PROPOSED

Covered Source Permit No. 0650-01-C

APPLICATION NO.: Application for a significant modification no. 0650-02

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

452,731.5 m E; 2,428,854.3 m N
NAD-83

RESPONSIBLE OFFICIAL: Eric Knutzen
Partner, Green Energy Team, LLC
P.O. Box 340
Anahola, HI 96703

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

PROPOSED PROJECT:

Permit no. 0650-01-C was issued to Green Energy Team, LLC on June 13, 2008 for two (2) 50 MMBtu/hr biomass gasifiers with close-coupled steam boilers and one 670 bhp diesel engine generator. In a letter dated November 1, 2009 Green Energy Team requested an extension of the authority to construct due to a delay in financing for the project. An extension of eighteen months to June 13, 2011 was granted by the Department. The facility had not been constructed as of November 29, 2010, when the Department received an application (0650-02) for a significant modification to the permit.

The applicant proposes to replace the two (2) 50 MMBtu/hr biomass gasifiers/boilers with a single nominal 100 MMBtu/hr biomass boiler with a steam turbine and to make other changes to the permit to reflect the final design. The original permitted equipment would have produced 7.1 MW gross rated output. The proposed facility will produce 7.9 MW gross rated output with no increase in emissions from the previously permitted equipment.

In addition to replacing the two 50 MMBtu/hr biomass gasifiers/boilers with a nominal 100 MMBtu/hr biomass boiler, the following additional changes are proposed:

1. Add selective non-catalytic reduction (ammonia/urea injection) to the boiler for NO_x emissions control;
2. Add diesel fuel co-firing of up to 150,000 gallons per year to aid in ignition during boiler startup and for combustion stabilization when very wet wood is being burned. The maximum amount of diesel fired in the boiler is not to exceed 10% of annual heat input;
3. Replace the PPC Industries electrostatic precipitator with a comparable unit designed to be compatible with the boiler;
4. Replace the Marley evaporative cooler with a larger evaporative cooler or cooling tower;
5. Replace the Tier 2 certified Caterpillar C5 emergency diesel engine generator with a comparable Tier 3 certified unit;

Review date: 04/15/11
Reviewed by: CL

6. Add an exempt 46 kW Tier 2 certified Cummins (or equivalent) fire pump engine in place of the Tier 1 Clarke fire pump engine (exempt in the review for application 0650-01); and
7. Changing the fuel handling system to receiving chipped wood instead of preparing fuel onsite, reducing the potential for fugitive dust.

The proposed conventional biomass boiler will be fired on albizia and eucalyptus wood chips as a primary fuel (and other wood fuels provided the permittee receives approval from the Department of Health prior to their use). As stated above, diesel or biodiesel fuel will be used during startups and to stabilize the combustion of very wet wood. The applicant proposes a total liquid fuel use limitation of 150,000 gallons per year and a limit of less than 10% of the total annual heat input from biomass.

EQUIPMENT:

1. One (1) nominal 100 MMBtu/hr Biomass Boiler

Manufacturer: Standardkessel Gmbh
Model and Serial no.: According to the applicant, the boiler is being designed and constructed to meet the specifications of the Green Energy Team project. Because each boiler installation is custom designed, Standardkessel Gmbh does not assign model or serial numbers.
Primary fuel: Albizia and Eucalyptus wood chips and other agricultural material upon receipt of approval from the Department of Health
Maximum hourly heat input: 103.5 MMBtu/hr
Nominal rated hourly heat input: 100 MMBtu/hr
Maximum annual heat input: 840,000 MMBtu/hr
Supplemental fuels: ultra-low sulfur diesel fuel and biodiesel
Supplemental fuel burner rating: 20.5 MMBtu/hr
Supplemental fuel burner rating: 150 gal/hr
Maximum supplemental fuel consumption: 150,000 gallons per year, limited to less than 10% of the total annual heat input capacity of the boiler

Nominal Specifications for Wood Chip Fuel

Typical heat content, as fired: 4,745 Btu/lb HHV
Typical moisture content, as fired: 40% by weight
Typical ash content, dry wood: 2.0% by weight
Maximum sulfur content, dry wood: 0.05 % by weight
Typical nitrogen content, dry wood: 0.5 % by weight

Nominal Specifications for Ultra Low Sulfur Diesel and Biodiesel Fuels

	ULSD	Biodiesel
Typical heat content, MMBtu/bbl (HHV)	5.735	5.0
Typical heat content, Btu/gal (HHV)	136,548	119,200
Typical ash content (% by weight)	<0.001	<0.02%
Maximum sulfur content (% by weight)	0.0015	0.0015
Typical nitrogen content (ppm)	9	18

2. Evaporative Cooler or Cooling Tower Emission

Manufacturer: to be determined
Model: to be determined
Recirculation rate: 9,025 gpm
Drift rate: 0.003% by weight
Total dissolved solids: 1,500 mg/L

AIR POLLUTION CONTROLS:

The biomass boiler utilizes an electrostatic precipitator (ESP) for particulate matter control.

Design Specifications – Electrostatic Precipitator	
Manufacturer	TBD
Design exhaust volume (acfm)	46,000
Exhaust temperature (degrees F)	248
Gas velocity (ft/sec)	TBD
Guaranteed emission rate (lb/MMBtu)	0.025

Unlike the ESP for the original project design, the proposed ESP now has the ability to be operated throughout the startup process. The new boiler will also use flue gas recirculation (FGR), overfire air, and selective non-catalytic reduction (SNCR) using ammonia/urea injection for NO_x control. FGR is a combustion modification that re-circulates exhaust gas to the combustion zone, reducing peak flame temperature and thus the formation of thermal NO_x in the combustion chamber. SNCR is a post-combustion control technique where ammonia/urea is injected into the boiler exhaust stream and reacts with the NO_x and combustion air to form nitrogen, water and traces of CO_2.

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 Db, Standards of Performance for 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	50.91
VOC	≥ 250	≥ 100	10.55
NO_x	≥ 2500	≥ 100	106.86
CO	≥ 2500	≥1000	86.46
Pb		≥ 5	2.02E-02
PM_{10}	≥ 250	≥ 100	11.13
$PM_{2.5}$[a]	≥ 250	≥ 100	11.13
Ammonia[b]	≥ 250	≥ 100	11.83

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

[b] Ammonia emission rate based on 2.7 lbs/hr.

The facility is a potential Type B CERR due to potential NOx emissions.

Annual Emissions Reporting Requirements

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

NSPS Applicability:

The nominal 100 MMBtu/hr boiler is subject to 40 Code of Federal Regulations (CFR) Part 60, Subpart Db - Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units. According to subpart Db, the regulation is applicable to each steam generating unit that commences construction, modification, or reconstruction after June 19, 1984, and that has a heat input capacity from fuels combusted in the steam generating unit of greater than or equal to 100 MMBtu/hour.

Two of the listed insignificant activities, the emergency diesel engine generator and the diesel fire pump engine, are subject to the requirements of 40 CFR Part 60, Subpart ZZZZ. Subpart ZZZZ states that a new or reconstructed stationary RICE located at an area source must meet the requirements of Subpart ZZZZ by meeting the requirements of 40 CFR Part 60, Subpart IIII. No other requirements of Subpart ZZZZ apply to the 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. Subpart IIII has emission certification requirements for the diesel engines. In addition, the diesel engines are subject to restrictions on the maximum fuel sulfur content, and minimum cetane index or maximum aromatic content.

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	106.86	40	yes
Sulfur Dioxide	50.91	40	yes
Carbon Monoxide	86.46	100	no
Volatile Organic Compounds	10.55	40	no
Particulate Matter - TSP	11.13	25	no
Particulate Matter - PM10	11.13	15	no
Lead	2.02E-02	6.00e-01	no
Sulfuric Acid Mist	na	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 NOx, SO2, CO, VOC, PM and PM10 are based on the operation of the boiler at the heat input limit of 840,000 MMBtu/yr plus emissions from startup and shutdown. 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 boiler 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.

Nitrogen Oxides (NOx)

Information on wood-fired boilers with a heat input greater than 100 MMBtu/hr was located in EPA's RBLC database. Information on boilers of comparable size and fuel use are described below:

- 2009 Erachem Comilog, Inc.

  69.3 MMBtu/hr wood fired boiler with NOx emission limit of 0.25 lb/MMBtu on a daily average basis, met without add-on controls.

- 2005 Laurention Energy

  230 MMBtu/hr wood fired boilers with a BACT/PSD emission limit of 0.15 lb/MMBtu on a 30-day average basis. SNCR utilized for NOx control. Emission limit is not comparable to the proposed Green Energy which is a 3-hour limit.

- 2004 South Point Power

  Seven wood fired boilers with a NOx limit of 0.44 MMBtu/hr. SCR utilized for NOx control.

- 2002 Martinsville Thermal, LLC Thermal Ventures

  120 MMBtu/hr wood/bark-fired boiler. Emission limit of 0.40 lb/MMBtu met through good combustion practices.

The proposed boiler design uses overfire air in both the ignition and afterburning zones, reducing both NOx and CO emissions. Flue gas recirculation (FGR) is being used for NOx control for the boiler. FGR is used to recirculate exhaust gas to the combustion zone, reducing flame temperatures and thus reducing thermal NOx formation in the combustion chamber.

Potential post-combustion controls for NOx emissions are selective catalytic reduction (SCR) and selective noncatalytic reduction (SNCR). SNCR is proposed for use in the boiler as it can be used in a high-dust environment because no catalyst is required.

Sulfur Dioxide (SO2)

The South Point Power boilers mentioned above uses a spray dryer adsorer system, primarily for the control of hydrochloric acid emissions although the spray dry adsorber system achieves some reduction in SO2 emissions. No HCl control is necessary on the proposed boiler; therefore, the HCl/SO2 control technology determination is not applicable to the proposed project. SO2 emissions are minimized through the use of low-sulfur fuel.

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 boiler is subject to CAM for NOx because it is located at a major source that is required to obtain a Part 70 permit (state issued Title V permit), is subject to an emission limit, uses a control device to achieve compliance, and has potential pre-control emissions of NOx that are greater than 100 tons/year. The unit does not meet any of the exemptions of 5.a through 5.g above.

The boiler <u>is not</u> subject to CAM for PM because the standard for particulate matter meets the exemption of 5.a. above, the emission limitation for PM was proposed by the Administrator after November 15, 1990.

MACT Applicability:

The boiler is subject to the requirement of 40 CFR Part 63, Subpart JJJJJJ, National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers Area Sources. This rule applies because it is an industrial boiler that combusts biomass and distillate and is located at an area source of HAP emissions.

Subpart JJJJJ requirements that apply to the boiler are:

a. PM limit of 0.03 lb per MMBtu of heat input (§63.11201)

b. Conduct a tune-up of the boiler biennially (§63.11223)

c. Maintain opacity to less than or equal to 10 percent (daily block average) OR maintain second stage voltage of ESP at or above lowest 1-hour average secondary voltage measured during most recent performance test (§63.11201)

d. Perform triennial performance tests to demonstrate compliance with the PM limit ((§63.11212)

NON-APPLICABLE REQUIREMENTS:

PSD Applicability:

The proposed project is not subject to PSD applicability because it 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	50.91
NO_x	106.86
CO	86.46
PM	11.13
VOC	10.55

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 of NO_x.

ALTERNATE OPERATING SCENARIOS:

The applicant has indicated that the make and model of the electrostatic precipitator 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. Evaporative Cooler/Cooling Tower Emissions
   Maximum PM10/PM2.5 emissions = 0.9 tons/year at 8,760 hours/year operation

   Basis for insignifant determination: HAR §11-60.1-82(f)(7)(d)
   Other activities which emit less than two tons per year of each regulated air pollutant other than carbon monoxide and which the director determines to be insignificant on a case-by-case basis.

2. 595 bhp (450 kW) Emergency Diesel Engine Generator

   Manufacturer: Caterpillar or equivalent
   Model: CAT C15 ATAAC (or equivalent) Diesel Engine
   Fuel: diesel no. 2 or biodiesel with a maximum sulfur content of 0.0015%
   Fuel feed rate: 34.9 gallons/hr
   Emission certification: Tier 3

   Basis for insignificant determination: HAR §11-60.1-82(f)(5):
   Standby generators used exclusively to provide electricity, standby sewage pump drives, and other emergency equipment used to protect the health and welfare of personnel and the public, all of which are used only during power outages, emergency equipment maintenance and testing, and which:
   (A) Are fired exclusively by natural or synthetic gas; or liquified petroleum gas; or fuel oil No. 1 or No. 2; or diesel fuel oil No. 1D or No. 2D; and
   (B) Do not trigger a Prevention of Significant Deterioration (PSD) or covered source review, based on their potential to emit regulated or hazardous air pollutants.

3. 62 bhp (46 kW) Fire Pump Engine

   Manufacturer: Cummins (or equivalent)
   Model: CFP3-F25 (or equivalent)
   Fuel: diesel no. 2 or biodiesel with a maximum sulfur content of 0.0015%
   Fuel feed rate: 3.4 gallons/hr
   Maximum heat input: 3.4 gallons/hour x 0.14 MMBtu/gallon = 0.476 MMBtu/hr
   Emission certification: Tier 2

   Basis for insignificant determination: §11-60.1-82(f)(2)
   (2) Other than smoke house generators and gasoline fired industrial equipment, fuel burning equipment with a heat input capacity less than one million BTU per hour, or a combination of fuel burning equipment operated simultaneously as a single unit having a total combined heat input capacity of less than one million BTU per hour.

4. Diesel and Biodiesel Fuel Storage Tanks

   Two 13,000 gallon (approximate) capacity fuel storage tanks. Ultra-low sulfur diesel and biodiesel fuel for the emergency diesel generator, fire pump engine, and backup fuel for the biomass boiler will be stored in these tanks.

   Basis for insignicant determination: §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:

Boiler Emissions - Normal Operation
Wood Combustion

pollutant	maximum heat input (MMBtu/hr)	emission rate [a] (lb/MMBtu)	emission rate (lb/hr)	emission rate at 8,760 hrs/yr at maximum capacity [b] (tons/yr)	emission rate at 840,000 MMBtu/yr [c] (tons/yr)
NOx	103.5	0.25	25.88	113.33	105.00
PM	103.5	0.025	2.59	11.33	10.50
CO	103.5	0.2	20.70	90.67	84.00
SO2	103.5	0.12	12.32	54.40	50.40
VOC	103.5	0.0246	2.55	11.15	10.35

[a] NOx emission rate is based on the Standardkessel guaranteed emission rate.

PM emission rate is the ESP manufacturer's guaranteed emission rate.

CO emission rate is the Standardkessel guaranteed emission rate.

SO_2 emission rate is 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

VOC emission rate based on emission limit from original permit of 2.55 lb/hr divided by the boiler's maximum hourly heat input of 103.5 MMBtu/hr. The original limit was based on the 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) with a 50% compliance margin.

[b] The boiler is limited to a heat input capacity of 840,000 MMBtu/yr which includes the heat input contributed during startups and shutdowns and normal operations. The emission rate in this column assumes continuous operation of the boiler for 8,760 hour/year with no startups or shutdowns.

[c] The heat input rate of 840,000 MMBtu/yr used to determine emissions for this column does not include startup and shutdown emissions.

Boiler Emissions - Normal Operation
Fuel Oil No. 2 Combustion

pollutant	maximum heat input (MMBtu/hr)	1000 gal/hr fuel consumption	emission rate[a] (lb/1000 gal)	emission rate (lb/MMBtu)	emission rate (lb/hr)	emission rate at 8,760 hrs/yr at maximum capacity (tons/yr)	emission rate at 21,000 MMBtu/yr max diesel heat input[b] (tons/yr)
NOx	103.5	0.74	24	0.17	17.74	77.71	1.80
PM	103.5	0.74	3.3	2.36E-02	2.44	10.69	0.25
CO	103.5	0.74	5	3.57E-02	3.70	16.19	0.38
SO2	103.5	0.74	0.213	1.52E-03	0.16	0.69	0.02
VOC	103.5	0.74	0.34	2.43E-03	0.25	1.10	0.03

[a] Emission rates are based on Table 1.3-1 Criteria Pollutant Emission Factors for Fuel Oil Combustion (5/10) for Boilers > 100 MMBtu/hr, No. 2 oil fired.

[b] 21,000 MMBtu/yr is based upon the diesel fuel consumption limit of 150,000 gallons/year x 0.014 MMBtu/gallon = 21,000 MMBtu/year

Boiler Emissions - Startup
Wood Combustion [b]

pollutant	emission rate [a] (lb/MMBtu)	maximum emission rate (lb/hr)	average emission rate [c] (lb/hr)	annual emissions assuming 24 each 8 hour startups per year [d] (approx. 2 per month) (tons/yr)
NOx	0.4541	28.2	14.10	1.35
SOx	0.1234	7.66	3.83	0.37
CO	0.6000	37.26	18.63	1.79
VOC	0.0490	3.04	1.52	0.15
PM10	0.1535	9.53	4.77	0.46

[a] Estimated NO_x emission rate without the SNCR is approximately 500 mg/m^3, or approximately 47 lb/hr at the maximum hourly heat input of 103.5 MMBtu/hr which amounts to 0.45 lb/MMBtu. Startup ends when the boiler reaches 60% load or 62.1 MMBtu/hr (0.45 lb/MMBtu x 62.1 MMBtu/hr = 28.2 lb/hr). Applicant assumed maximum heat input of 100 MMBtu/hr and lb/hr emission rate of 27 lb/hr (0.45 lb/MMBtu x 60 MMBtu/hr).

SO_2 emission rate is 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

CO and PM_{10} emission rates are based on AP-42 Tables 1.6-1 and 1.6-2 (wood fired boilers, factors for wet wood). The VOC emission factor is double the normal operation conditions emission rate to reflect lower combustion efficiency expected during startup. The PM_{10} emission rate is based on filterable plus condensable, with 50% control from ESP during startup (the ESP may not be able to achieve design control efficiency during startup and shutdown when PM coming from the boiler may be higher than during normal operation).

[b] The lb/hr emission rate for wood combustion is higher than that for fuel oil no. 2 and is therefore more conservative, and the reason why only wood combustion emission rates during startup are shown here.

[c] The average emission rate is based upon the average load over startup (30%) which is 50% of the final load of startup (60% load). 62.1 MMBtu/hr ÷ 2 = 31.05 MMBtu/hr.

[d] Annual emissions are based on assuming 24 each 8 hour startups per year and the use of the average lb/hr emission rate.

Boiler Emissions – Shutdown
Wood Combustion [b]

pollutant	emission rate [a] (lb/MMBtu)	maximum emission rate (lb/hr)	annual emissions assuming 24 each 2 hour shutdowns per year (approx. 2 per month) (tons/yr)
NOx	0.45	20.96	0.50
SOx	0.12	5.75	0.14
CO	0.60	27.95	0.67
VOC	0.05	2.28	0.05
PM10	0.15	7.15	0.17

[a] See Footnote a from the table Boiler Emissions – Startup for the basis of the lb/MMBtu shutdown emissions.

[b] The boiler does not fire fuel oil no. 2 at any time during shutdown.

Boiler Hazardous Air Pollutant Emissions

Compound	emission factor [a]	heat input	emissions	emissions	emissions 8,115.942 hrs/yr	emissions 8,115.942 hrs/yr [b]
	lb/MMBtu	MMBtu/hr	lb/hr	gr/sec	lb/yr	tons/yr
Acenaphthene	9.10E-07	103.5	9.42E-05	1.19E-05	7.64E-01	3.82E-04
Acenaphthylene	5.00E-06	103.5	5.18E-04	6.52E-05	4.20E+00	2.10E-03
Acetaldehyde	8.30E-04	103.5	8.59E-02	1.08E-02	6.97E+02	3.49E-01
Acetophenone	3.20E-09	103.5	3.31E-07	4.17E-08	2.69E-03	1.34E-06
Acrolein	4.00E-03	103.5	4.14E-01	5.22E-02	3.36E+03	1.68E+00
Anthracene	3.00E-06	103.5	3.11E-04	3.91E-05	2.52E+00	1.26E-03
Benzene	4.20E-03	103.5	4.35E-01	5.48E-02	3.53E+03	1.76E+00
Benzo(a)anthracene	6.50E-08	103.5	6.73E-06	8.48E-07	5.46E-02	2.73E-05
Benzo(a)pyrene	2.60E-06	103.5	2.69E-04	3.39E-05	2.18E+00	1.09E-03
Benzo(b)fluoranthene	1.00E-07	103.5	1.04E-05	1.30E-06	8.40E-02	4.20E-05
Benzo(e)pyrene	2.60E-09	103.5	2.69E-07	3.39E-08	2.18E-03	1.09E-06
Benzo(g,h,i)perylene	9.30E-08	103.5	9.63E-06	1.21E-06	7.81E-02	3.91E-05
Benzo(k)fluoranthene	3.60E-08	103.5	3.73E-06	4.69E-07	3.02E-02	1.51E-05

bis(2-Ethylhexyl)phthalate or Di(2-ethylhexyl)phthalate (DEHP)	4.70E-08	103.5	4.86E-06	6.13E-07	3.95E-02	1.97E-05
Bromomethane (methyl bromide)	1.50E-05	103.5	1.55E-03	1.96E-04	1.26E+01	6.30E-03
2-Butanone (MEK)	5.40E-06	103.5	5.59E-04	7.04E-05	4.54E+00	2.27E-03
Carbazole	1.80E-06	103.5	1.86E-04	2.35E-05	1.51E+00	7.56E-04
Carbon tetrachloride	4.50E-05	103.5	4.66E-03	5.87E-04	3.78E+01	1.89E-02
Chlorine	7.90E-04	103.5	8.18E-02	1.03E-02	6.64E+02	3.32E-01
Chlorobenzene	3.30E-05	103.5	3.42E-03	4.30E-04	2.77E+01	1.39E-02
Chloroform	2.80E-05	103.5	2.90E-03	3.65E-04	2.35E+01	1.18E-02
Chloromethane (methyl chloride)	2.30E-05	103.5	2.38E-03	3.00E-04	1.93E+01	9.66E-03
2-Chloronaphthalene	2.40E-09	103.5	2.48E-07	3.13E-08	2.02E-03	1.01E-06
Chrysene	3.80E-08	103.5	3.93E-06	4.96E-07	3.19E-02	1.60E-05
Dibenzo(a,h)anthracene	9.10E-09	103.5	9.42E-07	1.19E-07	7.64E-03	3.82E-06
1,2-Dichloroethane (ethylene dichloride)	2.90E-05	103.5	3.00E-03	3.78E-04	2.44E+01	1.22E-02
Dichloromethane (methylene chloride)	2.90E-04	103.5	3.00E-02	3.78E-03	2.44E+02	1.22E-01
1,2-Dichloropropane (propylene dichloride)	3.30E-05	103.5	3.42E-03	4.30E-04	2.77E+01	1.39E-02
2,4-Dinitrophenol	1.80E-07	103.5	1.86E-05	2.35E-06	1.51E-01	7.56E-05
Ethylbenzene	3.10E-05	103.5	3.21E-03	4.04E-04	2.60E+01	1.30E-02
Fluoranthene	1.60E-06	103.5	1.66E-04	2.09E-05	1.34E+00	6.72E-04
Fluorene	3.40E-06	103.5	3.52E-04	4.43E-05	2.86E+00	1.43E-03
Formaldehyde	4.40E-03	103.5	4.55E-01	5.74E-02	3.70E+03	1.85E+00
Hydrogen Chloride	1.90E-02	103.5	1.97E+00	2.48E-01	1.60E+04	7.98E+00
Indeno(1,2,3,c,d)pyrene	8.70E-08	103.5	9.00E-06	1.13E-06	7.31E-02	3.65E-05
2-Methylnaphthalene	1.60E-07	103.5	1.66E-05	2.09E-06	1.34E-01	6.72E-05
Naphthalene	9.70E-05	103.5	1.00E-02	1.26E-03	8.15E+01	4.07E-02
4-Nitrophenol	1.10E-07	103.5	1.14E-05	1.43E-06	9.24E-02	4.62E-05
Pentachlorophenol	5.10E-08	103.5	5.28E-06	6.65E-07	4.28E-02	2.14E-05
Perylene	5.20E-10	103.5	5.38E-08	6.78E-09	4.37E-04	2.18E-07
Phenanthrene	7.00E-06	103.5	7.25E-04	9.13E-05	5.88E+00	2.94E-03
Phenol	5.10E-05	103.5	5.28E-03	6.65E-04	4.28E+01	2.14E-02
Polychlorinated biphenyls	8.15E-09	103.5	8.43E-07	1.06E-07	6.84E-03	3.42E-06
Propionaldehyde	6.10E-05	103.5	6.31E-03	7.95E-04	5.12E+01	2.56E-02
Pyrene	3.70E-06	103.5	3.83E-04	4.83E-05	3.11E+00	1.55E-03
Styrene	1.90E-03	103.5	1.97E-01	2.48E-02	1.60E+03	7.98E-01
2,3,7,8-Tetrachlorodibenzo-p-dioxins	8.60E-12	103.5	8.90E-10	1.12E-10	7.22E-06	3.61E-09
Tetrachloroethene (tetrachloroethylene)	3.80E-05	103.5	3.93E-03	4.96E-04	3.19E+01	1.60E-02
Toluene	9.20E-04	103.5	9.52E-02	1.20E-02	7.73E+02	3.86E-01
1,1,1-Trichloroethane (methyl chloroform)	3.10E-05	103.5	3.21E-03	4.04E-04	2.60E+01	1.30E-02

Trichloroethene (trichloroethylene)	3.00E-05	103.5	3.11E-03	3.91E-04	2.52E+01	1.26E-02
2,4,6-Trichlorophenol	1.14E-08	103.5	1.18E-06	1.49E-07	9.58E-03	4.79E-06
Vinyl Chloride	1.80E-05	103.5	1.86E-03	2.35E-04	1.51E+01	7.56E-03
o-Xylene	2.50E-05	103.5	2.59E-03	3.26E-04	2.10E+01	1.05E-02
Antimony	7.90E-06	103.5	8.18E-04	1.03E-04	6.64E+00	3.32E-03
Arsenic	4.89E-06	103.5	5.06E-04	6.38E-05	4.11E+00	2.05E-03
Beryllium	1.10E-06	103.5	1.14E-04	1.43E-05	9.24E-01	4.62E-04
Cadmium	4.10E-06	103.5	4.24E-04	5.35E-05	3.44E+00	1.72E-03
Chromium, total	2.10E-05	103.5	2.17E-03	2.74E-04	1.76E+01	8.82E-03
Chromium, hexavalent	2.50E-06	103.5	2.59E-04	3.26E-05	2.10E+00	1.05E-03
Cobalt	6.50E-06	103.5	6.73E-04	8.48E-05	5.46E+00	2.73E-03
Lead	4.80E-05	103.5	4.97E-03	6.26E-04	4.03E+01	2.02E-02
Manganese	1.60E-03	103.5	1.66E-01	2.09E-02	1.34E+03	6.72E-01
Mercury	3.50E-06	103.5	3.62E-04	4.56E-05	2.94E+00	1.47E-03
Nickel (nickel subsulfide value used for RSL)	3.30E-05	103.5	3.42E-03	4.30E-04	2.77E+01	1.39E-02
Phosphorus	2.70E-05	103.5	2.79E-03	3.52E-04	2.27E+01	1.13E-02
Selenium	2.80E-06	103.5	2.90E-04	3.65E-05	2.35E+00	1.18E-03
Total						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 ÷ 103.5 MMBtu/hr = 8115.942 hrs/rolling twelve-month (12 month) period.

Although some pollutant's lb/hr emission rates from fuel oil no. 2 lb/hr are higher than those for wood combustion, this does not have an impact on total HAP emissions from the boiler. The maximum HAP contribution from fuel oil no. 2 is 3.55E-03 tons/year (based on a maximum firing rate of 150,000 gallons/year) which does not change the projected maximum HAP emissions of 16.26 tons/year from wood combustion.

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.

Summary of Boiler Emissions

pollutant	boiler normal operations emission rate at 840,000 MMBtu/yr (tons/yr)	boiler startup emissions (tons/yr)	boiler shutdown emissions (tons/yr)	boiler total emissions (tons/yr)
NOx	105.00	1.35	0.50	106.86
PM	10.50	0.46	0.17	11.13

CO	84.00	1.79	0.67	86.46
SO2	50.40	0.37	0.14	50.91
VOC	10.35	0.15	0.05	10.55
HAPs	16.26	---	---	16.26

GREEN HOUSE GAS EMISSIONS:

Green House Gas Emission Factors[a]

	CO_2	CH_4	N_2O
wood	93.8	3.20E-02	4.20E-03
diesel	73.96	3.00E-03	6.00E-04
CO_2 Equivalence	1	21	310

[a] Emission factors from 40 CFR Part 98 Mandatory Greenhouse Gas Reporting, Subpart C, Table C-1 to Subpart C of Part 98 —Default CO2 Emission Factors and High Heat Values for Various Types of Fuel and Table C-2 to Subpart C of Part 98 —Default CH4 and N2 O Emission Factors for Various Types of Fuel

unit	CO_2 (metric tonnes/yr)	CO_{2E} (metric tonnes/yr)[a]	CO_{2E} (metric tonnes/MWh)	CO_{2E} (tons/yr)
Boiler	80,307	81,970	1.24	90,167
Emergency DEG (exempt)	35	35	0.8	39
Fire Pump Engine (exempt)	3	3	n/a	4
Total	80,346	82,009	n/a	90,210

[a] Includes CH_4 and N_2O

AMBIENT AIR QUALITY ASSESSMENT:

An ambient air quality assessment was performed to determine the maximum projected impact for the nominal 100 MMBtu/hr boiler. The emergency diesel engine generator, fire pump engine, and wet cooler are exempt from permitting requirements, but are included in the ambient air quality analysis.

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 6 miles east-northeast of the project site.
3. Lihue airport upper air date.

Terrain and receptor locations:

Terrain is from USGS DEM and 7.5 minute quadrangle maps. The coarse grid consists of receptors spaced at 250 meters. A 25 meter grid was used around the facility fence line. The refined grid consists of receptors spaced at 25 meters.

Potential downwash effect:

EPA's BPIP program was used 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	maximum background concentration ($\mu g/m^3$)	applicant's background concentration ($\mu g/m^3$)	notes on background concentrations
NO_2	1-hour	West Beach	2009	64	49	applicant's value is the 98th percentile value
	annual	West Beach	2009	6	n/a	n/a
SO_2	1-hour	West Beach	2009	65.5	42	applicant's value is the 99th percentile value
	3-hour	West Beach	2009	23	n/a	n/a
	24-hour	West Beach	2009	11	n/a	n/a
	annual	West Beach	2009	3	n/a	n/a
PM_{10}	24-hour	West Beach	2009	134	34	applicant's value is from Lihue 2006
	annual	West Beach	2009	16	16	applicant's value is from Lihue 2005
$PM_{2.5}$	24-hour	Kapolei	2009	14	n/a	maximum is the 98th %ile 3-yr average
	annual	Kapolei	2009	4.6	n/a	maximum is the 3-yr average
CO	1-hour	Kapolei	2009	4237	n/a	n/a
	8-hour	Kapolei	2009	2977	n/a	n/a
Pb	quarterly	no data	no data	no data	n/a	n/a

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)
Boiler – normal conditions short term	0.4035[a]	1.57[b]	3.26[b]	2.61[b]	6.26E-04	30.48	393	17.27	1.25
Boiler – normal conditions long term	0.3197[c]	1.46[c]	3.07[c]	n/a	6.26E-04	30.48	393	17.27	1.25
Boiler – startup conditions short term (for 1-hour model)[e]	n/a	n/a	3.40[d]	4.54[d]	n/a	30.48	393	17.27	1.25

[a] The PM emission rate is used to demonstrate compliance with the standard for the 24-hour averaging period and includes emissions from startup and normal operation. The DOH calculated an emission rate of 0.4632 g/sec which includes startup, shutdown, and normal

operation. When the DOH emission rate is input into the model, compliance with the standard is still demonstrated.

[b] SO_2, NO_x, and CO short term emission rates are based on the maximum g/sec emission rate during normal operation.

[c] PM_{10}, SO_2, and NO_x long term emission rates are based on operating the boiler at its maximum annual heat input of 840,000 MMBtu/yr and also includes emissions from startup and shutdown.

[d] NO_x and CO maximum 1-hour emission rates during startup are based on the maximum heat input to the boiler during startup (applicant assumed 60 MMBtu/hr).

The NO_x emission rate is based on the estimated rate without the SNCR at the maximum heat input of 103.5 MMBtu/hr, 47 lbs/hr.

47 lb/hr ÷ 103.5 MMBtu/hr = 0.45 lb/MMBtu
60 MMBtu/hr (maximum heat input during startup)
0.45 lb/MMBtu x 60 MMBtu/hr = 27 lbs/hr or 3.40 g/sec

The CO emission rate is based upon AP-42, Table 1.6-2 Emission Factors for NOx, SO2, and CO from Wood Residue Combustion (9/03):

60 MMBtu/hr (maximum heat input during startup)
0.6 lb/MMBtu (AP-42 emission rate)
60 MMBtu/hr x 0.6 lb/MMBTu = 36 lb/hr or 4.54 g/sec

DOH emission rates of 3.55 g/sec for NO_x and 4.69 g/sec for CO for the 1-hour averaging period were input into the model based on the maximum heat input during startup of 62.1 MMBtu/hr (60% of 103.5 MMBtu/hr). Compliance with the ambient air quality standards was also demonstrated.

[e] 1-hour model performed for startup only since shutdown emission rates are lower than startup emission rates.

Boiler Ambient Air Quality Impacts – Normal Operating Emissions					
pollutant and averaging period	model impact[a]	background concentration[b]	total impact[c]	AAQS	impact as % of standard
	μg/m³	μg/m³	μg/m³	μg/m³	
NO_x 1-hour	118.0	49	167	188	89%
NO_x annual	4.7	6	10.7	70	15%
SO_2 1-hour	88.5	42	130.5	197	66%
SO_2 3-hr	50.0	23	73	1,300	6%
SO_2 24-hr	20.8	11	31.8	365	9%
SO_2 annual	2.9	3	5.9	80	7%
PM_{10} 24-hr	6.1	134	140.1	150	93%
PM_{10} annual	0.9	16	16.9	50	34%
$PM_{2.5}$ 24-hour	6.1	14	20.1	35	57%
$PM_{2.5}$ annual	0.9	4.6	5.5	15	37%
CO 1-hr	149.7	4237	4386.7	10,000	44%
CO 8-hr	54.3	2977	3031.3	5,000	61%
Pb quarterly[d]	8.30e-04	---	8.30e-04	1.5	0.06%

[a] The model impact is the maximum modeled concentration.

The ozone limiting method was applied to the 1-hour and annual model runs for NO_x.

[b] Background concentrations for the 1-hour annual averaging period represents the 98th percentile for NO_2 and the 99th percentile for SO_2. Compliance with the standards is also demonstrated when the maximum concentrations shown in the table **Background Air Quality Data** are used. The PM_{10} background concentration for the 24-hour averaging period is the maximum concentration from Kapolei. For the PM_{10}, 24-hour averaging period the applicant used the background concentration from Lihue 2006. When the model concentration is combined with either background concentration, compliance with the standard is demonstrated.

[c] Total impact = model impact + background concentration

[d] 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 boiler is 13.26 μg/m³:

6.26E-04 g/s x 13.26 μg/m³ per g/s = 8.30E-04 μg/m³

Boiler Ambient Air Quality Impacts – Startup Emissions					
pollutant and averaging period	model impact	background concentration	total impact	AQQS	impact as % of standard
	μg/m³	μg/m³	μg/m³	μg/m³	
NO_x 1-hour	109.2	49	158.2	188	84%
CO 1-hr	256.2	4237	4493.2	10,000	45%

The applicant has demonstrated compliance with the state and national ambient air quality standards using emissions from both normal operating conditions and startup conditions.

Significant Permit Conditions:

Conclusion:

Green Energy Team, LLC received an initial covered source permit on June 13, 2008 for two gasifier/boiler systems. An extension to the start of construction was granted by the Department for an eighteen month period to June 13, 2011. The facility had not been constructed as of November 29, 2010, when the Department received an application (0650-02) for a significant modification to the permit.

The applicant proposes to replace the two (2) 50 MMBtu/hr biomass gasifiers/boilers with a single 100 MMBtu/hr biomass boiler with a steam turbine and to make other changes to the permit to reflect the final design. The original permitted equipment would have produced 7.1 MW gross rated output. The proposed facility will produce 7.9 MW gross rated output with no increase in emissions from the previously permitted equipment.

The boiler is subject to the following federal regulations:

40 CFR Part 60, Subpart A – General Provisions
40 CFR Part 60, Subpart Db – Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units

40 CFR Part 63, Subpart A – General Provisions
40 CFR Part 63, Subpart JJJJJJ – National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers Area Sources.

The boiler is also subject to 40 CFR Part 64 – Compliance Assurance Monitoring for NO_x.

The ambient air quality modeling analysis performed for the facility demonstrates the boiler 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 and takes into consideration emissions from startup and shutdown. Although determined insignificant activities the emergency diesel engine generator, fire pump engine, and evaporative cooler are included in the modeling analysis. 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.