2. The unit is subject to an emission limitation or standard for the applicable pollutant;
3. The unit uses a control device to achieve compliance;

4. Potential pre-control emissions of the pollutant are at least 100% of major source amount; and
5. The unit is not otherwise exempt, exemptions include:
   a. emission limitations or standards proposed by the Administrator after November 15, 1990 pursuant to section 111 or 112 of the Act;
   b. stratospheric ozone protection requirements;
   c. acid rain program requirements;
   d. emission limitations, standards, or other requirements that apply solely under an approved emission trading program;
   e. emissions cap that meets requirements of 40 CFR §70.4(b)(12);
   f. emission limitations or standards for which a part 70 or 71 permit specifies a continuous compliance determination method (defined as a method which is used to determine compliance with an emission limitation or standard on a continuous basis, consistent with the averaging period established for the emission limitation or standard). The exemption provided in this paragraph shall not apply if the applicable compliance method includes an assumed control device emission reduction factor that could be affected by the actual operation and maintenance of the control device;
   g. backup utility power units that meet certain criteria.

The gasifiers/boilers are exempt from CAM because they are subject to an emission limitation that was proposed by the Administrator after November 15, 1990. In this case, the boilers are subject to a PM emission limit that was proposed after November 15, 1990.

Synthetic Minor Status:

A synthetic minor source is a facility that is potentially major (as defined in HAR § 11-60.1-1), but is made non-major through federally enforceable permit conditions. This facility is not a synthetic minor based on potential emissions exceeding 100 tons per year for NO_x and CO.

ALTERNATE OPERATING SCENARIOS:

The applicant has indicated that the make and model of the gasifier/boiler systems, electrostatic precipitator, evaporative cooler, and diesel engine generator are potentially subject to change prior to construction of the facility. The Department of Health is incorporating a condition in the permit allowing for such a change to occur. The permittee will be required to obtain written approval from the Department prior to any changes in the equipment. This alternative operating scenario is applicable only prior to construction of the facility.

INSIGNIFICANT ACTIVITIES:

1. Diesel fire pump engine

The diesel fire pump engine is an insignificant activity per HAR § 11-60.1-82(g)(6). The engine will only be operated for testing and maintenance on average one hour per week and for fire-fighting. The engine will be fired on diesel fuel no. 2.

Diesel Fire Pump Engine Design Specifications	
manufacturer	Clark or equivalent
model	JU4H-UF12 or equivalent
fuel	diesel no. 2
engine work output (bhp)	59
fuel feed rate (gal/hr)	3.4
maximum heat input rate (MMBtu/hr)	0.5

Diesel Fire Pump Engine Criteria Pollutant Emissions						
pollutant	emission factor [a]	engine bhp rating	emission rate	emission rate	emission rate	emission rate 8,760 hrs/yr
	g/bhp-hr	bhp	g/hr	lb/hr	g/sec	tons/year
NO_x	5.25	59	309.75	0.680	0.086	0.375
SO_2	---	---	---	0.024 [b]	0.003	0.013
CO	2.30	59	135.7	0.299	0.038	0.165
VOC	0.10	59	5.9	0.010	0.001	0.006
PM	0.40	59	23.6	0.050	0.006	0.028

[a] NO_x, CO, VOC, and PM emission rates are based on manufacturer's literature for a Clark JU4H-UF12 diesel fire pump.

[b] SO_2 emission rate based on mass balance calculation.
Maximum fuel consumption = 3.4 gallons/hr
lb/hr SO_2 emissions = 3.4 gallons/hr x 7.00 lbs fuel/gal fuel x 0.0005 S x 2 lb SO_2/lb S = 0.0238 lbs/hr

Diesel Fire Pump Engine Hazardous Air Pollutant Emissions				
pollutant	emission factor [a]	heat input [b]	emission rate	emission rate
	lb/MMBtu	MMBtu/hr	lb/hr	tons/year
Benzene	9.33E-04	0.4726	4.41E-04	1.93E-03
Toluene	4.09E-04	0.4726	1.93E-04	8.47E-04
Xylene	2.85E-04	0.4726	1.35E-04	5.90E-04
1,3-Butadiene	3.91E-05	0.4726	1.85E-05	8.09E-05
Formaldehyde	1.18E-03	0.4726	5.58E-04	2.44E-03
Acetaldehye	7.67E-04	0.4726	3.62E-04	1.59E-03
Acrolein	9.25E-05	0.4726	4.37E-05	1.91E-04
Total PAH	1.68E-04	0.4726	7.94E-05	3.48E-04
TOTAL HAPs				8.02E-03

[a] Emission factors from AP-42 Table 3.4-3 Speciated Organic Compound Emission Factors for Large Uncontrolled Stationary Diesel Engines and Table 3.4-4 PAH Emission Factors for Large Uncontrolled Stationary Diesel Engines.

[b] Heat input based on maximum fuel consumption of 3.4 gallons/hr.

3.4 gallons/hr x 0.139 MMBtu/gal = 0.4726 MMBtu/hr

2. Diesel fuel storage tanks and dispenser

   Diesel fuel for the diesel engine generator, fire pump engine, and plant mobile equipment will be stored in small, aboveground storage tanks with capacities of approximately 400 gallons, 25 gallons, and 500 gallons, respectively. The tanks are an insignificant activity per HAR § 11-60.1-82(f)(1) Any storage tank, reservoir, or other container of capacity equal to or less than forty thousand gallons storing volatile organic compounds, except those storage tanks, reservoirs, or other containers subject to any standard or other requirement pursuant to Sections 111 and 112 of the Act.

PROJECT EMISSIONS:

Gasifier/boiler emissions are based on the two gasifier/boiler systems being permitted to operate up to a combined maximum wood chip heat input of 840,000 MMBtu per rolling twelve months. This includes the wood chip heat input to the gasifiers during startup, shutdown, and normal operation.

Criteria Pollutant Emissions During Gasifier Startup [a]							
pollutant	emission factor [b]	emission rate each gasifier	emission rate two gasifiers	emission rate two gasifiers [c]	duration of startup per gasifier	number of startups per gasifier	emissions from two gasifiers
	lb/ton	lb/hr	lb/hr	g/sec	hours	startups/rolling 12 mos.	tons/year
NO_x	1	5.96	11.92	1.50	2	50	0.60
SO_2	1	5.96	11.92	1.50	2	50	0.60
CO	26	154.96	309.92	39.05	2	50	15.50
VOC	1.1	6.56	13.11	1.65	2	50	0.66
$PM_{10}/PM_{2.5}$	1.1	6.56	13.11	1.65	2	50	0.66

[a] According to the applicant, during startup the gasifier cannot combust more than the gasifier's maximum heat input capacity of 50 MMBtu/hr. A 50 MMBtu/hr heat input rate per gasifier is used to determine gasifier startup emissions:

4,195 Btu/lb of wood at 30% moisture content
8.39 MMBtu/ton of wood at 30% moisture content
50 MMBtu/hr per hour each gasifier ÷ 8.39 MMBtu/ton of wood = 5.96 tons of wood/hour per gasifier

[b] The NO_x emission factor is from the AP-42 Table 2.7-1 Emission Factors for Waste Incineration in Conical Burners without Controls (10/92).

The SO_2 emission factor based on the following mass balance calculation:
Sulfur content of dry wood = 0.05% by weight
High heating value of dry wood = 8,389 Btu/lb
0.05% S wood x 1 lb wood/8,389 Btu = 0.0596 lb S/MMBtu x 2 lb SO_2/lb S = 0.12 lb SO_2/MMBtu
100 MMBtu/hr per gasifier x 0.12 lb SO_2/MMBtu = 11.9 lb SO_2/hr per gasifier

CO, VOC, and PM_{10} emission factors are from the document *Reducing $PM_{2.5}$ Emissions through Technology (Results from a Recent Study Evaluating the Effectiveness of an Air Curtain Incinerator)* from the United States Department of Agriculture Forest Service.

[c] Emissions from both gasifiers exit through a single stack.

Criteria Pollutant Emissions During Boiler Startup								
pollutant	emission factor [a]	heat input one gasifier	emission rate one gasifier	emission rate two gasifiers	emission rate two gasifiers [b]	duration of startup per boiler	number of startups per boiler	emissions from two gasifiers
	lb/MMBtu	MMBtu/hr	lb/hr	lb/hr	g/sec	hours	startups/rolling 12 mos.	tons/year
NO_x	0.22	25	5.5	11.0	1.39	8	50	2.20
SO_2	0.12	25	3.0	6.0	0.76	8	50	1.20
CO	0.6	25	15.0	30.0	3.78	8	50	6.00
VOC	0.026	25	0.638	1.3	0.16	8	50	0.26
$PM_{10}/PM_{2.5}$	0.217	25	5.4	10.8	1.36	8	50	2.16

[a] NO_x, CO, and VOC emissions from AP-42 Section 1.6 Wood Residue Combustion In Boilers, Tables 1.6-2 and 1.6-3.

PM_{10} emissions based on 0.20 lb/MMBtu (filterable PM_{10} from the multicyclone) plus 0.017 lb/MMBtu (condensible PM from AP-42 Section 1.6 Table 1.6-1).

SO_2 emission factor based on the following mass balance calculation:
Sulfur content of dry wood = 0.05% by weight
High heating value of dry wood = 8,389 Btu/lb
0.05% S wood x 1 lb wood/8,389 Btu = 0.0596 lb S/MMBtu x 2 lb SO_2/lb S = 0.12 lb SO_2/MMBtu

[b] Emissions from both gasifiers exit through a single stack.

Criteria Pollutant Emission During Boiler Shutdown [a]								
pollutant	emission factor [a]	heat input one gasifier	emission rate one gasifier	emission rate two gasifiers	emission rate two gasifiers	duration of startup per boiler	number of startups per boiler	emissions from two gasifiers
	lb/MMBtu	MMBtu/hr	lb/hr	lb/hr	g/sec	hours	startups/rolling 12 mos.	tons/year
NO_x	0.22	25	5.5	11.0	1.39	1	50	0.28
SO_2	0.12	25	3.0	6.0	0.76	1	50	0.15
CO	0.6	25	15.0	30.0	3.78	1	50	0.75
VOC	0.026	25	0.638	1.3	0.16	1	50	0.03
$PM_{10}/PM_{2.5}$ [b]	0.025	25	0.625	1.25	0.16	1	50	0.03

[a] Same footnotes as Criteria Pollutant Emissions During Boiler Startup (except for the calculation of PM_{10} emissions).

[b] PM_{10} emissions based on ESP in operation.

Criteria Pollutant Emission During Gasifier Shutdown [a]								
pollutant	emission factor [a]	heat input one gasifier	emission rate one gasifier	emission rate two gasifiers	emission rate two gasifiers	duration of startup per boiler	number of startups per boiler	emissions from two gasifiers
	lb/MMBtu	lb/MMBtu	lb/hr	lb/hr	g/sec	hours	startups/rolling 12 mos.	tons/year
NO_x	0.22	25	5.5	11.0	1.39	3	50	0.83
SO_2	0.12	25	3.0	6.0	0.76	3	50	0.45
CO	0.6	25	15.0	30.0	3.78	3	50	2.25
VOC	0.026	25	0.638	1.3	0.16	3	50	0.10
$PM_{10}/PM_{2.5}$	0.217	25	5.4	10.8	1.36	3	50	0.81

[a] Same footnotes as Criteria Pollutant Emissions During Boiler Startup.

Criteria Pollutant Emissions During Normal Gasifier/Boiler Operation [a]					
pollutant	emission factor [b]	heat input two gasifiers	emission rate two gasifiers	emission rate two gasifiers [c]	emission rate two gasifiers
	lb/MMBtu	MMBtu/hr	lb/hr	g/sec	tons/year
NO_x	0.25	100	25	3.15	105.00
SO_2	0.12	100	11.9	1.50	49.98
CO	0.20	100	20	2.52	84.00
VOC	0.0255	100	2.55	0.32	10.71
PM	0.025	100	2.5	0.31	10.50

[a] Based on maximum heat input of 840,000 MMBtu/rolling twelve month period.
840,000 MMBtu/rolling twelve months ÷ (50 MMBtu/hr x 2 gasifiers) = 8,400 hrs/rolling 12 month period.

[b] NO_x, CO, and PM emission rates based on manufacturer guaranteed emission rates for the gasifiers.

SO_2 emission factor based on the following mass balance calculation:
Sulfur content of dry wood = 0.05% by weight
High heating value of dry wood = 8,389 Btu/lb
0.05% S wood x 1 lb wood/8,389 Btu = 0.0596 lb S/MMBtu
0.0596 lb S/MMBtu x 2 lb SO_2/lb S = 0.12 lb SO_2/MMBtu

VOC emission rate based on AP-42 Table 1.6-3 Emission Factors for Speciated Organic Compounds, TOC, VOC, Nitrous Oxide, and Carbon Dioxide from Wood Residue Combustion (9/03). The emission factor has been multiplied by 1.5.

[c] Emissions from both gasifiers exit through a single stack.

Gasifier Hazardous Air Pollutant Emissions				
pollutant	emission factor [a]	heat input two gasifier	emission rate from two gasifiers	emission rate from two gasifiers [b]
	lb/MMBtu	MMBtu/hr	lb/hr	tons/year
Acenaphthene	9.1E-07	100	9.10E-05	3.82E-04
Acenaphthylene	5.0E-06	100	5.00E-04	2.10E-03
Acetaldehyde	8.3E-04	100	8.30E-02	3.49E-01
Acetophenone	3.2E-09	100	3.20E-07	1.34E-06
Acrolein	4.0E-03	100	4.00E-01	1.68
Anthracene	3.0E-06	100	3.00E-04	1.26E-03
Benzene	4.2E-03	100	4.20E-01	1.76
Benzo(a)anthracene	6.5E-08	100	6.50E-06	2.73E-05
Benzo(a)pyrene	2.6E-06	100	2.60E-04	1.09E-03
Benzo(b)fluoranthene	1.0E-07	100	1.00E-05	4.20E-05
Benzo(e)pyrene	2.6E-09	100	2.60E-07	1.09E-06
Benzo(g,h,i)perylene	9.3E-08	100	9.30E-06	3.91E-05
Benzo(k)fluoranthene	3.6E-08	100	3.60E-06	1.51E-05
bis(2-Ethylhexyl)phthalate	4.7E-08	100	4.70E-06	1.97E-05
Bromomethane (methyl bromide)	1.5E-05	100	1.50E-03	6.30E-03
2-Butanone (MEK)	5.4E-06	100	5.40E-04	2.27E-03
Carbazole	1.8E-06	100	1.80E-04	7.56E-04
Carbon tetrachloride	4.5E-05	100	4.50E-03	1.89E-02
Chlorine	7.9E-04	100	7.90E-02	3.32E-01
Chlorobenzene	3.3E-05	100	3.30E-03	1.39E-02
Chloroform	2.8E-05	100	2.80E-03	1.18E-02
Chloromethane (methyl chloride)	2.3E-05	100	2.30E-03	9.66E-03
2-Chloronaphthalene	2.4E-09	100	2.40E-07	1.01E-06
Chrysene	3.8E-08	100	3.80E-06	1.60E-05
Dibenzo(a,h)anthracene	9.1E-09	100	9.10E-07	3.82E-06
1,2-Dichloroethane (ethylene dichloride)	2.9E-05	100	2.90E-03	1.22E-02
Dichloromethane (methylene chloride)	2.9E-04	100	2.90E-02	1.22E-01
1,2-Dichloropropane (propylene dichloride)	3.3E-05	100	3.30E-03	1.39E-02
2,4-Dinitrophenol	1.8E-07	100	1.80E-05	7.56E-05
Ethylbenzene	3.1E-05	100	3.10E-03	1.30E-02
Fluoranthene	1.6E-06	100	1.60E-04	6.72E-04
Fluorene	3.4E-06	100	3.40E-04	1.43E-03
Formaldehyde	4.4E-03	100	4.40E-01	1.85
Hydrgogen Chloride	1.9E-02	100	1.90	7.98
Indeno(1,2,3,c,d)pyrene	8.7E-08	100	8.70E-06	3.65E-05
2-Methylnaphthalene	1.6E-07	100	1.60E-05	6.72E-05
Naphthalene	9.7E-05	100	9.70E-03	4.07E-02
4-Nitrophenol	1.1E-07	100	1.10E-05	4.62E-05
Pentachlorophenol	5.1E-08	100	5.10E-06	2.14E-05
Perylene	5.2E-10	100	5.20E-08	2.18E-07
Phenanthrene	7.0E-06	100	7.00E-04	2.94E-03
Phenol	5.1E-05	100	5.10E-03	2.14E-02
Polychlorinated biphenyls	8.1E-09	100	8.15E-07	3.42E-06
Propionaldehyde	6.1E-05	100	6.10E-03	2.56E-02
Pyrene	3.7E-06	100	3.70E-04	1.55E-03
Styrene	1.9E-03	100	1.90E-01	7.98E-01
2,3,7,8-Tetrachlorodibenzo-p-dioxins	8.6E-12	100	8.60E-10	3.61E-09
Tetrachloroethene (tetrachloroethylene)	3.8E-05	100	3.80E-03	1.60E-02

Toluene	9.2E-04	100	9.20E-02	3.86E-01
1,1,1-Trichloroethane (methyl chloroform)	3.1E-05	100	3.10E-03	1.30E-02
Trichloroethene (trichloroethylene)	3.0E-05	100	3.00E-03	1.26E-02
2,4,6-Trichlorophenol	1.14E-08	100	1.14E-06	4.79E-06
Vinyl Chloride	1.8E-05	100	1.80E-03	7.56E-03
o-Xylene	2.5E-05	100	2.50E-03	1.05E-02
Antimony	7.9E-06	100	7.90E-04	3.32E-03
Arsenic	4.89E-06	100	4.89E-04	2.05E-03
Beryllium	1.1E-06	100	1.10E-04	4.62E-04
Cadmium	4.1E-06	100	4.10E-04	1.72E-03
Chromium, total	2.1E-05	100	2.10E-03	8.82E-03
Chromium, hexavalent	2.5E-06	100	2.50E-04	1.05E-03
Cobalt	6.5E-06	100	6.50E-04	2.73E-03
Lead	4.8E-05	100	4.80E-03	2.02E-02
Manganese	1.6E-03	100	1.60E-01	6.72E-01
Mercury	3.5E-06	100	3.50E-04	1.47E-03
Nickel (PRG table = nickel subsulfide)	3.3E-05	100	3.30E-03	1.39E-02
Phosphorus	2.7E-05	100	2.70E-03	1.13E-02
Selenium	2.8E-06	100	2.80E-04	1.18E-03
TOTAL HAPs				16.26

[a] Emission rates are based on AP-42 Table 1.6-3 Emission Factors for Speciated Organic Compounds, TOC, VOC, Nitrous Oxide, and Carbon Dioxide from Wood Residue Combustion (9/03).

Arsenic, Hexavalent Chromium, and 2,4,6 Trichlorophenol lb/MMBtu emission factors revised using AP-42 Related Information document (see Sierra Research emails dated 12/11/07 and 12/14/07).

[b] Based on maximum heat input of 840,000 MMBtu/rolling twelve month period.
840,000 MMBtu/rolling twelve months ÷ (50 MMBtu/hr x 2 gasifiers) = 8,400 hrs/rolling 12 month period.

Total hazardous air pollutant emission equal less than 10 tons per year for each HAP and less than 25 tons per year all HAPs combined.

Diesel Engine Generator Criteria Pollutant Emissions						
pollutant	emission factor [a]	heat input	emission rate	emission rate	emission rate	emission rate
	g/bhp-hr	MMBtu/hr	g/hr	lb/hr	g/sec	tons/year
NO_x	5.78	670	3872.60	8.54	1.08	0.85
SO_2	---	---	---	0.2618 [b]	0.03	0.03
CO	0.39	670	261.30	0.58	0.07	0.06
VOC	0.01	670	6.70	0.01	1.86E-03	1.48E-03
PM	0.017	670	11.39	0.03	3.16E-03	2.51E-03

[a] NO_x, CO, VOC, and PM emission rates are based on manufacturer's literature for a Caterpillar 500 kW diesel engine generator.

[b] SO_2 emission rate based on mass balance calculation.
Maximum fuel consumption = 37.4 gallons/hr

lb/hr SO_2 emissions = 37.4 gallons/hr x 7.00 lbs fuel/gal fuel x 0.0005 S x 2 lb SO_2/lb S = 0.2618 lbs/hr

Diesel Engine Generator Hazardous Air Pollutant Emissions					
pollutant	emission factor [a]	Heat Input [b]	emission rate	emission rate	emission rate
	lb/MMBtu	MMBtu/hr	lb/hr	g/sec	tons/year
Benzene	7.76e-04	5.20	4.04E-03	5.08E-04	4.04E-04
Toluene	2.81e-04	5.20	1.46E-03	1.84E-04	1.46E-04
Xylene	1.93e-04	5.20	1.00E-03	1.26E-04	1.00E-04
Formaldehyde	7.89e-05	5.20	4.10E-04	5.17E-05	4.10E-05
Acetaldehye	2.52e-05	5.20	1.31E-04	1.65E-05	1.31E-05
Acrolein	7.88e-06	5.20	4.10E-05	5.16E-06	4.10E-06
Total PAH	2.12e-04	5.20	1.10E-03	1.39E-04	1.10E-04
TOTAL HAPs					8.18e-04

[a] Emission factors from AP-42 Table 3.4-3 Speciated Organic Compound Emission Factors for Large Uncontrolled Stationary Diesel Engines and Table 3.4-4 PAH Emission Factors for Large Uncontrolled Stationary Diesel Engines (10/96).

[b] Heat input based on maximum fuel consumption of 37.4 gallons/hr.
37.4 gallons/hr x 0.139 MMBtu/gal = 5.20 MMBtu/hr

Evaporative Cooler PM_{10} Emissions	
water flow rate, lb/hr	2,000,000
water flow rate, gal/min	4002
drift rate, %	0.005
drift, lb/hr	100
total dissolved solids, mg/L	1,500
PM_{10} emission rate, lb/hr	0.15
PM_{10} emission rate, tons/yr	0.66

Summary of Facility Emissions					
	NO_x	SO_2	CO	VOC	$PM_{10}/PM_{2.5}$
description of activity	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr
Gasifier/Boiler (excluding startups and shutdowns)	105.0	50.4	84.0	10.7	10.5
Gasifier Startup	0.6	0.6	15.5	0.66	0.66
Boiler Startup	2.2	1.2	6.0	0.3	2.2
Boiler Shutdown	0.3	0.2	0.8	0.03	0.03
Gasifier Shutdown	0.8	0.5	2.3	0.1	0.8
Subtotal, Gasifer/Boiler	108.9	52.9	108.6	11.8	14.2
Evaporative Cooler	---	---	---	---	0.66
Diesel Engine Generator	0.85	0.02	0.06	0.0014	0.003
Facility Total	109.75	52.9	108.7	11.8	14.9

AMBIENT AIR QUALITY ASSESSMENT:

An ambient air quality impact analysis was performed to determine the maximum projected impact from the two gasifier/boiler systems, the diesel engine generator and the fire pump engine. The analysis incorporates the operating limits of the gasifier/boiler systems and the diesel engine generator. Analysis of the fire pump engine was not required since the unit is considered an insignificant activity, for details see the **Insignificant Activities** section above;

note: fire pump engine emissions input into the model are based on a maximum 8 hours of operation over a period of 24 hours and 200 hours of operation in any rolling twelve month period. The dispersion modeling analysis was performed using the AERMOD model. Assumptions used in the modeling analysis are:

1. Rural dispersion parameters.
2. Meteorological data from Puhi station (Field 390), 1993-1994. The site is located about six miles east-northeast of the project site.
3. Lihue airport upper air data.

Terrain and receptor locations:

Terrain is from USGS DEM data and 7.5 minute quadrangle maps. The coarse grid consists of spacing receptors at 180 meter intervals. A 25 meter grid was used around the facility fence line. In areas where the coarse grid maximums occurred, a 30 meter grid was used to locate maximum impacts.

Potential downwash effect:

Potential downwash inducing structures associated with the facility are shown in following table:

Potential Downwash Inducing Structures			
structure	height (m)	width (m)	length (m)
energy plant	3.88	24.4	24.4
energy plant	15.24	42.8	21.2
condenser	5.18	2.77	2.57
stack area	9.14	4.9	9.8
feed stock	12.19	24.4	51.6
bin #1	9.14	9.9	7.4
bin #2	9.14	9.9	7.4

The applicant used a Lakes Environmental software package that incorporates EPA's BPIP program to derive 36 wind direction-specific building heights and projected widths for use in the model.

Background air quality data:

Background Air Quality Data				
pollutant	averaging period	location	date	background concentration ($\mu g/m^3$)
NO_2	annual	West Beach, Oahu	2006	6
SO_2	3-hour	West Beach, Oahu	2005	40
	24-hour	"	2005	11
	annual	"	2006	2
PM_{10}	24-hour	Lihue, Kauai	2006	34
	annual	"	2004	16
CO	1-hour	Kapolei, Oahu	2004	2,394
	8-hour	"	2006	1,183
Pb	quarterly	none	none	none

Stack parameters:

Stack parameters and emission rates used in the ambient air quality analysis are presented in the following table.

Emission Rates and Stack Parameters									
	emission rates					stack parameters			
unit	PM_{10} (g/s)	SO_2 (g/s)	NO_x (g/s)	CO (g/s)	Pb (g/s)	height (m)	temp (K)	velocity (m/s)	diameter (m)
two gasifiers/boilers, startup 1-hr averaging period	---	---	---	39.05 [a]	---	22.86	444.11	6.052	1.372
two gasifiers/boilers, startup 3-hr averaging period	---	2.25 [b]	---	---	---				
two gasifiers/boilers, startup 8-hr averaging period	---	---	---	12.60 [c]	---				
two gasifiers/boilers, startup 24-hr averaging period	0.91 [d]	1.38 [e]	---	---	---				
two gasifiers, short term normal operation	0.31	1.51	---	2.52	6.05e-03	22.86	444.11	12.104	1.372
two gasifiers/boilers, long term	0.43 [f]	1.54 [g]	3.15 [h]	---	---				
diesel engine generator	3.16e-03	0.03	1.08	0.07	---	4.572	782.11	25.4	0.305

[a] CO 1-hr averaging period: see **Project Emissions** section, Gasifier Startup Emissions.

[b] SO_2 3-hr averaging period: 3 g/sec x 2 hour gasifier startup = 6 g/sec
0.76 g/sec x 1 hr boiler startup = 0.76 g/sec
(6 g/sec + 0.76 g/sec)/3 hrs = 2.25 g/sec

[c] CO 8-hr averaging period: 39.05 g/sec x 2 hr gasifier startup = 78.1 g/sec
3.78 g/sec x 6 hr boiler startup = 22.68 g/sec
(78.1 g/sec + 22.68 g/sec)/8 hrs = 12.60 g/sec

[d] PM_{10} 24-hr averaging period: 3.3 g/sec x 2 hr gasifier startup = 6.6 g/sec
1.36 g/sec x 8 hr boiler startup = 10.88 g/sec
0.31 g/sec x 14 hr normal operation = 4.34 g/sec
(6.6 g/sec + 10.88 g/sec + 4.34 g/sec)/24 hrs = 0.91 g/sec

[e] SO_2 24-hr averaging period: 3 g/sec x 2 hour gasifier startup = 6 g/sec
0.76 g/sec x 8 hr boiler startup = 6.08 g/sec
1.51 g/sec x 14 hr normal operation = 21.14 g/sec
(6 g/sec + 6.08 g/sec + 21.14 g/sec)/24 hrs = 1.38 g/sec

[f] PM_{10} long term: see **Project Emissions** section, Summary of Facility Emissions
14.82 tons/yr x 2000 lbs/ton / 8,760 hrs/yr x 453.59 g/lb / 3,600 sec/hr = 0.43 g/sec

[g] SO_2 long term: see **Project Emissions** section, Summary of Facility Emissions
53.4 tons/yr x 2000 lbs/ton / 8,760 hrs/yr x 453.59 g/lb / 3,600 sec/hr = 1.54 g/sec

[h] NO_x long term: see **Project Emissions** section, Summary of Facility Emissions
109.5 tons/yr x 2000 lbs/ton / 8,760 hrs/yr x 453.59 g/lb / 3,600 sec/hr = 3.15 g/sec

Gasifer/Boiler Startup Ambient Air Quality Impacts [a]							
pollutant and averaging period	unit impact from one boiler [b]	emission rate	impact from one boiler	background concentration	total impact	AAQS	impact as % of standard
	μg/m³	g/sec	μg/m³	μg/m³	μg/m³	μg/m³	
SO_2 3-hr	68.80	2.25	154.80	40	194.8	1,300	15.0
SO_2 24-hr	42.38	1.38	58.48	11	69.48	365	19.0
PM_{10} 24-hr	42.38	0.91	38.57	34	72.57	150	48.4
CO 1-hr	92.83	39.05	3,625.01	2,394	6,019.01	10,000	60.2
CO 8 hr	46.75	22.36	1,045.33	1,183	2,228.33	5,000	44.6

[a] The application states it is unlikely that both gasifiers would startup at the same time. The above modeled impacts represent the startup of both gasifiers at the same time, this is reflected in the g/sec emission rate which is for two gasifiers.

[b] Unit impact performed with exhaust flow rates of a single boiler.

Gasifier/Boiler Ambient Air Quality Impacts					
pollutant and averaging period	impact from two boilers	background concentration	total impact	AQQS	impact as % of standard
	μg/m³	μg/m³	μg/m³	μg/m³	
NO_x annual [a]	9.38	6	15.38	70	22.0
SO_2 3-hr	66.96	40	106.96	1,300	8.2
SO_2 24-hr	49.55	11	60.55	365	16.6
SO_2 annual	5.61	2	7.61	80	9.5
PM_{10} 24-hr	13.52	34	47.52	150	31.7
PM_{10} annual	1.90	16	17.9	50	35.8
CO 1-hr	228.28	2,394	2,622.28	10,000	26.2
CO 8-hr	102.38	1,183	1,285.38	5,000	25.7
Pb quarterly	0.19 [b]	---	0.19	1.5	12.8

[a] NO_x concentration using ambient ratio method of 75% of modeled concentration
12.51 μg/m³ x 75% = 9.38 μg/m³

[b] The calculation of the Pb concentration for the quarterly averaging period was obtained by calculating the 24-hour averaging period unit impact concentration by the Pb emission rate. The 24-hour averaging period unit impact concentration for the two boilers is 31.79 μg/m³:

6.05e-03 g/s x 31.79 μg/m³ per g/s = 0.19 μg/m³

HAP ASSESSMENT:

Although not required, an assessment was performed to demonstrate that the emissions of hazardous air pollutants from the source will not result in any non-carcinogenic hazardous air pollutant that has a TLV-TWA: any eight-hour average ambient air concentration in excess of 1/100 of the TLV-TWA, and any annual average ambient air concentration in excess of 1/420 of the TLV-TWA; and for any carcinogenic hazardous air pollutant, any ambient air concentration that may result in an excess individual lifetime cancer risk of more than ten in one million assuming continuous exposure for seventy years.

1. Non-carcinogenic hazardous air pollutant with a TLV-TWA

Eight-hour average concentration compared to 1/100 of the TLV-TWA							
Compound	emission factor	TLV	emission rate	maximum 8-hr unit impact	maximum 8-hr concentration	1/100 of TLV	8-hr concentration exceed 1/100 TLV?
	lb/MMBtu	μg/m³	gr/sec for two units	μg/m³ per gr/sec	μg/m³	μg/m³	
Acetophenone	3.2E-09	49,284	4.03E-08	34.19	1.38E-06	493	no
Benzene	4.2E-03	1,597	5.29E-02	34.19	1.81	16	no
bis(2-Ethylhexyl)phthalate	4.7E-08	5,000	5.92E-07	34.19	2.02E-05	50	no
2-Butanone (MEK)	5.4E-06	589,775	6.80E-05	34.19	2.33E-03	5,898	no
Carbon tetrachloride	4.5E-05	31,460	5.67E-04	34.19	0.02	315	no
Chlorine	7.9E-04	1,450	9.95E-03	34.19	3.40E-01	15	no
Chlorobenzene	3.3E-05	46,037	4.16E-04	34.19	1.42E-02	460	no
Chloroform	2.8E-05	48,826	3.53E-04	34.19	1.21E-02	488	no
1,2-Dichloroethane (ethylene dichloride)	2.9E-05	40,474	3.65E-04	34.19	1.25E-02	405	no
Dichloromethane (methylene chloride)	2.9E-04	173,681	3.65E-03	34.19	1.25E-01	1,737	no
1,2-Dichloropropane (propylene dichloride)	3.3E-05	4,621	4.16E-04	34.19	1.42E-02	46	no
Ethylbenzene	3.1E-05	434,192	3.91E-04	34.19	1.34E-02	4,342	no
Fluorene	3.4E-06	1,554	4.28E-05	34.19	1.46E-03	16	no
2-Methylnaphthalene	1.6E-07	2,908	2.02E-06	34.19	6.89E-05	29	no
Naphthalene	9.7E-05	52,434	1.22E-03	34.19	4.18E-02	524	no
Pentachlorophenol	5.1E-08	500	6.43E-07	34.19	2.20E-05	5	no
Phenol	5.1E-05	19,243	6.43E-04	34.19	2.20E-02	192	no
Propionaldehyde	6.1E-05	47,526	7.69E-04	34.19	2.63E-02	475	no
Styrene	1.9E-03	85,186	2.39E-02	34.19	8.18E-01	852	no
Tetrachloroethene (tetrachloroethylene)	3.8E-05	169,530	4.79E-04	34.19	1.64E-02	1,695	no
Toluene	9.2E-04	75,362	1.16E-02	34.19	3.96E-01	754	no
1,1,1-Trichloroethane (methyl chloroform)	3.1E-05	1,909,611	3.91E-04	34.19	1.34E-02	19,096	no
Trichloroethene (trichloroethylene)	3.0E-05	53,742	3.78E-04	34.19	1.29E-02	537	no
Vinyl Chloride	1.8E-05	2,556	2.27E-04	34.19	7.75E-03	26	no
o-Xylene	2.5E-05	434,356	3.15E-04	34.19	1.08E-02	4,344	no
Antimony	7.9E-06	500	9.95E-05	34.19	3.40E-03	5	no
Arsenic	4.9E-06	10	6.16E-05	34.19	2.11E-03	0.10	no
Beryllium	1.1E-06	2	1.39E-05	34.19	4.74E-04	0.02	no
Cadmium	4.1E-06	2	5.17E-05	34.19	1.77E-03	0.02	no
Chromium, total	2.1E-05	500	2.65E-04	34.19	9.05E-03	5.00	no
Chromium, hexavalent	2.5E-06	10	3.15E-05	34.19	1.08E-03	0.10	no
Cobalt	6.5E-06	20	8.19E-05	34.19	2.80E-03	0.20	no
Lead	4.8E-05	50	6.05E-04	34.19	2.07E-02	0.50	no

Manganese	1.6E-03	200	2.02E-02	34.19	6.89E-01	2.00	no
Mercury	3.5E-06	10	4.41E-05	34.19	1.51E-03	0.10	no
Nickel (PRG for nickel subsulfide only)	3.3E-05	100	4.16E-04	34.19	1.42E-02	1.00	no
Phosphorus	2.7E-05	100	3.40E-04	34.19	1.16E-02	1.00	no
Selenium	2.8E-06	200	3.53E-05	34.19	1.21E-03	2.00	no

Annual average concentration compared to 1/420 of the TLV-TWA							
Compound	emission factor	TLV	emission rate	maximum annual unit impact	maximum annual concentration	1/420 of TLV	annual concentration exceed 1/420 TLV?
	lb/MMBtu	μg/m³	gr/sec for two units	μg/m³ per gr/sec	μg/m³	μg/m³	
Acetophenone	3.2E-09	49,284	4.03E-08	3.65	1.47E-07	117	no
Benzene	4.2E-03	1,597	5.29E-02	3.65	0.19	4	no
bis(2-Ethylhexyl)phthalate	4.7E-08	5,000	5.92E-07	3.65	2.16E-06	12	no
2-Butanone (MEK)	5.4E-06	589,775	6.80E-05	3.65	2.48E-04	1,404	no
Carbon tetrachloride	4.5E-05	31,460	5.67E-04	3.65	0.00	75	no
Chlorine	7.9E-04	1,450	9.95E-03	3.65	3.63E-02	3	no
Chlorobenzene	3.3E-05	46,037	4.16E-04	3.65	1.52E-03	110	no
Chloroform	2.8E-05	48,826	3.53E-04	3.65	1.29E-03	116	no
1,2-Dichloroethane (ethylene dichloride)	2.9E-05	40,474	3.65E-04	3.65	1.33E-03	96	no
Dichloromethane (methylene chloride)	2.9E-04	173,681	3.65E-03	3.65	1.33E-02	414	no
1,2-Dichloropropane (propylene dichloride)	3.3E-05	4,621	4.16E-04	3.65	1.52E-03	11	no
Ethylbenzene	3.1E-05	434,192	3.91E-04	3.65	1.43E-03	1,034	no
Fluorene	3.4E-06	1,554	4.28E-05	3.65	1.56E-04	4	no
2-Methylnaphthalene	1.6E-07	2,908	2.02E-06	3.65	7.36E-06	7	no
Naphthalene	9.7E-05	52,434	1.22E-03	3.65	4.46E-03	125	no
Pentachlorophenol	5.1E-08	500	6.43E-07	3.65	2.35E-06	1	no
Phenol	5.1E-05	19,243	6.43E-04	3.65	2.35E-03	46	no
Propionaldehyde	6.1E-05	47,526	7.69E-04	3.65	2.81E-03	113	no
Styrene	1.9E-03	85,186	2.39E-02	3.65	8.74E-02	203	no
Tetrachloroethene (tetrachloroethylene)	3.8E-05	169,530	4.79E-04	3.65	1.75E-03	404	no
Toluene	9.2E-04	75,362	1.16E-02	3.65	4.23E-02	179	no
1,1,1-Trichloroethane (methyl chloroform)	3.1E-05	1,909,611	3.91E-04	3.65	1.43E-03	4,547	no
Trichloroethene (trichloroethylene)	3.0E-05	53,742	3.78E-04	3.65	1.38E-03	128	no
Vinyl Chloride	1.8E-05	2,556	2.27E-04	3.65	8.28E-04	6	no
o-Xylene	2.5E-05	434,356	3.15E-04	3.65	1.15E-03	1,034	no
Antimony	7.9E-06	500	9.95E-05	3.65	3.63E-04	1.19	no
Arsenic	4.9E-06	10	6.16E-05	3.65	2.25E-04	2.38E-02	no
Beryllium	1.1E-06	2	1.39E-05	3.65	5.06E-05	4.76E-03	no
Cadmium	4.1E-06	2	5.17E-05	3.65	1.89E-04	4.76E-03	no
Chromium, total	2.1E-05	500	2.65E-04	3.65	9.66E-04	1.19	no

Chromium, hexavalent	2.5E-06	10	3.15E-05	3.65	1.15E-04	2.38E-02	no
Cobalt	6.5E-06	20	8.19E-05	3.65	2.99E-04	4.76E-02	no
Lead	4.8E-05	50	6.05E-04	3.65	2.21E-03	1.19E-01	no
Manganese	1.6E-03	200	2.02E-02	3.65	7.36E-02	4.76E-01	no
Mercury	3.5E-06	10	4.41E-05	3.65	1.61E-04	2.38E-02	no
Nickel (PRG for nickel subsulfide only)	3.3E-05	100	4.16E-04	3.65	1.52E-03	2.38E-01	no
Phosphorus	2.7E-05	100	3.40E-04	3.65	1.24E-03	2.38E-01	no
Selenium	2.8E-06	200	3.53E-05	3.65	1.29E-04	4.76E-01	no

2. Carcinogenic hazardous air pollutant

Carcinogenic HAP Excess Individual Lifetime Cancer Risk						
Compound	emission factor	emission rate	maximum annual unit impact	maximum annual concentration	ca PRG	PRG cancer risk
	lb/MMBtu	gr/sec for two units	$\mu g/m^3$ per gr/sec	$\mu g/m^3$	$\mu g/m^3$	
Acetaldehyde	8.3E-04	1.05E-02	3.65	3.82E-02	8.7E-01	4.4E-08
Benzene	4.2E-03	5.29E-02	3.65	1.93E-01	2.5E-01	7.7E-07
Benzo(a)anthracene	6.5E-08	8.19E-07	3.65	2.99E-06	9.2E-03	3.2E-10
Benzo(a)pyrene	2.6E-06	3.28E-05	3.65	1.20E-04	9.2E-04	1.3E-07
Benzo(b)fluoranthene	1.0E-07	1.26E-06	3.65	4.60E-06	9.2E-03	5.0E-10
Benzo(k)fluoranthene	3.6E-08	4.54E-07	3.65	1.66E-06	9.2E-02	1.8E-11
bis(2-Ethylhexyl)phthalate	4.7E-08	5.92E-07	3.65	2.16E-06	4.8E-01	4.5E-12
Carbazole	1.8E-06	2.27E-05	3.65	8.28E-05	3.4E-01	2.4E-10
Carbon tetrachloride	4.5E-05	5.67E-04	3.65	2.07E-03	1.3E-01	1.6E-08
Chloroform	2.8E-05	3.53E-04	3.65	1.29E-03	8.3E-02	1.6E-08
Chrysene	3.8E-08	4.79E-07	3.65	1.75E-06	9.2E-01	1.9E-12
Dibenzo(a,h)anthracene	9.1E-09	1.15E-07	3.65	4.18E-07	9.2E-04	4.5E-10
1,2-Dichloroethane (ethylene dichloride)	2.9E-05	3.65E-04	3.65	1.33E-03	7.4E-02	1.8E-08
Dichloromethane (methylene chloride)	2.9E-04	3.65E-03	3.65	1.33E-02	4.1	3.3E-09
1,2-Dichloropropane (propylene dichloride)	3.3E-05	4.16E-04	3.65	1.52E-03	9.9E-02	1.5E-08
Formaldehyde	4.4E-03	5.54E-02	3.65	2.02E-01	1.5E-01	1.3E-06
Indeno(1,2,3,c,d)pyrene	8.7E-08	1.10E-06	3.65	4.00E-06	9.2E-03	4.3E-10
Naphthalene	9.7E-05	1.22E-03	3.65	4.46E-03	5.6E-02	8.0E-08
Pentachlorophenol	5.1E-08	6.43E-07	3.65	2.35E-06	5.6E-02	4.2E-11
Polychlorinated biphenyls	8.1E-09	1.03E-07	3.65	3.75E-07	3.4E-03	1.1E-10
2,3,7,8-Tetrachlorodibenzo-p-dioxins	8.6E-12	1.08E-10	3.65	3.96E-10	4.5E-08	8.8E-09
Tetrachloroethene (tetrachloroethylene)	3.8E-05	4.79E-04	3.65	1.75E-03	3.2E-01	5.5E-09
Trichloroethene (trichloroethylene)	3.0E-05	3.78E-04	3.65	1.38E-03	1.7E-02	8.1E-08
2,4,6-Trichlorophenol	1.1E-08	1.44E-07	3.65	5.24E-07	9.6E-02	5.5E-12
Vinyl Chloride	1.8E-05	2.27E-04	3.65	8.28E-04	1.1E-01	7.5E-09
Arsenic	4.9E-06	6.16E-05	3.65	2.25E-04	4.5E-04	5.0E-07
Beryllium	1.1E-06	1.39E-05	3.65	5.06E-05	8.0E-04	6.3E-08

Cadmium	4.1E-06	5.17E-05	3.65	1.89E-04	1.1E-03	1.7E-07
Chromium, hexavalent	2.5E-06	3.15E-05	3.65	1.15E-04	2.3E-05	5.0E-06
Cobalt	6.5E-06	8.19E-05	3.65	2.99E-04	6.9E-04	4.3E-07
						8.71E-06

The assessment performed for non-carcinogenic HAPs with a TLV-TWA demonstrates the eight-hour averaging period concentration of a pollutant is less than 1/100 of the TLV-TWA and the annual averaging period concentration of a pollutant is less than 1/420 of the TLV-TWA. The assessment performed for carcinogenic HAPs demonstrates the excess individual lifetime cancer risk is less than ten in one-million.

SIGNIFICANT PERMIT CONDITIONS:

1. Gasifier/Boiler System Heat Input

   a. The total wood chip heat input to the two (2) gasifiers shall not exceed a combined total of 840,000 MMBtu in any rolling twelve (12) month period. Heat input shall include all periods of operation of the gasifier/boiler system (including all startup and shutdown periods);

   b. The measurement of heat input to the two (2) gasifiers shall be based on an approved or conditionally approved protocol as specified in Attachment II, Special Condition No. E.4.; and

   c. The protocol must receive the approval or conditional approval of the Department of Health prior to the first fire of the gasifier/boiler system.

2. Gasifier/Boiler System Startup and Shutdown

   a. Combustion shall not begin in the gasifier unless the induced draft fan is in operation to draw combustion air from the gasifier chamber through the gasifier/boiler system and out of the stack.

      If an inspection indicates visible emissions exiting from the gasifier doors, the Department of Health may at any time require the permittee to perform visible emissions monitoring of the gasifier doors during gasifier startup.

3. Gasifier/Boiler System Air Pollution Control Equipment

   a. The permittee shall design, install, continuously operate and maintain the following air pollution control equipment to meet the particulate matter emission limit as specified in Attachment II, Special Condition Nos. C.5.a. and C.5.b.:

      i. One (1) multicyclone for each gasifier/boiler system; and

      ii. One (1) electrostatic precipitator for the two (2) gasifier/boiler systems.

   b. The multicyclone equipped with each gasifier/boiler system shall be fully operational at all times when the respective gasifier/boiler system is in operation. At a minimum, the multicyclone shall be in full operation at the beginning of the gasifier's startup and shall continue to operate until the end of the gasifier's shutdown.

c. The electrostatic precipitator shall be fully operational at all times when at least one or both gasifier/boiler systems are in operation. At a minimum, the electrostatic precipitator shall be in full operation at the end of the first boilers startup and shall continue to operate until the beginning of the last gasifier's shutdown.

d. The permittee shall not operate the gasifiers/boiler systems if a problem affecting PM control efficiency of the multicyclone and/or ESP is observed or apparent at any time. The permittee shall investigate and correct the problem before resuming operation of the gasifier/boiler systems.

e. Following the initial source performance test, the electrostatic precipitator's second-stage voltage shall be maintained at or above the minimum second stage voltage established during the initial source performance test of Attachment II, Special Condition No. F.1. The minimum second stage voltage shall be maintained at all times when at least one or both gasifier/boiler systems are in operation. The minimum second stage voltage shall be maintained from end of the first boilers startup and shall be maintained until the beginning of the last gasifier's shutdown.

7. One Time Alternate Operating Scenario

This one time alternate operating scenario shall only be applicable to alternate unit(s) requested prior to the installation of the unit(s) listed in Attachment II, Special Condition No. A.1. and shall not apply to the replacement of any unit following initial installation.

The permittee may replace the Biomass Gasifier/Boiler System, Electrostatic Precipitator, Evaporative Cooler, or Diesel Engine Generator listed in Attachment II, Special Condition No. A.1. with alternate unit(s) if the following provisions are adhered to:

a. The permittee shall submit a written request and receive prior written approval from the Department of Health before the replacement;

b. For the Biomass Gasifier/Boiler System, Evaporative Cooler, and Diesel Engine Generator:

   i. The alternate unit(s) is of comparable size or smaller with equal or lesser emissions;

   ii. The alternate unit(s) complies with all applicable conditions including all air pollution control equipment requirements and operating restrictions; and

   iii. The alternate unit(s) shall be installed at the same location as the unit(s) it is replacing.

c. For the Electrostatic Precipitator:

   i. The alternate units capacity to control particulate matter emissions is equal to or greater than that of the ESP listed in Attachment II, Special Condition No. A.1.; and

ii. The alternate unit complies with all applicable conditions including all air pollution control equipment requirements and operating restrictions;

d. The written request shall include the following information:

i. Identify the unit(s) to be replaced;

ii. The reason(s) for the replacement;

iii. Written documentation on the alternate unit(s) including, but not limited to: the make, model, size, serial number, manufacturer's literature, emissions data (including but not limited to manufacture's guarantees), description of air pollution controls, control efficiencies, stack parameters, and calculations of emissions with supporting documentation;

iv. An ambient air quality impact assessment for the alternate unit(s) showing compliance with all State and National Ambient Air Quality Standards (SAAQS/NAAQS); and

v. Any additional information as requested by the Department of Health.

10. Diesel Engine Generator Operating Hours

a. The maximum operating hours of the diesel engine generator shall not exceed eight (8) hours per day.

b. The maximum operating hours of the diesel engine generator shall not exceed two-hundred (200) hours in any rolling twelve (12) month period.

CONCLUSION:

Green Energy Team, LLC is proposing to construct and operate two 50 MMBtu/hr biomass gasifiers with close coupled steam boilers and a steam turbine generator to produce electricity for the island of Kauai. The gasifiers will be fired on albizia and eucalyptus wood chips. Other permitted equipment include a 500 kW diesel engine generator. The facility is subject to the following Standards of Performance for New Stationary Sources: 40 CFR Part 60, Subpart A General Provisions, Dc Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units, and IIII Standards of Performance for Stationary Compression Ignition Internal Combustion Engines.

The ambient air quality modeling analysis performed for the facility demonstrates the combustion turbine and diesel engine generator will operate in compliance with state and national ambient air quality standards. The analysis was performed at the heat input limit of 840,000 MMBtu/yr for the two biomass gasifier/boiler systems and 200 hours per year for the diesel engine generator. Emissions from startup and shutdown are included in the assessment. Issuance of a covered source permit is recommended based on the review of the information provided by the applicant and subject to the permit conditions and forty-five day EPA review.